- Final -

ENVIRONMENTAL ASSESSMENT

FOR

MINUTEMAN III MODIFICATION

Prepared for:

ICBM System Program Office
Ogden Air Logistics Center
Hill Air Force Base, UT

Prepared by:

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14. ABSTRACT

This Environmental Assessment documents the potential environmental impacts of: (1) Minuteman III missile flight tests using modified Reentry System (RS) hardware/software, in addition to the continuation of Force Development Evaluation flight tests; (2) deployment of new and modified RS hardware/software; and (3) deployment activities for new command and control console equipment. The locations covered in this EA include: FE Warren Air Force Base (AFB), WY; Hill AFB, UT; Malmstrom AFB, MT; Minot AFB, ND; Vandenberg AFB, CA; and US Army Kwajalein Atoll, Republic of the Marshall Islands.

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FINDING OF NO SIGNIFICANT IMPACT (FONSI)

ENVIRONMENTAL ASSESSMENT FOR MINUTEMAN III MODIFICATION

Agency: United States Air Force (USAF)

Background: Pursuant to the provisions of the National Environmental Policy Act (NEPA) of 1969, Executive Order 12114, Council on Environmental Quality (CEQ) Regulations [40 Code of Federal Regulations (CFR) Parts 1500-1508], 32 CFR Part 989, and the US Army Kwajalein Atoll Environmental Standards (UES), the USAF has conducted an assessment of the potential environmental consequences of the testing and deployment activities associated with proposed modifications to the Minuteman (MM) III Intercontinental Ballistic Missile (ICBM) system. The assessment focused on those activities that have the potential to change the human and natural environments.

The United States has historically relied on the concept of deterrence to maintain peace. Because the MM III will become the only land-based ICBM system in America's nuclear arsenal, the Department of Defense (DOD) is extending the life of the existing force of MM III ICBMs through the year 2020. As a life-extension action, the proposed modifications involve reconfiguration of the MM III missile Reentry System (RS) to be capable of carrying the Mark 21 reentry vehicle (RV) and warhead—currently deployed on Peacekeeper ICBM missiles undergoing deactivation—as well as the existing Mark 12A RV. The newer and more capable Mark 21 RVs will replace the older Mark 12 RVs now deployed on MM IIIs, thus enhancing nuclear safety and improving the future reliability of the weapon system. The proposed modifications will require testing and deployment of system hardware/software, equipment, and trainers needed to incorporate Mark 21 RVs onto missiles at any of the MM Launch Facilities (LFs) located within the three MM Wings (FE Warren AFB, Wyoming; Malmstrom AFB, Montana; and Minot AFB, North Dakota).

In conjunction with the RS modification and deployment of Mark 21 RVs, upgrade and replacement of electronic command and control console equipment, and software, is also needed at all Launch Control Centers (LCCs) located within the three MM Wings, and at other USAF and contractor trainer/test facilities supporting MM III ICBM operations. The planned console equipment upgrades are needed to resolve a variety of software deficiencies and aging hardware failures. The upgrades will also implement changes to the console operations software required for deployment of the Mark 21 RVs. All of the proposed MM III modifications are needed for continued nuclear deterrence and improved safety and reliability of the weapon system, and to compensate for the deactivation of Peacekeeper missiles.

The Environmental Assessment (EA) considers all potential impacts of the Proposed Action and the No Action Alternative. This Finding of No Significant Impact (FONSI) summarizes the results of the evaluations of the proposed activities associated with the proposed MM III modification.

Proposed Action and No Action Alternative: The EA assesses the environmental impacts of the proposed testing and deployment activities associated with the proposed MM III modification. During the test and evaluation phase, MM III missile flight tests, utilizing the modified RS, will originate from Vandenberg AFB, California. The MM boosters used in the flight tests will be pulled from operational LFs randomly selected at the Wings. The LFs will then receive replacement boosters provided by the rocket motor depot maintenance facility at Hill AFB, Utah.

At Vandenberg AFB, the missile launches will occur from existing silos that are regularly used for these types of tests. On each test missile, the operational RVs are replaced with one to three RV simulators. At the terminal end of each missile flight, the test RVs will impact near the US Army Kwajalein Atoll (USAKA) in the Republic of the Marshall Islands (RMI). Test RVs containing high explosives would be detonated at some altitude (airburst), or upon impact on land or water. RVs that do not contain high explosives will remain intact as they impact land or water at high velocities. In addition to the ongoing three to four MM III Force Development Evaluation flight tests conducted every year, two additional flight tests per year will occur in Fiscal Years 2005 and 2006.

During the deployment phase for RS modifications at the Wings, efforts will include the distribution of new and modified hardware for mounting the Mark 21 RVs onto MM IIIs, new electronic flight equipment, changes to command and launch equipment, new support equipment, new and modified software, and modifications to personnel training hardware. RS-related test and support equipment at both Hill and Vandenberg AFBs will also be modified accordingly. Deployment of the RS modification kits and Mark 21 RVs at the three MM Wings will begin in 2006 and continue through 2011.

For the new command and control console equipment, deployment activities will involve the replacement of older console equipment (including Visual Display Units and computer Head Disk Assemblies), and related software upgrades, at all operational LCCs located within the three MM Wings, and at various trainer and support facilities located at each Wing support base, Hill AFB, Vandenberg AFB, and at other USAF/contractor support locations. Deployment at all trainer units will be completed prior to fielded deployment in 2006. Deployment of the remaining equipment at operational facilities will occur as part of routine maintenance, or by force deployment over a 3-year period beginning at the end of 2005 or 2006. In most cases, the old console equipment will be declassified and turned over to the local or regional Defense Reutilization and Marketing Office for resale, material recycling, and/or disposal as solid or hazardous waste.

Under the No Action Alternative, the USAF would not proceed with the proposed MM III modification. However, ongoing system monitoring and testing of MM III components and subsystems (including annual missile flight tests) would continue at all locations where such operations are currently conducted. By not implementing the proposed modifications, the nuclear safety and future reliability of the MM III weapon system would not be enhanced. Eventually, the No Action Alternative would require some missiles to be removed from the operational force, thus reducing the overall mission readiness of the MM III ICBM system and jeopardizing national security.

Though other possible alternatives to the Proposed Action were considered—including computer simulations and alternative test locations—all were deemed unreasonable and eliminated from further analysis.

Environmental Effects: Potential environmental effects associated with the Proposed Action and No Action Alternatives were assessed for the following environmental resources: air quality, noise, biological resources, cultural resources, health and safety, and hazardous materials and waste management. Other resource areas—including hydrology and groundwater, utilities, solid waste management, land use, socioeconomics, environmental justice, soil resources, and visual and aesthetic resources—were not analyzed further because no significant impacts to these resources are anticipated as a result of implementing the Proposed Action. Potential effects on the environment from implementation of the Proposed Action are described in the following paragraphs.

- ***Air Quality.*** For missile flight tests at Vandenberg AFB, rocket motor exhaust emissions will be released into the lower atmosphere. Because the launches are infrequent, short-term events, emissions products will be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. No changes to existing or new air emission permits are required. Also, a review of the General Conformity Rule resulted in a finding of presumed conformity with the State Implementation Plan. From a global perspective, the exhaust emissions released from the MM III motors into the upper atmosphere will add to the overall global loading of chlorine and other gases that contribute to long-term ozone depletion. However, when compared to the amount of emissions released on a global basis, the flight tests will not be statistically significant in contributing to cumulative impacts on the stratospheric ozone layer. Overall, no significant impacts to air quality will occur.

- ***Noise.*** Each MM III flight test launch will generate noise levels ranging from 125 decibels (dB) (unweighted) in the immediate vicinity of the launch site at Vandenberg AFB, to around 105 dB (unweighted) or lower in some populated areas off base. While these noise exposure levels can be characterized as very loud, they will occur infrequently, are very short in duration (about 20 seconds per launch), and will have little effect on the Community Noise Equivalent Level off base. Sonic booms generated by the MM III missile will typically start reaching the surface some 25 nautical miles downrange of the launch site, and thus will not affect coastal land areas. Consequently, no significant impacts to the noise environment will occur.

- ***Biological Resources.*** For biological resources at Vandenberg AFB, some disturbances to marine mammals and migratory birds from missile launches and helicopter overflights are expected. However, a National Marine Fisheries Service (NMFS) incidental "take" permit is in place that authorizes incidental harassment of pinnipeds. Helicopter overflights are required to maintain minimal distances away from protected seal haul-outs/rookeries and bird roosting/nesting areas. On-base monitoring before and after launches has shown no long-term effects on seals, or seabirds and shorebirds. Other studies at the base have shown no concerns for long-term acidification of surface waters as a result of launch emissions. Some temporary distress to vegetation near launch sites can be expected. Though the probability for an aborted MM III launch to occur is extremely low, the dispersion of unburned propellant in such cases is not expected to cause concern for perchlorate build-up in local waters. Base actions would immediately be taken to recover and cleanup unburned propellant and any other hazardous materials that had fallen on the beach or in shallow waters. Any liquid or solid propellant falling into the offshore waters would be subject to continual mixing and dilution due to the ocean waves and currents, and hence, local accumulation of perchlorates from the propellants would not be significant.

  For the over-ocean launch corridor, sonic boom overpressures from MM III launch vehicles could be audible to protected marine species underwater. Underwater pressure waves generated by the sonic booms are expected to be less than 140 dB, which is well below the lower limit (178 dB) for inducing behavioral reactions, and the lower limit (218 dB) for inducing temporary threshold shift (TTS) in marine mammals and sea turtles, all sound pressure levels being referenced to 1 micro Pascal (μPa). Because the resulting pressures will be relatively low, and very short in duration, no long-term adverse effects are anticipated. For marine animals, the potential also exists for direct contact or exposure to underwater shock/sound waves from the splashdown of spent rocket motors. However, in the open ocean, the probability of impacting protected marine mammals and sea turtles is insignificant based on statistical analyses. The MM III flight tests will occur only 3 to 4 times per year, and motor impacts from each flight will likely not occur at the exact same locations. Though residual amounts of battery electrolytes, hydraulic fluid, propellants, and other materials in the spent rocket motors could lead to the contamination of seawater, the risk of marine life coming in contact with, or ingesting, toxic levels of solutions is unlikely, considering the rapid dilution of any contaminants and the rapid sinking of any contaminated components to the ocean floor.

At USAKA, target sites for test RVs are located in the deep ocean area east of the Kwajalein reef or in the vicinity of Illeginni Island. Though migratory seabirds and shorebirds near RV impact areas can be expected to exhibit brief flight responses to sonic boom overpressures, local populations do not appear to have been adversely affected by years of testing. The sonic booms could also affect hearing in marine mammals and sea turtles underwater. However, at 117 to 176 dB (referenced to 1 µPa), the resulting underwater pressures will fall just below the lower limit for inducing behavioral reactions (178 dB referenced to 1 µPa), and well below the lower limit for inducing TTS (218 dB referenced to 1 µPa) in such animals. Because the resulting pressures will be relatively low, and very short in duration, no long-term adverse effects are anticipated. Like the spent MM III rocket motors, an RV impacting in the ocean or Kwajalein Atoll lagoon will result in underwater shock/sound waves, but with much higher pressure-levels being generated. At distances within a few thousand yards of an RV impact point, underwater pressure levels could induce behavioral reactions (e.g., abrupt movements, changes in surfacing, and sudden dives) in marine mammals, and possibly sea turtles. If they occur, such reactions would last for a very brief period and not result in any long-term effects. At a distance of 128 feet (ft) [39 meters (m)] from the RV splashdown site, TTS could begin to occur; and within several feet of the impact point, the pressure levels could prove fatal to these animals. However, the number of groups (small pods or schools) of these animals to be struck or exposed to harmful underwater shock/sound waves is estimated to be no higher than 0.000003 to 0.000009 per RV test event, depending on the number of RV simulators carried on the launch vehicle. The risk of physically injuring or killing the animals is extremely low in view of the facts that: (1) only 3 to 4 MM III launches will be conducted every year, (2) RV target locations are not always the same, and (3) the probability of impact on marine mammals and sea turtles caused by underwater shock/sound waves is insignificant.

Target areas for RVs will be selected to minimize impacts to protected reefs and identified wildlife habitats. When an RV impacts directly on Illeginni Island or in the shallow coral reefs of Kwajalein Atoll, a crater will form. Post-test debris recovery and cleanup operations on Illeginni Island will also cause some short-term disturbance. Such impacts could potentially result in the loss of some protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting habitat, and coral reef habitat. The USAF has projected that approximately four to five RVs will impact at Illeginni over the next 20 years. The overall effects of these impacts are considered to be minimal.

Following an RV airburst or impact of an RV in the ocean, the Kwajalein Atoll lagoon, and/or on Illeginni Island, the resulting debris would disseminate any on-board hazardous materials—such as beryllium (Be) and depleted uranium (DU)—around the impact point and some distance downwind. However, the contaminants released by some RVs are extremely insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels. Short-term exposures to birds or other wildlife is unlikely to result in significant accumulations, particularly when considering the small amount of unrecovered material that may persist in the environment. Thus, RV contaminants do not present a major hazard to terrestrial and marine life.

In the biological opinion regarding effects on nesting habitat for green sea turtles (*Chelonia mydas*) at Illeginni Island (Appendix D in the EA), the US Fish and Wildlife Service (USFWS) determined that the Proposed Action (along with reasonable and prudent measures, and conservation measures) is not likely to jeopardize the continued existence of the species. No critical habitat has been designated for this species; therefore, none will be affected. An Incidental Take statement—for the loss of no more than three green sea turtle nests, or injury or loss of up to 300 hatchlings, per year as a result of project-related RV impacts in the vicinity of Illeginni Island—is included in the biological opinion.

Though such losses are not likely to occur, it is expected that they would be offset by the implementation of conservation measures identified in the biological opinion.

Overall, no significant impacts to biological resources will occur at any of the locations affected. The implementation of mitigation measures identified in the EA will help minimize or eliminate potentially adverse impacts that might occur.

Because of the potential for adverse impacts on biological resources at USAKA, the proposed RV flight test activities will also require a Document of Environmental Protection (DEP) in accordance with the UES. Separate from the NEPA process under which the EA is being prepared, the DEP process serves to provide a structured forum for USAKA, US Government agencies, the RMI Environmental Protection Authority (RMIEPA), and the general public to review and comment on proposed US activities that have the potential to affect the USAKA environment.

- ***Cultural Resources.*** Given the extremely limited potential for any remaining traditional/prehistoric remains on Illeginni Island, the likelihood of impacts to any resources must be considered either non-existent or extremely low. Though several buildings on the island are of the Cold War era, they currently do not meet RMI criteria for historic significance. Additionally, there is a low probability for the buildings to be impacted by RV tests. As a result, little or no impacts to cultural resources are expected.

- ***Health and Safety.*** All program activities will be accomplished in accordance with applicable DOD, Federal, state, and foreign health and safety standards. Regarding rocket motor transportation over public roads, accident rates for ICBM-related operations have historically been very low. For flight tests from Vandenberg AFB, range safety officials will evacuate the launch hazard area and issue Notices to Airmen, as well as to Mariners, and the missile hazard zones will be determined clear of both aircraft and surface vessels before proceeding with any flight test. At USAKA, the RV flight tests will require that the Mid-Atoll Corridor Impact Area be cleared of aircraft and vessels in a similar manner. Non-essential personnel are evacuated from the RV impact area, while remaining personnel are placed in protective shelters.

  As previously mentioned, some RV tests at USAKA will release hazardous and toxic materials around the impact area. For a land impact on Illeginni Island, such debris will occur close to the point of impact, mostly within a 328-ft (100-m) radius. As a result, the major potential health concern of these tests is the subsequent effects on workers visiting the island, in support of long-term management and restoration of the island. However, modeling and post-test sampling results from prior RV flight tests have shown that air sampling levels for Be and DU contaminants are far below Federal guidelines, and similar to pre-test background levels. Various post-test safety and health procedures already in place will be followed. These procedures include securing the impact area from inadvertent traffic, and the protection of on-site workers from respiratory exposure during post-test cleanup operations. These and other mitigation measures listed in Section 4.7 of the EA will be applied to all RV tests at USAKA.

  By adhering to established safety standards and procedures, the level of risk to military personnel, contractors, and the general public will be minimal at all of the locations affected. Thus, no significant impacts to either occupational or public health and safety are expected to occur.

- ***Hazardous Materials and Waste Management*.** For hazardous materials and waste management, activities at each affected installation are governed by specific environmental regulations, and existing pollution prevention and facility response plans, that minimize any potential environmental consequences resulting from the use and handling of these materials. Each installation has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials, including a description of appropriate countermeasures to contain, clean up, and mitigate the effects of a spill or discharge. Appropriate permits are in place and workers are trained to follow procedures for the proper storage, transportation, and disposal of hazardous waste. Hazardous material and waste handling capacities will not be exceeded, and management programs will not have to change.

In regards to the release of hazardous and toxic materials from RV tests at Illeginni Island, any residual fragments of RVs will be recovered from land or shallow water areas and properly disposed of in accordance with the UES and all applicable US regulations. As previous sampling results have shown, levels of Be and DU contaminants in the air at Illeginni Island continue to remain at or near background levels, even after years of testing. Be and DU soil concentrations on the island can exceed background levels in the vicinity of RV impact sites. However, the Be and DU concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels.

Consequently, no significant impacts from the management of hazardous materials and waste will occur at any of the sites affected.

Monitoring and Mitigation: Within the EA, various management controls and engineering systems for all locations affected are described. Required by Federal, state, DOD, and Service-specific environmental and safety regulations, and international agreements, these measures are implemented through normal operating procedures.

In addition, to minimize the level of impacts that might occur at USAKA as a result of the RV flight tests, specific monitoring activities and mitigation measures have been identified for implementation as part of the proposed MM III Modification. They include specific recovery and cleanup procedures for the removal of RV debris, air and soil monitoring for potential contaminants, minimizing disturbance of forest vegetation, the preservation and protection of sea turtle nesting habitat, and biological tissue sampling. These and other mitigation measures to be implemented are summarized in Section 4.7 of the EA. Additional measures for the protection of sea turtle nesting habitat at USAKA are included in the USFWS biological opinion provided in Appendix D of the EA.

As part of the DEP process described earlier, the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, the US Environmental Protection Agency (Region IX), and the RMIEPA, to clarify current mitigation measures and determine whether any additional mitigation measures are warranted. Biennial biological resource inventories at USAKA, which are conducted by USFWS and NMFS personnel, will also continue in accordance with the UES.

Public Review and Comment: An availability notice for public review of the Draft EA and Draft FONSI was published in local newspapers for each program support location on or before September 2, 2004, initiating a 30-day review period that ended on October 1, 2004. Because of an inadvertent failure of the *Kwajalein Hourglass* to publish the availability notice on schedule, the notice was published at a later date, and the residents of USAKA were provided an additional 15-day review period that ended on October 29, 2004. During review periods, copies of the Draft EA and Draft FONSI were made available in local libraries or offices in California, Colorado, Montana, Nebraska, North Dakota, Utah, Wyoming, and the RMI. The Draft EA and Draft FONSI also appeared on the Space and Missile Systems Center (SMC), Los Angeles AFB web site at http://ax.losangeles.af.mil/axf, listed under "announcements." Comments received during the public review were addressed and incorporated in the Final EA.

Points of Contact: The point of contact for questions, issues, and information relevant to the EA for MM III Modification is Dr. Ram Ramanujam, SERV Models and Environmental Engineer, ICBM System Program Office, Hill AFB, Utah. Dr. Ramanujam can be reached by calling (801) 777-2846, by facsimile at (801) 775-2587, or by e-mail at Ram.Ramanujam@hill.af.mil. The SMC point of contact for this EA is Mr. Thomas Huynh, SMC/AXFV, Los Angeles AFB, California. Mr. Huynh can be reached by calling (310) 363-1541, by facsimile at (310) 363-1503, or by e-mail at Thomas.Huynh@losangeles.af.mil.

Conclusion: Based upon review of the facts and analyses contained in the EA, the USAF has concluded that implementation of the Proposed Action will not have a significant environmental impact, either by itself or cumulatively with other projects. Accordingly, the requirements of NEPA, the CEQ Regulations, 32 CFR Part 989, and UES are fulfilled and an Environmental Impact Statement is not required.

Approved:

[signature] 24 FEB 05

JAMES B. ENGLE
Deputy Assistant Secretary
(Science, Technology and Engineering)
Assistant Secretary of the Air Force for Acquisition

Date

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFPD	Air Force Policy Directive
AFSPC	Air Force Space Command
ALC	Air Logistics Center
Al_2O_3	Aluminum Oxide
AS&I	Assembly, Surveillance, and Inspection
AVE	Aerospace Vehicle Equipment
Be	Beryllium
CA	California
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CH_6N_2	Monomethylhydrazine
cm	Centimeter
CNEL	Community Noise Equivalent Level
CO	Carbon Monoxide
CO	Colorado
CO_2	Carbon Dioxide
COP	Console Operations Program
CRT	Cathode Ray Tube
CSF	Conforming Storage Facility
dB	Decibels
dBA	A-weighted Decibels
DEP	Document of Environmental Protection
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
DRMS	Defense Reutilization and Marketing Service
DU	Depleted Uranium
EA	Environmental Assessment
ECSG	Electronic Command Signal Generator
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMAD	Embedded Memory Array Dynamic
ESQD	Explosive Safety Quantity Distance
ETR	Extended Test Range
EWR	Eastern and Western Range
FDE	Force Development Evaluation
ft	Feet
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
GBI	Ground-Based Interceptor
GMD	Ground-Based Midcourse Defense
HAFB	Hill Air Force Base
gal	Gallon
HCl	Hydrogen Chloride
HDA	Head Disk Assembly
HMMP	Hazardous Materials Management Plan
Hz	Hertz
ICBM	Intercontinental Ballistic Missile
IRP	Installation Restoration Program
JTA	Joint Test Assembly
KEEP	Kwajalein Environmental Emergency Plan
kg	Kilogram
km	Kilometer
L	Liter
lb	Pounds
LCC	Launch Control Center
LF	Launch Facility
LHA	Launch Hazard Area
LLNL	Lawrence Livermore National Laboratory
LOA	Letter of Authorization
m	Meter
MAF	Missile Alert Facility
MDA	Missile Defense Agency
mi	Mile
MM	Minuteman
MMPA	Marine Mammal Protection Act
MOD	Model
MPF	Missile Processing Facility
MSL	Mean Sea Level
MT	Missile Transporter
MT	Montana
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
ND	North Dakota
NEPA	National Environmental Policy Act

NMFS	National Marine Fisheries Service
NO_2	Nitrogen Dioxide
N_2O_4	Nitrogen Tetroxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NO_X	Nitrogen Oxides
NRHP	National Register of Historic Places
OO-ALC/SPO	Ogden Air Logistics Center ICBM System Program Office
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PL	Public Law
$PM_{2.5}$	Particulate Matter Less Than or Equal to 2.5 Micrometers
PM_{10}	Particulate Matter Less Than or Equal to 10 Micrometers
PMFC	Pacific Marine Fishery Council
PMRF	Pacific Missile Range Facility
ppm	Parts per Million
psf	Pounds per Square Foot
PSRE	Propulsion System Rocket Engine
PTS	Permanent Threshold Shift
RCRA	Resources Conservation and Recovery Act
REACT SLEP	Rapid Execution and Combat Targeting Service Life Extension Program
RMI	Republic of the Marshall Islands
RMIEPA	Republic of the Marshall Islands Environmental Protection Authority
ROI	Region of Influence
RS	Reentry System
RTS	Ronald Reagan Ballistic Missile Defense Test Site
RV	Reentry Vehicle
SBCAPCD	Santa Barbara County Air Pollution Control District
SERV	Safety Enhanced Reentry Vehicle
SHPO	State Historic Preservation Office
SMIC	Strategic Missile Integration Complex
SO_2	Sulfur Dioxide
SW	Space Wing
SWI	Space Wing Instruction
TE	Transporter Erector
TTS	Temporary Threshold Shift
TVC	Thrust Vector Control
U	Uranium
UES	USAKA Environmental Standards
US	United States
USAF	United States Air Force
USAKA	US Army Kwajalein Atoll
USASMDC	US Army Space and Missile Defense Command
USASSDC	US Army Space and Strategic Defense Command
USC	United States Code
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
UT	Utah
VAFB	Vandenberg Air Force Base
VOC	Volatile Organic Compound
VDU	Visual Display Unit
WMO	World Meteorological Organization
WPRFMC	Western Pacific Regional Fishery Management Council
WY	Wyoming
μg/g	Micrograms per Gram
$\mu g/m^3$	Micrograms per Cubic Meter
μPa	Micro Pascal
$\mu Pa^2 s$	Micro Pascal-Squared·Second

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

As a result of previous United States (US) initiatives to cancel development programs for new intercontinental ballistic missile (ICBM) weapon systems, and its ongoing action to retire the current Peacekeeper ICBM weapon system, the Minuteman (MM) III weapon system will become the only land-based ICBM in America's nuclear arsenal (HAFB, 2003). In the December 2001 Nuclear Posture Review Report submitted to Congress, the Secretary of Defense laid out the direction for American nuclear forces over the next 10 years (DOD, 2002). As specified in the Report, the newer Peacekeeper Mark 21 reentry vehicles (RVs) would be transferred onto the fielded MM III ICBMs to enhance the safety and maintain the reliability of the MM III weapon system.

In addition to the transfer of the Mark 21 RVs, the command and control system for fielded MM III ICBMs requires the upgrade and replacement of aging electronic assemblies located at existing MM III Launch Control Centers (LCCs). The planned upgrades would include software improvements and hardware changes necessary to correct system deficiencies.

As the proponent for the proposed MM III modification, the Ogden Air Logistics Center ICBM System Program Office (OO-ALC/SPO) at Hill AFB is responsible for providing technical and logistical support for ICBM follow-on test and evaluation requirements, and managing acquisition efforts associated with silo-based ICBM systems.

The Purpose of an Environmental Assessment

An Environmental Assessment (EA) is prepared by a Federal agency to determine if an action it is proposing would significantly affect any portion of the environment.

The intent of an EA is to provide project planners and Federal decision-makers with relevant information on the impacts that a proposed action might have on the human and natural environments.

If the study finds no significant impacts, then the agency can record the results of that study in an EA document, and publish a Finding of No Significant Impact (FONSI). The agency can then proceed with the action. However, if the results of the EA indicate that there would be potentially significant impacts associated with the action, then the agency must proceed with the following actions:

- The executing agency must prepare and implement a mitigation plan that reduces the action's environmental impact(s) to less-than-significant levels; or,
- If the action cannot be feasibly mitigated to a level of no significant impact, the executing agency must then prepare and publish a detailed Environmental Impact Statement (EIS) to analyze the impacts in greater depth for the decision-makers' consideration.

In support of the OO-ALC/SPO, the Space and Missile Systems Center, Environmental Management Branch of Acquisition Civil and Environmental Engineering, determined that an Environmental Assessment (EA) was required to assess the potential environmental impacts from the testing and deployment activities associated with the MM III modification. This EA was prepared in accordance with the following regulations, statutes, and standards:

- National Environmental Policy Act (NEPA, 1969)
- Executive Order 12114 (*Environmental Effects Abroad of Major Federal Actions*) (Office of the President, 1979)

- The President's Council on Environmental Quality (CEQ) Regulations for Implementing NEPA [40 Code of Federal Regulations (CFR) Parts 1500-1508] (CEQ, 2002)

- US Air Force (USAF) Regulations for Implementing NEPA (32 CFR Part 989, *Environmental Impact Analysis Process*) (USAF, 2001d)

- *Environmental Standards and Procedures for US Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands* (USASMDC, 2003a).

1.2 BACKGROUND

The USAF is currently in the process of deactivating from service all 50 Peacekeeper ICBMs currently deployed in underground silos near FE Warren Air Force Base (AFB), Wyoming. Previously analyzed in the *Final Environmental Impact Statement for Peacekeeper Missile System Deactivation and Dismantlement* (USAF, 2000b), the deactivation process should be completed in 2005.

To compensate for deactivation of the Peacekeeper missiles, and for the termination of earlier ICBM replacement programs, the Department of Defense (DOD) will extend the life of the MM III weapon system. The current MM force consists of 500 missiles located within the three MM Wings at FE Warren AFB; Malmstrom AFB, Montana; and Minot AFB, North Dakota. A comprehensive set of life-extension/sustainment programs is currently underway to keep the missiles safe, secure, and reliable through the year 2020. Representing additional MM III life-extension actions, the proposed modifications analyzed in this EA involve reconfiguring the MM III ICBM so that it is capable of carrying the Mark 21 RV, which is currently deployed on Peacekeeper missiles.

In conjunction with the modifications for Mark 21 RVs, upgrade of electronic command and control console equipment and software would be needed at all LCCs located within the three MM Wings, and at several other USAF and contractor trainer/test facilities supporting MM III ICBM operations. The upgrades are needed to resolve a variety of software deficiencies and aging hardware failures. Only with the planned console upgrades can the USAF ensure a reliable command and control for the MM III weapon system through the year 2020.

1.3 PURPOSE OF THE PROPOSED ACTION

The proposed MM III modification involves design, development, testing, and deployment of new hardware/software, equipment, data, and trainers needed to incorporate Mark 21 RVs onto the Reentry System (RS) of existing MM III missiles at all three MM Wings. While reducing the overall number of nuclear warheads deployed on MM III missiles, this action would enhance the nuclear safety and improve the future reliability of the weapon system.

In conjunction with the deployment of RS modification kits and Mark 21 RVs, electronic command and control console equipment would be deployed, and console operations software upgraded, at all existing MM III LCCs and at other support locations. In addition to enhancing the targeting flexibility of the Mark 21 RVs through software changes, implementation of the console upgrades would correct a multitude of software deficiencies that affect critical combat capabilities for the MM III weapon system. It would also upgrade and replace aging electronic hardware assemblies with newer and more reliable units having improved logistics supportability.

1.4 NEED FOR THE PROPOSED ACTION

Because of recent developments concerning long-term nuclear weapons safety and reliability, force structure changes driven by nuclear arms reductions, and the absence of a replacement system for the MM III ICBM, it is imperative that US forces be given the ability to: (1) transition the newer Mark 21 RV from the deactivated Peacekeeper weapon system to the existing MM III force; and (2) upgrade the existing command and control systems at MM III LCCs, and at other supporting locations. Without these improvements, the long-term safety and reliability of MM III missiles currently deployed with the older RVs could be degraded. Eventually, this would require those missiles to be removed from the operational force. In addition, the continued use of deficient command and control software, and aging console hardware, would ultimately degrade system reliability and availability of fielded MM IIIs at all three MM Wings. Not implementing these improvements would reduce the overall mission readiness of the MM III ICBM system and jeopardize national security.

1.5 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA documents the environmental analysis of: (1) MM III missile flight tests using modified RS hardware/software, in addition to the continuation of Force Development Evaluation (FDE) flight tests; (2) deployment of new and modified RS hardware/software; and (3) deployment activities for new command and control console equipment. The types of activities and locations involved with these actions are briefly described in the following paragraphs, and are shown in Figure 1-1.

- **Flight Test and Evaluation of the RS Modification.** Following the development and qualification of hardware/software modifications to the RS, MM III missile flight tests, utilizing the modified RS, would be conducted at Vandenberg AFB, California. The MM boosters used in the flight tests would be pulled from operational launch facilities (LFs) randomly selected at the Wings. The LFs would then receive replacement boosters provided by the rocket motor depot maintenance facility at Hill AFB, Utah.

  At Vandenberg AFB, the missile launches would occur from existing silos that are regularly used for these types of tests. On each test missile, the operational RVs are replaced with simulated RVs. At the terminal end of each missile flight test, the RVs would impact near USAKA in the Republic of the Marshall Islands (RMI). In addition to the ongoing three to four MM III FDE flight tests conducted every year, two additional flight tests per year would occur in Fiscal Years 2005 and 2006.

- **Deployment of RS Modification Kits and Mark 21 RVs.** Starting in late 2006, RS modification kits and related support equipment would be shipped from existing contractor facilities to each of the Wings (FE Warren, Malmstrom, and Minot AFBs), and to other test and trainer facility locations. Then, beginning in 2006 and continuing through 2011, the kits would be deployed onto existing MM III missiles at all three Wings. During this process, Mark 21 RVs would also be deployed at select missile silos, in addition to removal of all the older Mark 12 RVs.

  The long-term storage and/or disposition requirements for the Mark 12 RVs are not part of the proposed MM III modification.

- **Deployment of New Console Equipment.** Deployment activities would involve the replacement of command and control console equipment, and related software upgrades, at all operational LCCs located within the three MM Wings; and at various trainer and support facilities at each Wing support base, Hill AFB, Vandenberg AFB, and at other USAF/contractor support locations. The deployment activities would consist of: (1) replacement of the computer Head Disk Assembly (HDA),

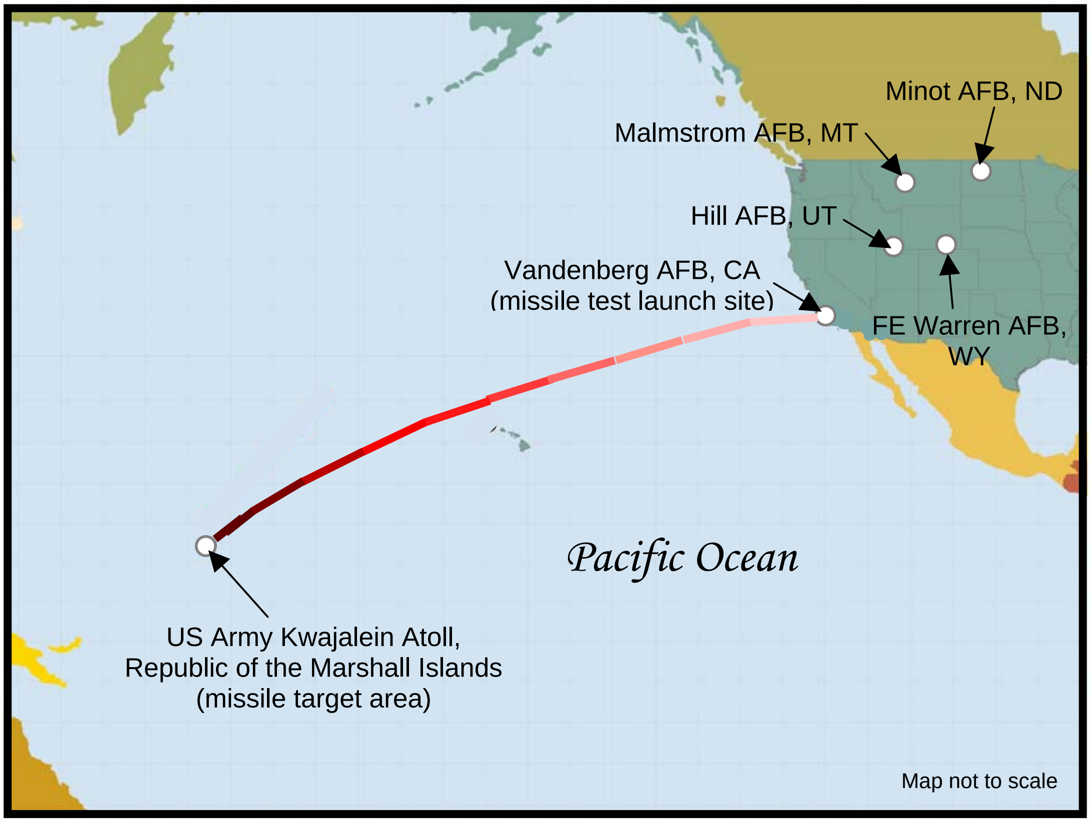

Figure 1-1. Locations for Proposed Minuteman III Modification

(2) replacement of the Visual Display Unit (VDU), and (3) upgrade of the Console Operations Program (COP) software and replacement of the Embedded Memory Array Dynamic (EMAD) module.

Deployment at all trainer units would be completed prior to fielded deployment in 2006. Operational facilities would likely receive the COP upgrade and replacement EMAD modules in 2006. Deployment of the remaining HDAs and VDUs would occur as part of routine maintenance, or by force deployment over a 3-year period beginning at the end of 2005 or 2006.

In accordance with CEQ and USAF regulations [40 CFR 1502.14(d) and 32 CFR 989.8(d), respectively], this EA also analyzes the No Action Alternative, which serves as the baseline from which to compare the Proposed Action. Under the No Action Alternative, none of the activities supporting the proposed MM III modification would occur. However, through ICBM follow-on test and evaluation programs, ongoing system monitoring, testing, and routine maintenance of MM III components (including annual missile flight tests at Vandenberg AFB) would continue to ensure weapon system safety, accuracy, and reliability for the remaining life of the MM III system.

1.6 DECISIONS TO BE MADE

Supported by the information and environmental impact analysis presented in this EA, the USAF will decide on whether to proceed in implementing the proposed MM III modification, or to select the No Action Alternative.

1.7 INTERAGENCY COORDINATION

Ongoing interagency coordination is integral to the preparation of this EA. The USAF has closely coordinated with both the Department of Energy (DOE) and the US Army Space and Missile Defense Command (USASMDC) as cooperating agencies during the analysis—the DOE for their involvement in supporting RV flight tests, and the USASMDC for the use of USAKA as a targeting area for test RVs.

Beginning in October 2003, the USAF initiated informal consultations with the Pacific Islands Regional Offices of the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), both located in Honolulu, Hawaii. Pursuant to the requirements of the *Environmental Standards and Procedures for US Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands* (USASMDC, 2003a), hereafter referred to as the USAKA Environmental Standards or UES, the USAF has held several consultation meetings and teleconferences with the agencies to discuss the potential for environmental impacts from the proposed RV flight test activities at USAKA, and to identify possible mitigation measures to minimize the level of impacts.

On January 29, 2004, the USAF held a formal consultation meeting with the RMI Environmental Protection Authority (RMIEPA) and RMI Historic Preservation Office in Majuro, capital of the RMI Government, to review the proposed RV flight tests, and their potential for environmental and public health impacts at Kwajalein Atoll. Representatives from the USASMDC, USAKA, USFWS, NMFS, DOE, and US Environmental Protection Agency (USEPA) Region IX participated in this meeting. The USAF also solicited comments on the *Coordinating Draft Environmental Assessment for Minuteman III Modification* from the RMI Government and all of the participating agencies.

In September 2004, the USAF initiated formal consultation with the USFWS (Pacific Islands Regional Office), as required by Section 3-4.5.3 (Consultation Procedures for Endangered and Threatened Resources) of the UES (USASMDC, 2003a), because of potential effects on green sea turtle (*Chelonia mydas*) nesting habitat at USAKA. In response, the USFWS provided the USAF a biological opinion on the effects of the proposed project on the green sea turtle, a Federally listed threatened species under the US Endangered Species Act and a USAKA Species of Concern for which consultation was triggered under the UES. A copy of the USFWS biological opinion is provided in Appendix D of this Final EA.

Through interagency coordination, it has also been determined that the proposed RV flight test activities at USAKA will require a Document of Environmental Protection (DEP) in accordance with Section 2-17.3 of the UES (USASMDC, 2003a) because of potential impacts on biological resources. Separate from the NEPA process under which this EA is being prepared, the DEP process serves to provide a structured forum for USAKA, US Government agencies, the RMIEPA, and the general public to review and comment on proposed US activities that have the potential to affect the USAKA environment. At the completion of the process, appropriate agencies will sign the DEP to indicate agreement with the proposed activity, requirements, and limitations. With the support of the USASMDC, the USAF formally initiated the DEP process with submittal of a Notice of Proposed Activity to the USFWS, NMFS, USEPA (Region IX), US Army Corps of Engineers, and the RMIEPA on September 28, 2004. Completion of the DEP process is expected in early 2005, following public review and comment on the Draft DEP.

1.8 PUBLIC NOTIFICATION AND REVIEW

In accordance with CEQ (2002) and USAF (2001d) regulations for implementing NEPA, the USAF solicited comments on the Draft EA from interested and affected parties. A Notice of Availability (NOA) for the Draft EA and the enclosed Draft FONSI, was published in local newspapers for each location involved (see Table 1-1), announcing the 30-day review and comment period which ended on October 1, 2004. As part of this effort, copies of the Draft EA and Draft FONSI were placed in local libraries or

Table 1-1. Newspaper Publications for the Notice of Availability			
State or Country	**City/Town**	**Newspaper**	**Publication Date**
California	Santa Barbara	*Santa Barbara News-Press*	August 31, 2004
	Santa Maria	*Lompoc Record*	August 31, 2004
		Santa Maria Times	August 31, 2004
Colorado	Greeley	*Greeley Tribune*	August 31, 2004
	Sterling	*Journal Advocate*	August 31, 2004
Montana	Choteau	*Choteau Acantha*	September 1, 2004
	Cut Bank	*Cut Bank Pioneer Press*	September 1, 2004
	Great Falls	*Great Falls Tribune*	August 31, 2004
		High Plains Warrior	August 27, 2004
	Havre	*Havre Daily News*	August 30, 2004
	Lewistown	*Lewistown News-Argus*	September 1, 2004
Nebraska	Scottsbluff	*Star-Herald*	August 31, 2004
	Sidney	*Sidney Sun-Telegraph*	August 31, 2004
North Dakota	Minot	*Minot Daily News*	August 31, 2004
		Northern Star	August 27, 2004
Utah	Ogden	*Hilltop Times*	August 26, 2004
		Standard-Examiner	August 26, 2004
Wyoming	Cheyenne	*Wyoming Tribune-Eagle*	August 31, 2004
Republic of the Marshall Islands	Majuro	*Marshall Islands Journal*	August 27, 2004
	USAKA	*Hourglass*	October 15, 2004

offices (see Table 1-2), in addition to making them available over the Internet. Copies of the Draft EA and Draft FONSI were also mailed directly to Federal, state, and local agencies and officials; the RMI Government; and special interest groups, identified by each of the affected installations and ranges. Because of an inadvertent failure of the *Kwajalein Hourglass* to publish the NOA on schedule, the notice was published at a later date, and the residents of USAKA were provided an additional 15-day review period that ended on October 29, 2004.

Following the public review period, comments received were considered in the preparation of the Final EA and the recommended changes were incorporated, as appropriate. Appendix C of this Final EA contains a reproduction of all the written comments received, and responses to those comments. A copy of the Final EA and FONSI has been sent to those organizations and individuals who provided comments on the Draft EA/FONSI, or who specifically requested a copy of the final document. The Final EA and FONSI can also be accessed over the Internet at http://ax.losangeles.af.mil/axf.

Table 1-2. Locations for Viewing the Draft Environmental Assessment

State or Country	City/Town	Location
California	Lompoc	Lompoc Public Library
	Santa Barbara	Davidson Library, University of California
		Santa Barbara Public Library
	Santa Maria	Santa Maria Public Library
Colorado	Greeley	Farr Branch Library
	Sterling	Sterling Public Library
Montana	Cut Bank	Glacier County Public Library
	Great Falls	Great Falls Public Library
	Havre	Havre-Hill County Library
	Lewistown	Lewistown Public Library
Nebraska	Kimball	Kimball Public Library
	Sidney	Sidney Public Library
North Dakota	Minot	Gordon B. Olson Library, Minot State University
		Minot Public Library
Utah	Ogden	The Draft EA was available over the Internet and from the NEPA Program Manager at Hill AFB.
Wyoming	Burns	Burns Branch Library
	Cheyenne	Laramie County Library
	Pine Bluffs	Pine Bluffs Branch Library
	Torrington	Goshen County Library
Republic of the Marshall Islands	Majuro	Alele Museum, Library, and National Archives
	USAKA	Grace Sherwood Library
		Roi-Namur Library

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2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

Two alternatives are assessed in this EA—the Proposed Action and the No Action Alternative. Section 2.1 provides a description of the MM III system, including missile system components and the operational MM Wings. Section 2.2 provides a description of the No Action Alternative. Section 2.3 gives a detailed description of the Proposed Action by phase and activity. Alternatives to the Proposed Action that were considered and eliminated from further study are discussed in Section 2.4. A summary comparison of the environmental impacts associated with the Proposed Action and the No Action Alternative is presented in Section 2.5. Lastly, Section 2.6 identifies the USAF's preferred alternative.

2.1 MINUTEMAN III SYSTEM DESCRIPTION

2.1.1 Minuteman III Missile

The MM III ICBM consists of five major missile sections: the three-stage solid-propellant booster, the propulsion system rocket engine (PSRE), the missile guidance set, the Model or MOD 7 instrumentation wafer (flight test configuration only), and the RS. The latter four sections make up what is generally referred to as the post-boost vehicle. The missile is approximately 59.9 feet (ft) [18.3 meters (m)] long, with a maximum diameter of 5.5 ft (1.7 m), and weighs approximately 79,400 pounds (lb) [36,000 kilograms (kg)]. Further discussions on key components of the MM III missile are provided in the paragraphs that follow. A diagram of the MM III is provided in Figure 2-1.

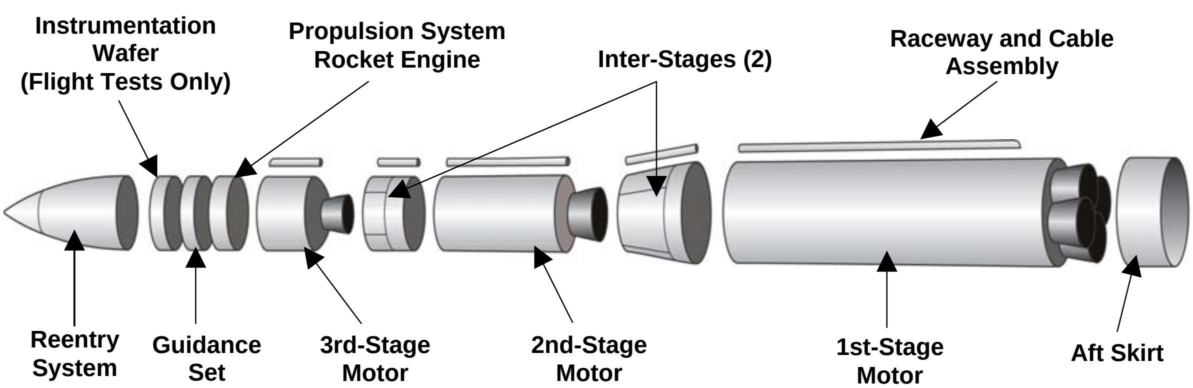


Figure 2-1. Minuteman III Missile

Solid-Propellant Booster

The solid-propellant booster is comprised of the assembled 1st, 2nd, and 3rd stage motors, along with the inter-stages and ordnance systems. Information on the dimensions of each motor—and propellant weight, main chemical components, and DOD explosive classification—is provided in Table 2-1. The DOD classification determines the method of shipping and storing of the rocket propellants and other ordnance (DOD, 1999; USAF, 2001c).

Table 2-1. Solid-Propellant Rocket Motors					
Stage	Diameter ft (m)	Length ft (m)	Propellant		
			Quantity (approx.) lb (kg)	Main Chemical Components	DOD Classification
1st	5.5 (1.7)	18.6 (5.7)	45,700 (20,730)	Ammonium Perchlorate Aluminum Polybutadiene-Acrylic Acid-Acrylonitrile	Class 1.3
2nd	4.3 (1.3)	9.1 (2.8)	13,750 (6,240)	Ammonium Perchlorate Aluminum Polybutadiene-Carboxyl Terminated	
3rd	4.3 (1.3)	5.5 (1.7)	7,300 (3,310)		

Source: Ogden ALC, 2003; USAF, 2001b

During powered flight, each rocket motor uses a different Thrust Vector Control (TVC) system (steering mechanism) for pitch and yaw control. Descriptions of each and the materials they use are as follows:

- **1st Stage.** The TVC system on the 1st-stage motor uses hydraulically actuated, moveable nozzles for altering the thrust vector. Several gallons of hydraulic fluid are contained in the system.

- **2nd Stage.** The TVC is accomplished through the liquid injection of perfluorohexane into the rocket's gas exhaust. Approximately 200 lb (91 kg) of perfluorohexane are used.

- **3rd Stage.** The 3rd stage motor uses a liquid injection TVC system nearly identical in concept to the 2nd-stage system, except that strontium perchlorate is used. The TVC system uses approximately 50 lb (23 kg) of the liquid.

Small amounts of ordnance, in the form of linear explosive assemblies, are used to separate the stages during flight. Other ordnance carried on the three-stage booster includes motor igniter assemblies and an ordnance destruct package, used only for test launches at Vandenberg AFB.

Propulsion System Rocket Engine (PSRE)

Just above the 3rd-stage motor on the MM III is the PSRE. It is a liquid propellant rocket unit consisting of two sealed propellant storage assemblies, a helium gas storage tank for pressurizing the propellant, and several small rocket engines. The propellants used are monomethylhydrazine (CH_6N_2) as the fuel, and nitrogen tetroxide (N_2O_4) as the oxidizer, which form a hypergolic combination. The PSRE is completely assembled and fueled with 13.2 gallons (gal) [50 liters (L)] of fuel and oxidizer each at the time of manufacture. Other ordnance materials within the PSRE contain less than 1 ounce (28 grams) of additional explosives.

Missile Guidance Set and MOD 7 Instrumentation Wafer

Mounted on top of the PSRE are the electronic missile guidance set and the MOD 7 instrumentation wafer (used only for flight tests). The guidance set is an inertial guidance system that directs the flight of the MM III missile. Components within the instrumentation wafer transmit data to track the missile's flight path and evaluate performance, following launch from Vandenberg AFB.

Reentry System (RS)

The payload section on top of the MM III missile is referred to as the RS. Inside of the RS, the Support Payload Bulkhead provides a structural support base for the RVs, and carries the electronics needed to activate and deploy them in flight. A two-piece shroud covers the bulkhead and RVs, protecting them during ascent. The nose cap on top of the shroud contains a small rocket motor containing 6.8 lb (3.1 kg) of solid propellant, which is used to eject the shroud from the vehicle while in flight. Other small quantities of ordnance carried on board the RS include a shroud ejection motor initiator, gas generators, and gas generator initiators, which, when combined, contain less than 1 lb (0.45 kg) of additional explosives.

In its current configuration, the fielded MM III RS employs either the Mark 12 RV or the Mark 12A RV (see Figure 2-2).

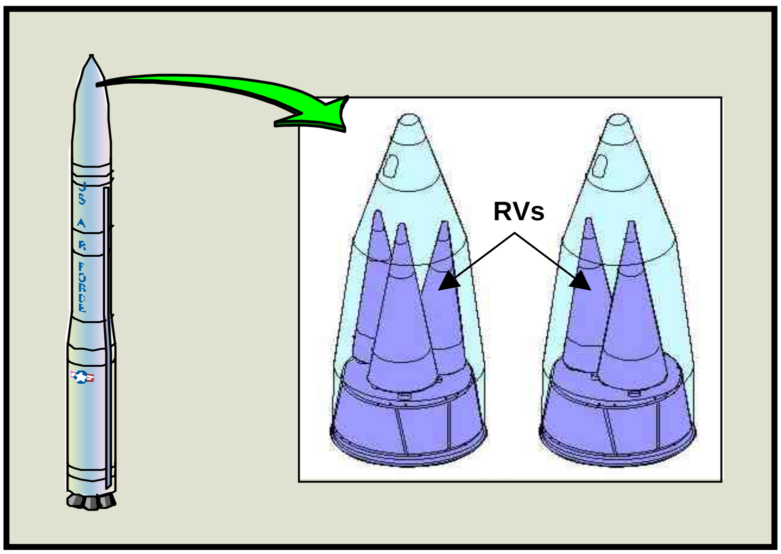


Figure 2-2. Minuteman III Reentry System (Existing)

Batteries

To provide electrical power to the MM III subsystems, several different types of batteries are carried on board the motors, the RS, and other sections of the missile. These include multiple silver-zinc batteries, a single lithium carbon monofluoride battery, and a single lithium silicon/iron disulfide (thermal) battery. Approximately 15 batteries are carried on each MM III flight test missile (depending on the RS configuration used), each weighing from 1 to 21 lb (0.5 to 9.5 kg).

2.1.2 Minuteman Wings

Of the 500 MM III ICBMs currently deployed, 200 are located within the missile Wing at Malmstrom AFB, while 150 each are at FE Warren and Minot AFBs. All of the missiles are widely dispersed in underground, hardened LF silos within the Wing area. For every grouping or “flight” of 10 LFs in the field, there is one manned LCC providing command and control interface with the LFs.

As shown in Figures 2-3 through 2-5, the individual Wings cover broad areas, ranging in size from 8,500 to 12,600 square miles [22,015 to 32,635 square kilometers (km)]. Each polygon on the figures

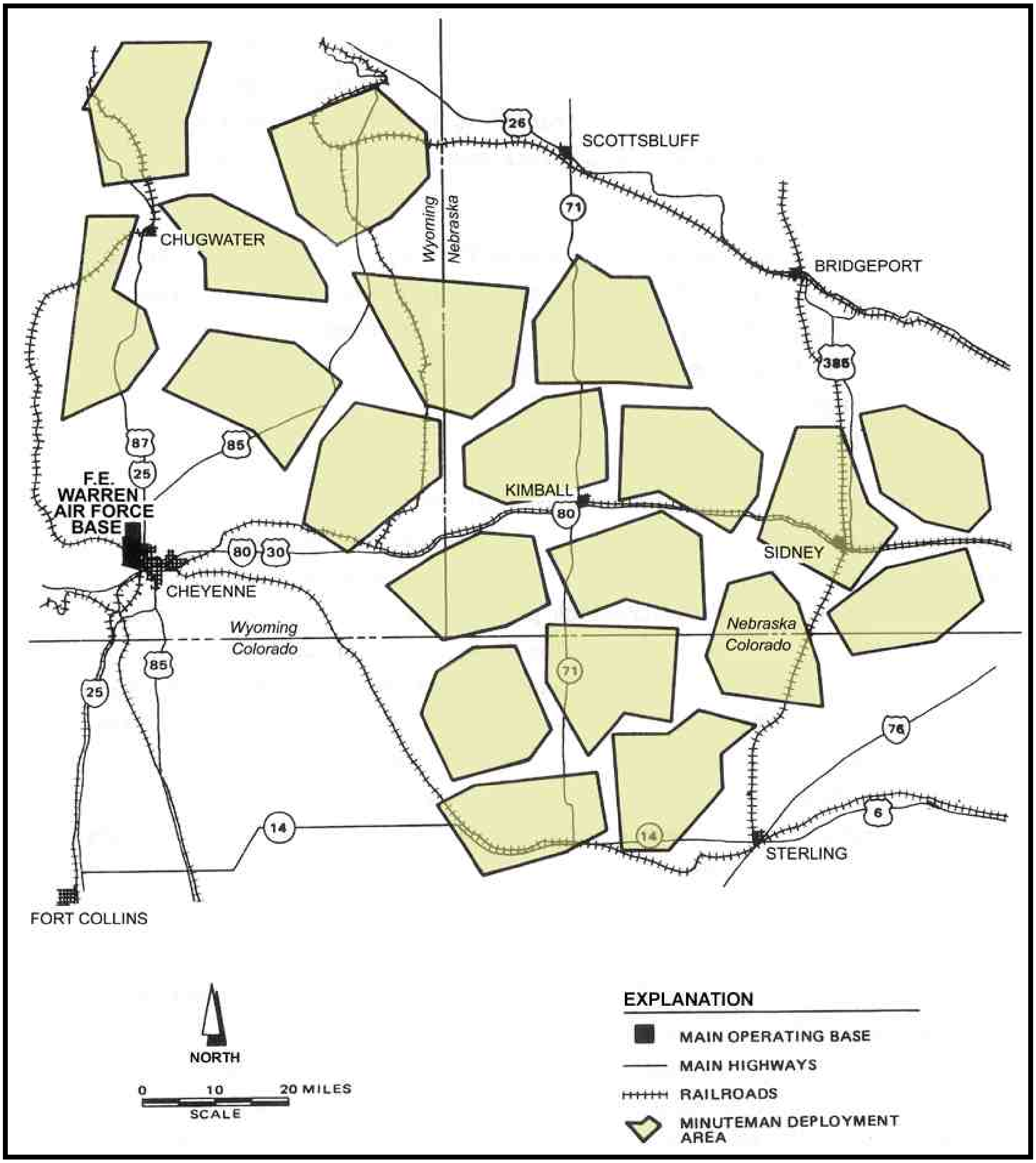


Figure 2-3. Minuteman Wing for FE Warren AFB, Wyoming

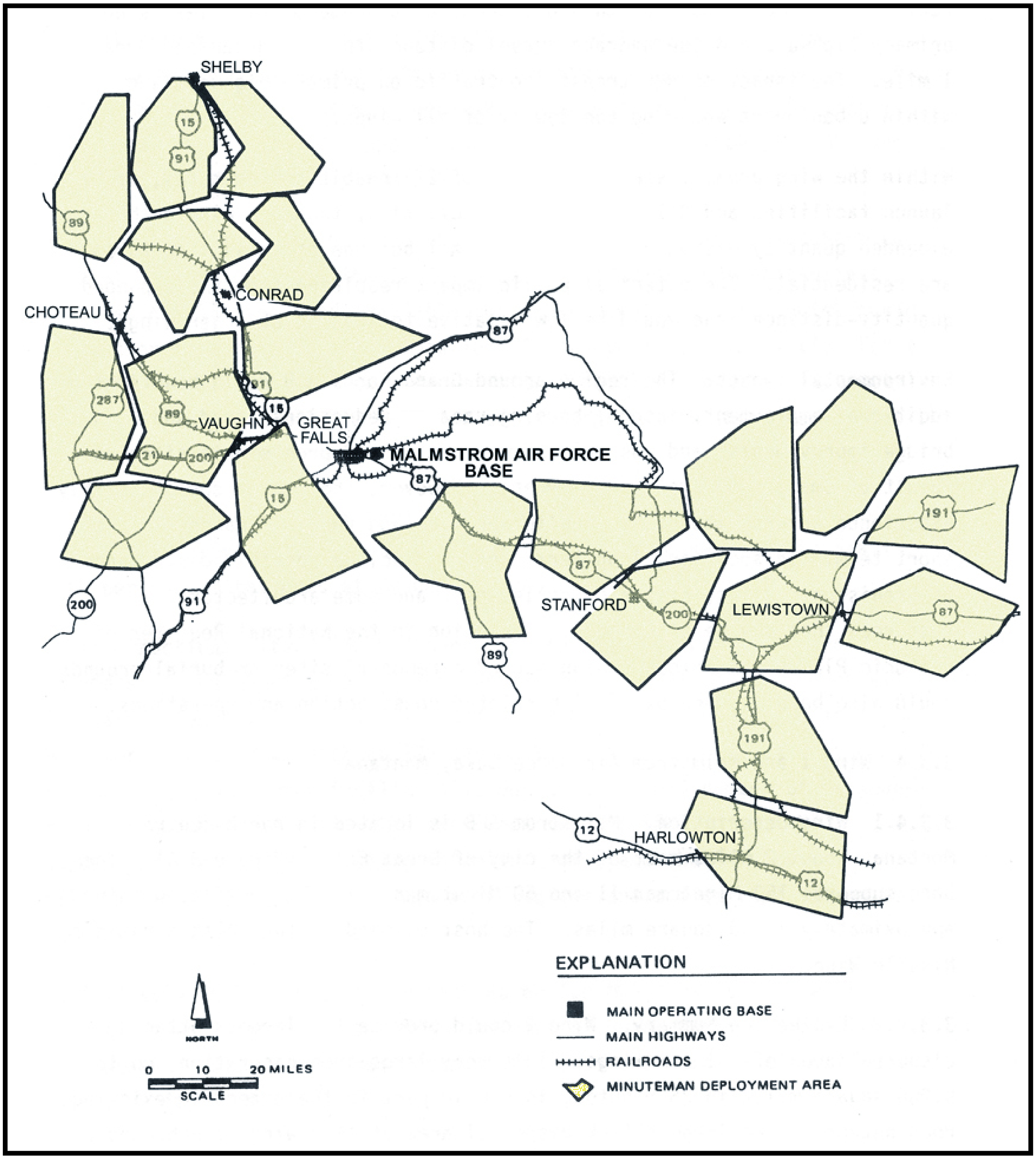


Figure 2-4. Minuteman Wing for Malmstrom AFB, Montana

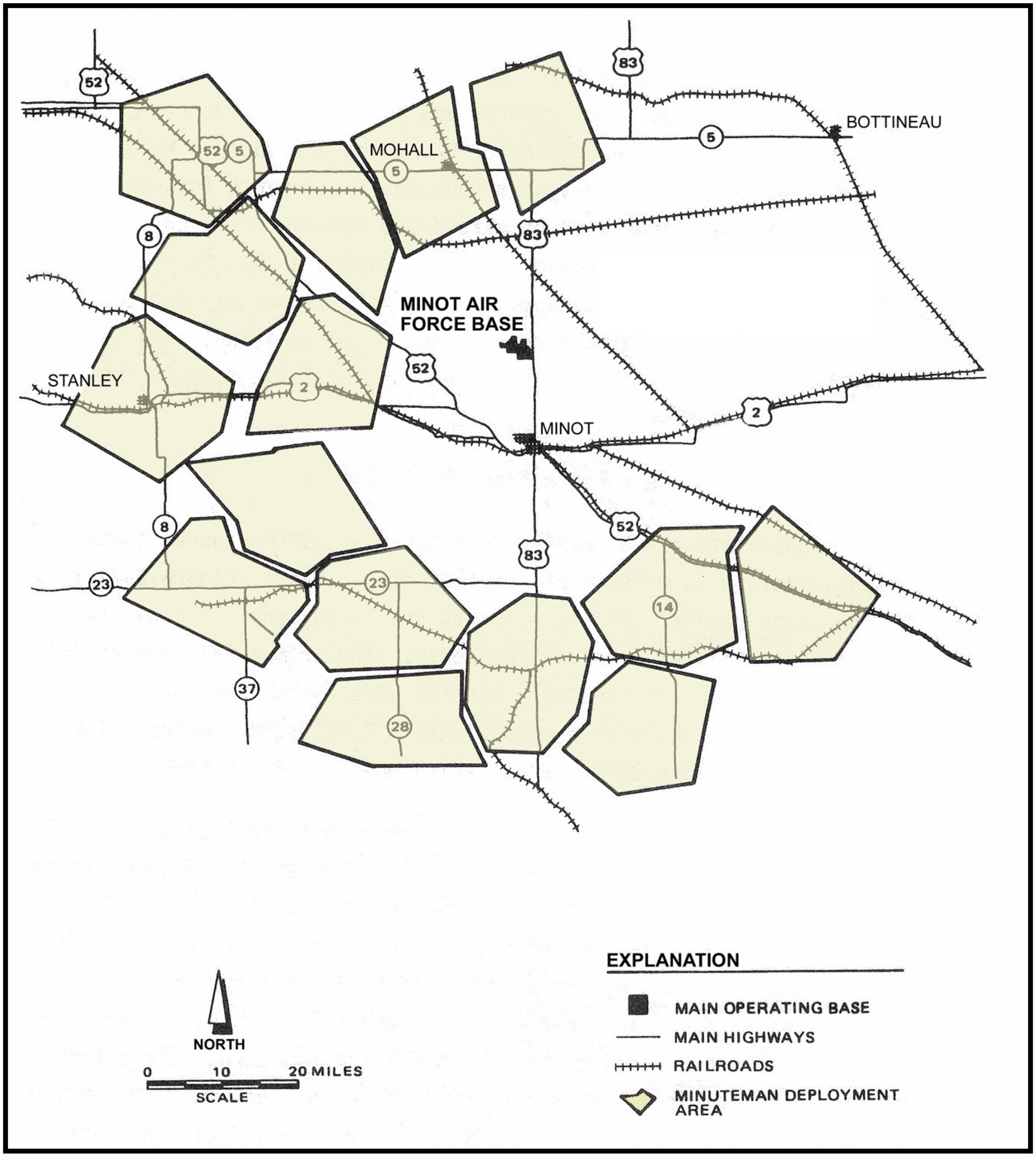


Figure 2-5. Minuteman Wing for Minot AFB, North Dakota

represents an area containing a single "flight" of 10 missile LFs and one LCC. Additional missile maintenance and training facilities are located at each Wing.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed MM III modification would not be implemented. The RS-related equipment would not be flight tested at Vandenberg AFB, or deployed on the fielded MM III ICBMs at each of the Wings. In addition, the MM III command and control console equipment (hardware and software) upgrades would not be deployed to the LCCs, or to other trainer and support facilities. Command and control operations would continue to use and maintain the existing console equipment, and replace failed units for as long as spares are available.

Through ICBM follow-on test and evaluation programs, ongoing system monitoring and testing of MM III components would continue to ensure weapon system safety, accuracy, and reliability for the remaining life of the MM III system. All of the installations and facilities that would have supported the proposed MM III modification would continue their current operations in support of maintaining the MM III ICBM weapon system. The ICBM follow-on test and evaluation activities for these locations are described in the following sections.

Though not specifically described herein as part of the No Action Alternative, other ongoing and future life-extension programs for the MM III weapon system would continue as planned.

2.2.1 FE Warren, Malmstrom, and Minot Air Force Bases

As part of ongoing operations at the three MM Wings, MM III missiles and/or certain missile components are periodically removed from the remote LFs and transported back to the Wing support base for maintenance, system checks, parts replacement, and occasional system upgrades. If the three-stage solid-propellant booster requires maintenance or motor change-out, or is to be used for flight tests at Vandenberg AFB, then a Transporter Erector (TE) vehicle (Figure 2-6) is brought in to remove the booster from the LF and transport it back to the support base.

At the support base, the intact booster is transferred from the TE to a Missile Transporter (MT) trailer (Figure 2-7) and readied for transport to either Hill AFB or Vandenberg AFB, depending on the actions required. When necessary, the RS and PSRE are transported separately back to the support base. The design of the PSRE is such that its handling and storage does not require the transfer of liquid propellants. If such actions or other maintenance procedures are required, the PSRE is shipped to the depot maintenance facility at Hill AFB. Any maintenance or other work done on the RS is conducted at the Wing support base.

Once the missile maintenance, upgrades, or other parts replacement actions are completed, the MM III components are transported from the support base back to the missile LF, and reinstalled in the reverse order from when they were first pulled.

To safeguard the RS, PSRE, booster, and other ordnance from fire or other mishap, all transportation, handling, and storage of these components would be accomplished in accordance with DOD, USAF, and US Department of Transportation (DOT) policies and regulations. Personnel supporting the ICBM program are regularly trained on missile handling and maintenance procedures using existing trainer facilities.

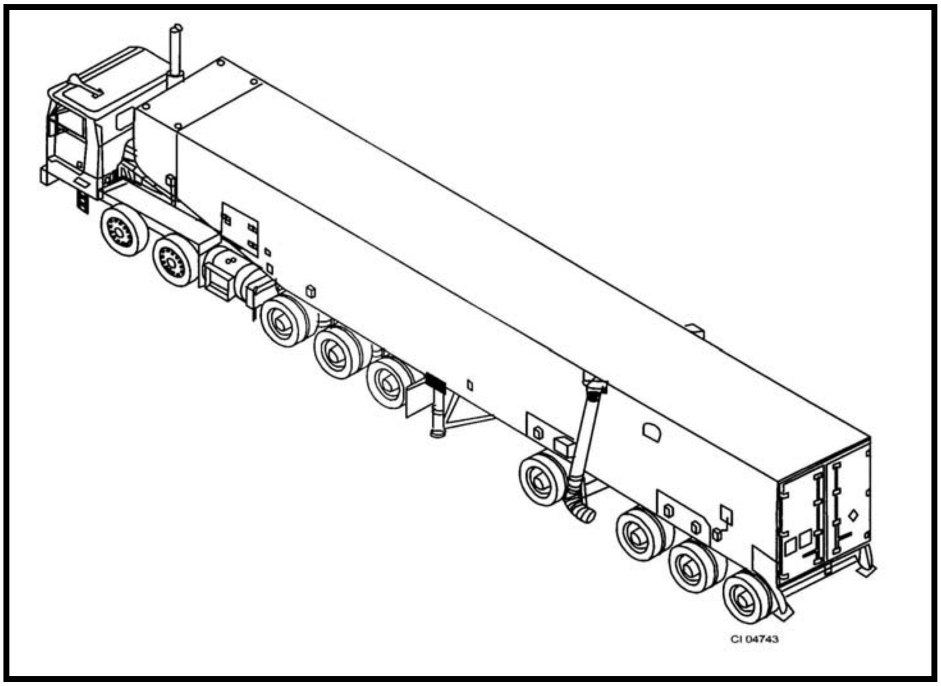


Figure 2-6. Transporter Erector

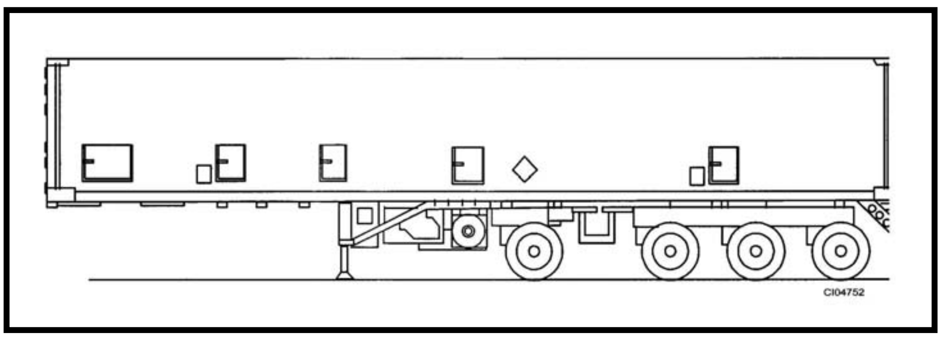


Figure 2-7. Missile Transporter Trailer

At each of the LCCs in the Wing areas, command and control operations, and missile monitoring, continue around the clock, 7 days a week. The console equipment at each LCC, which includes an HDA, VDUs, and an EMAD, is critical to the command and control operations, and interfaces with the silo-based missiles within each "flight." Similar consoles used for training and maintenance purposes are located on each of the Wing support bases and at other MM III system support locations. Because of aging equipment problems, computer and other electronic console equipment will sometimes fail. Replacement of entire failed units is often the only option, since replacement parts are usually no longer available for equipment repairs. Failed HDA and VDU units that cannot be repaired are declassified and sent to the local or regional Defense Reutilization and Marketing Office (DRMO) for resale, material recycling, and/or disposal as solid or hazardous waste. FE Warren AFB is the only Wing support base without an on-site DRMO. In this case, the failed equipment is turned over to the base supply organization, which then ships it to Fort Carson's DRMO in Colorado Springs, Colorado.

2.2.2 Hill Air Force Base

Located just south of Ogden, Utah, Hill AFB regularly provides logistics management and repair support for the nation's land-based ICBMs. As part of this effort, MM boosters are disassembled and reassembled at the base to allow for rocket motor inspections and testing for flight worthiness, motor refurbishment, and motor change-outs and upgrades when required. This includes the annual replacement of three to four MM boosters pulled from the Wing LFs for flight tests at Vandenberg AFB, and the supply of other missile components needed for the tests. These actions are considered routine at Hill AFB and are dictated by standard operating procedures.

Most of the rocket motor operations at Hill AFB are conducted within the Missile Assembly Maintenance and Storage area, which is centrally located on base. For each building where motors are involved, Explosive Safety Quantity Distances (ESQDs) are in place to provide explosive hazard buffers between the buildings, and any non-related facilities and roadways nearby. Relatively small amounts of adhesives, sealers, and solvents are used in the booster assembly process.

Also at Hill AFB, the Strategic Missile Integration Complex (SMIC) is used for conducting a variety of tests on ICBM hardware and software components, in addition to providing training support. Just as at the Wings, failed HDA and VDU units in test consoles used at the SMIC, that cannot be repaired, are declassified and sent to the local DRMO on base for resale, material recycling, and/or disposal as solid or hazardous waste.

2.2.3 Vandenberg Air Force Base

The MM III missile is just one of a number of ballistic missiles and space-lift vehicles launched from Vandenberg AFB. As part of ongoing performance testing of the MM III system, Vandenberg AFB regularly conducts three to four MM III FDE launches every year. A comparison of the relative size of the MM III missile to some of the other launch vehicles used at Vandenberg is provided in Figure 2-8.

For each flight test, the USAF randomly selects a MM III missile from one of the three operational Wings. Using the methods previously described in Section 2.2.1, the solid-propellant booster, the PSRE, guidance set, and RS (minus the operational RVs) are shipped separately to Vandenberg AFB in preparation for a launch. An instrumentation wafer for the missile is also shipped to the base from storage at Hill AFB.

Pre-Flight Preparations

Upon arrival at the base, the booster is either placed temporarily in a missile storage bunker, or taken to the Missile Processing Facility (MPF) (Figure 2-9), depending on the launch schedule. After being unloaded at the MPF, the booster undergoes inspections and system checks, and the destruct package is added. The purpose of the destruct package is to terminate motor thrust if unsafe conditions develop during powered flight. The destruct package also contains the logic to detect a premature separation of the booster stages and initiate a thrust termination action on its own. Thrust is terminated by initiation of a linear shaped explosive charge, which splits the motor casing, releasing motor pressure. Usually, no more than four base personnel are involved during this installation process. The ESQDs from the MPF are set between 600 and 1,000 ft (183 and 305 m). These distances are expanded to 2,500 ft (762 m) during Safe and Arm Checks. The typical elapsed time from when the booster arrives at Vandenberg AFB to when the flight test is conducted is 3 to 4 months.

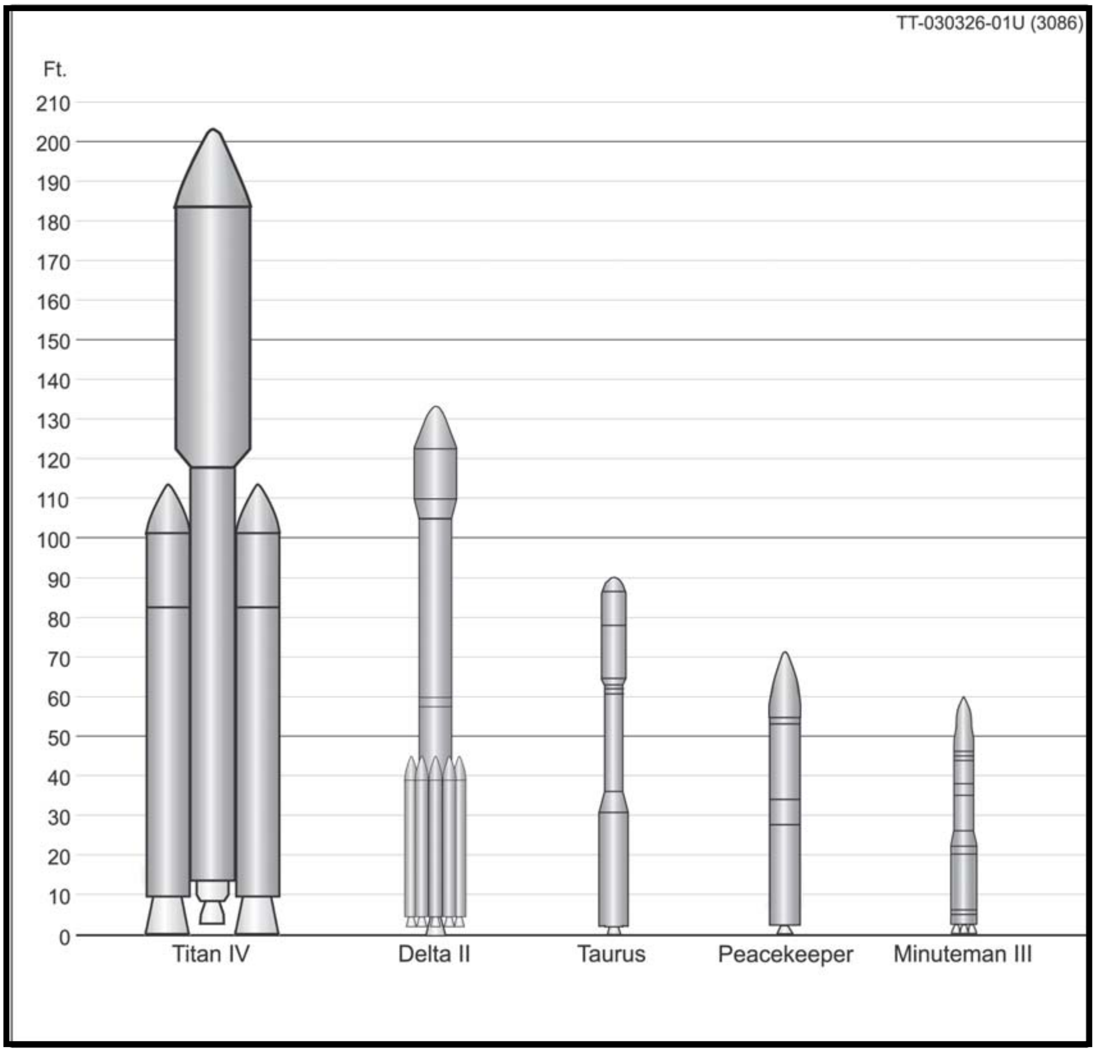


Figure 2-8. Comparison of Launch Vehicles

Once ready, the booster is transported in a TE to the designated LF near the north end of the base, where it is lowered into the underground silo. There are four LF silos at Vandenberg AFB for conducting MM III launches—LFs 04, 09, 10, and 26—which are used on a rotating basis in the launch cycle. The locations of these LFs are shown in Figure 2-9. Once the booster has been placed in the silo, ESQDs similar to those applied to the MPF are established for the LF.

After the booster is readied at the LF, the PSRE is removed from Building 1551 (where it was stored upon arrival at the base), and transported to the designated LF for placement on top of the booster. For safety purposes, Building 1551 has an ESQD of 1,250 ft (381 m) established around it. Following placement of the PSRE on the booster, the guidance set and instrumentation wafer are added.

At Vandenberg AFB, the RS is assembled at the Assembly, Surveillance, and Inspection (AS&I) facility (Munitions Assembly Building), which also has an ESQD of 1,250 ft (381 m) established around it. For the flight tests, the operational RVs that were removed at the Wing are replaced with one, two, or three test RVs. The test RVs serve to simulate operational RVs to help ensure that the weapon system is

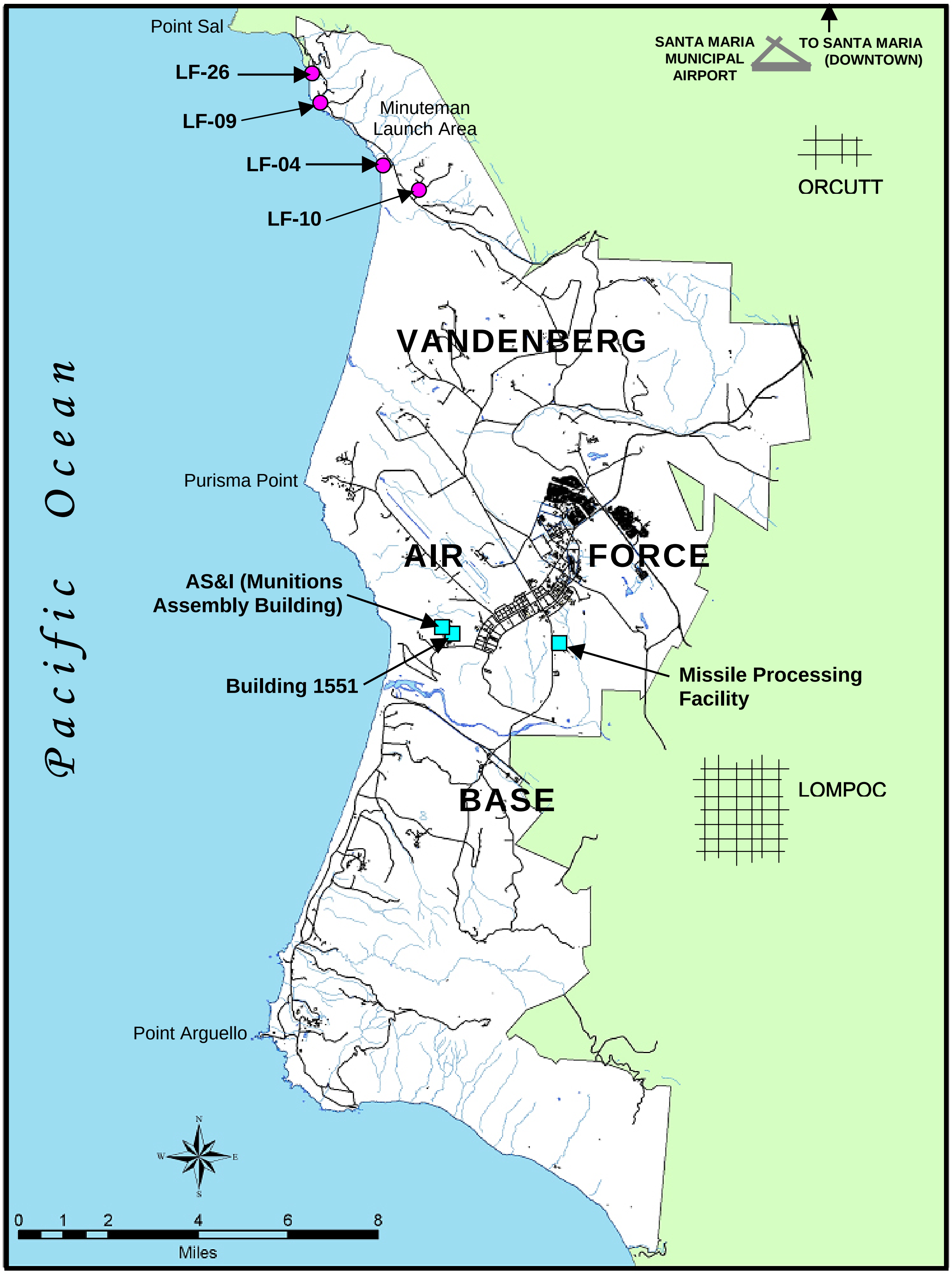


Figure 2-9. Minuteman III Flight Test Support Facilities at Vandenberg AFB, California

functioning correctly. The RV simulators do not contain any fissile materials; however, depending on mission requirements, some of them may contain varying quantities of hazardous materials, including high explosives, beryllium (Be), depleted uranium (DU)[1], and batteries. Such test RVs arrive at the base pre-assembled from the DOE. During assembly of the RS, various pieces of ordnance are installed (e.g., the shroud ejection motor, gas generators, etc.). An insulating sealant is applied to the joining edges of the shroud. Once completed, the RS, containing one to three test RVs, is loaded onto a payload transporter and taken to the LF for placement on top of the MM III booster.

Also, prior to each launch, a protective silicon rubber sealant is manually applied (not sprayed) to cable pass-through holes and other openings along the launch tube walls of the LF. This sealant prevents rocket exhaust gases from damaging the facility.

Flight Activities

Figure 2-10 shows a representative missile flight path and the booster drop zones for a MM III FDE test missile launched from Vandenberg AFB towards USAKA in the Marshall Islands. Following motor burnout and separation, the spent 1st-stage motor will splash down in the Pacific Ocean approximately 110 to 160 mi (180 to 260 km) off the California coast. Following in sequence, the spent 2nd-stage motor will also splash down approximately 870 to 950 mi (1,400 to 1,520 km) off the coast. As the missile travels along a flight path several hundred miles north of the Hawaiian Islands, it will reach an apogee several hundred miles in altitude. Prior to this point, the 3rd-stage motor will have separated from the post-boost vehicle. The spent 3rd-stage motor will travel on a ballistic course, splashing down in the open ocean approximately 60 to 270 mi (100 to 430 km) northeast of the Marshall Islands, as the post-boost vehicle steers the RVs toward designated target points in the vicinity of USAKA.

Prior to conducting each MM III FDE flight test, USAF and contractor personnel conduct a comprehensive safety analysis to determine specific missile launch and flight hazards. As part of this analysis, risks to off-base areas and non-participating aircraft, sea vessels, and personnel are determined. The results of this analysis are used to identify the launch hazard area, expended booster drop zones, post-boost vehicle impact area, and a terminal hazard area for the RVs. A flight termination boundary along the MM III flight path is also predetermined, should a missile malfunction or flight termination action occur. The flight termination boundary defines the limits at which command flight termination would be initiated in order to contain the missile and its debris within predetermined hazard and warning areas, thus minimizing the risk to test support personnel and the general public.

Typical launch hazard areas for each of the four MM III LFs are delineated in Figure 2-11, along with the range of launch trajectories. As part of standard procedures, commercial and private aircraft and watercraft are notified of all the hazard areas several days prior to launch through a Notice to Airmen (NOTAM) and a Notice to Mariners (NOTMAR), respectively. Within a day prior to each launch, radar, helicopters, and other remote sensors are used to verify that the hazard areas are clear of non-mission-essential aircraft, vessels, and personnel. Depending on which of the MM III LFs is used, range safety procedures may require closure of Point Sal State Beach located just north of LF-26—typically for less than a day—and the coordination and monitoring of any train traffic passing through the base.

[1] Natural uranium (U) is a silver-colored metal that is radioactive and nearly twice as dense as lead. Small amounts of U naturally occurring in soil, water, air, plants, and animals contribute to natural background radiation in the environment. DU is a byproduct of the enrichment process used to make weapons grade U-235. DU retains the natural toxicological properties of U, but approximately half of its radiological activity. DU is a non-fissile material.

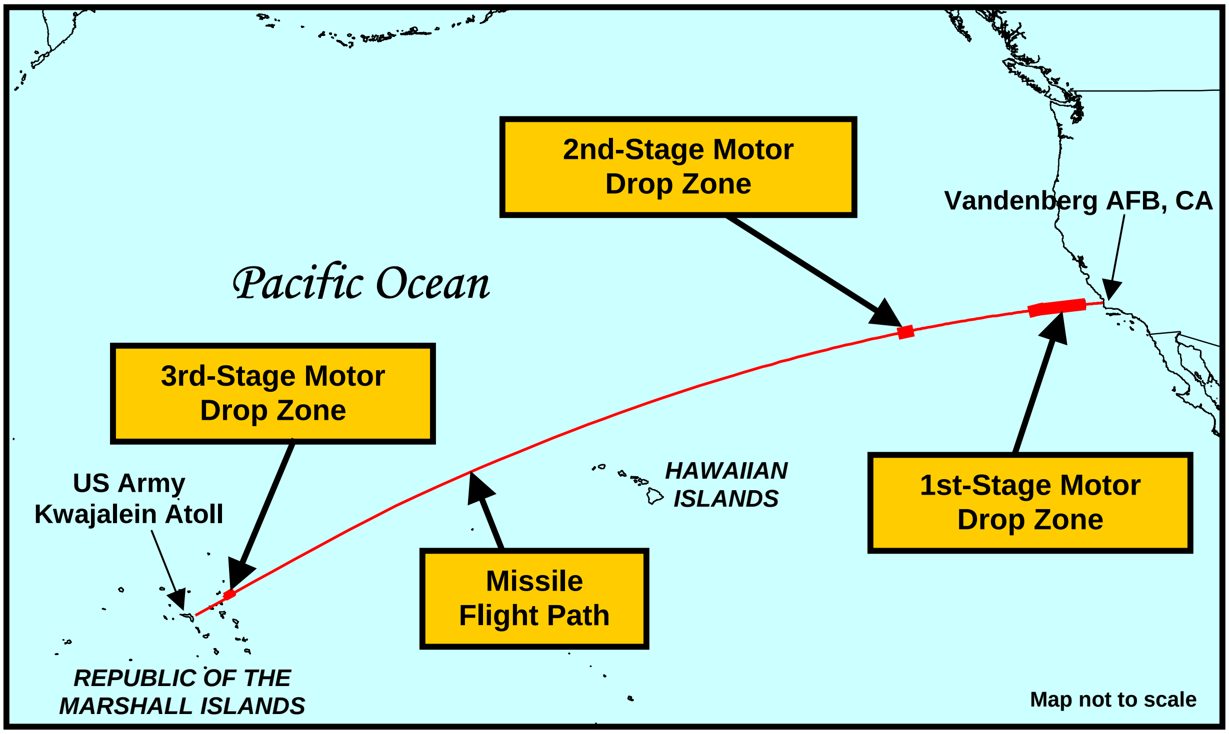


Figure 2-10. Representative Missile Flight Path and Motor Drop Zones for Minuteman III Flight Tests from Vandenberg AFB, California

Should a MM III missile head off course or should other problems occur during flight, the Missile Flight Control Officer would activate the destruct package on the missile. This would stop the vehicle's forward thrust, and the missile would then fall along a ballistic trajectory into the ocean.

Post-Launch Operations

Following each flight test, post-launch refurbishment of the LF is required for the replacement of cables and other damaged components, and the painting of components (e.g., missile suspension system) for corrosion control. In addition, the silicon rubber sealant applied to the tube walls, prior to launch, must be scraped from holes and openings, and collected in a single 55-gal (208-L) drum for disposal as a hazardous waste.

After every four flights, the walls of the launch tube are also hand brushed to remove accumulated blast residues. The residues are swept up and collected in 55-gal (208-L) drums for disposal as hazardous waste.

The expended rocket motors and other missile hardware are not recovered from the ocean following flight tests.

Console Equipment Maintenance

Similar to the MM III Wings, Vandenberg AFB has a number of ICBM command and control consoles used for training, testing, and maintenance purposes. Just as at the Wings, failed HDA and VDU units that cannot be repaired are declassified and sent to the local DRMO on base for resale, material recycling, and/or disposal as solid or hazardous waste.

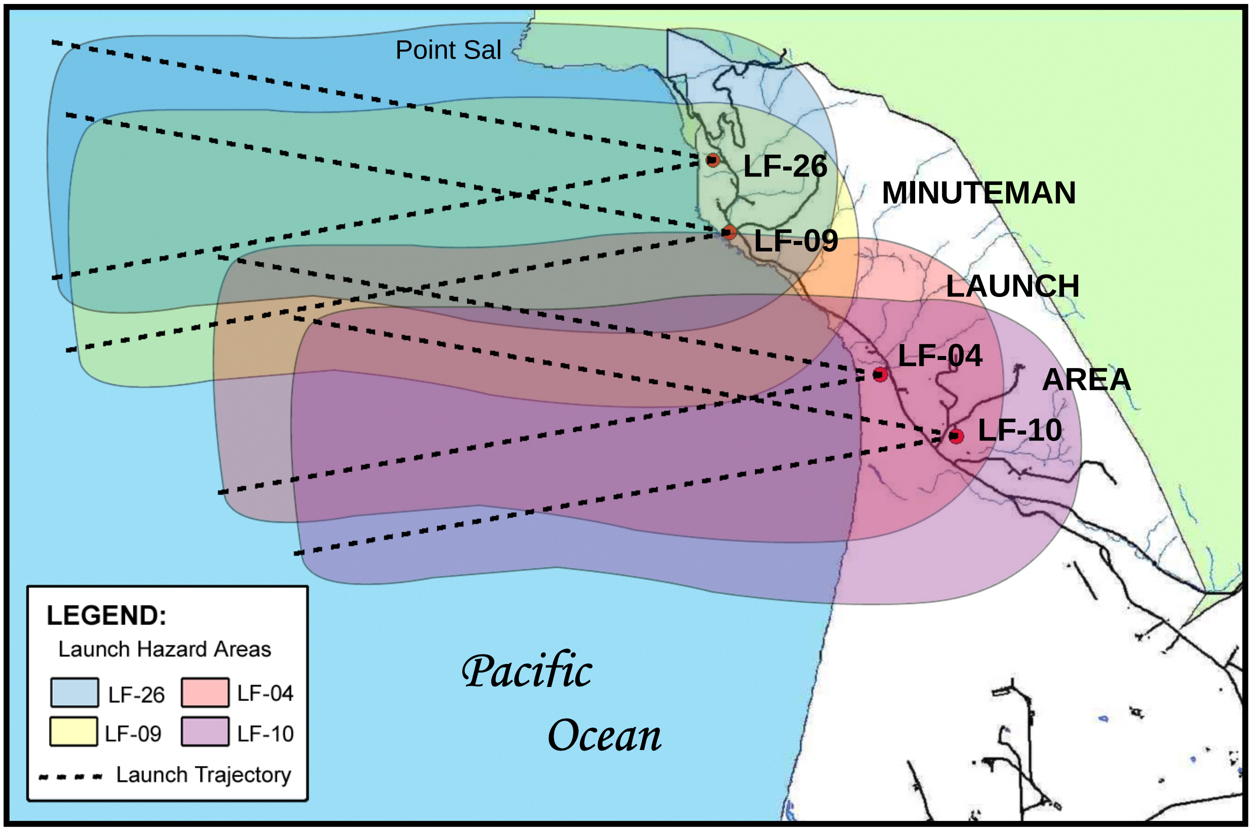


Figure 2-11. Range of Minuteman III Launch Trajectories and Launch Hazard Areas at Vandenberg AFB, California

2.2.4 US Army Kwajalein Atoll

Towards the terminal end of each MM III FDE flight, beyond the 3rd-stage motor drop zone, the post-boost vehicle fragments impact in a predetermined area of the ocean northeast of USAKA in the RMI. The hazard areas for missile impact are shown in Figure 2-12 for a representative MM III flight path. Traveling slightly farther, the one to three RVs (per flight) are targeted towards designated deep ocean areas east of the Kwajalein reef, or in the vicinity of Illeginni Island, depending on mission requirements. Test RVs containing high explosives would be detonated at some altitude (airburst), or upon impact on land or water. RVs that do not contain high explosives would remain intact as they impact land or water at high velocities. Targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated as habitat for species of concern, under the UES, would not be targeted.

To ensure the safe conduct of these types of tests, a Mid-Atoll Corridor Impact Area has been established across USAKA, as is shown in Figure 2-12. When a point of impact is to occur in this area, a number of strict precautions are taken to protect personnel. Such precautions may consist of evacuating nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor. Just as at Vandenberg AFB, NOTAMs and NOTMARs are published and circulated in accordance with established procedures to provide warning to personnel, including natives of the Marshall Islands, concerning any

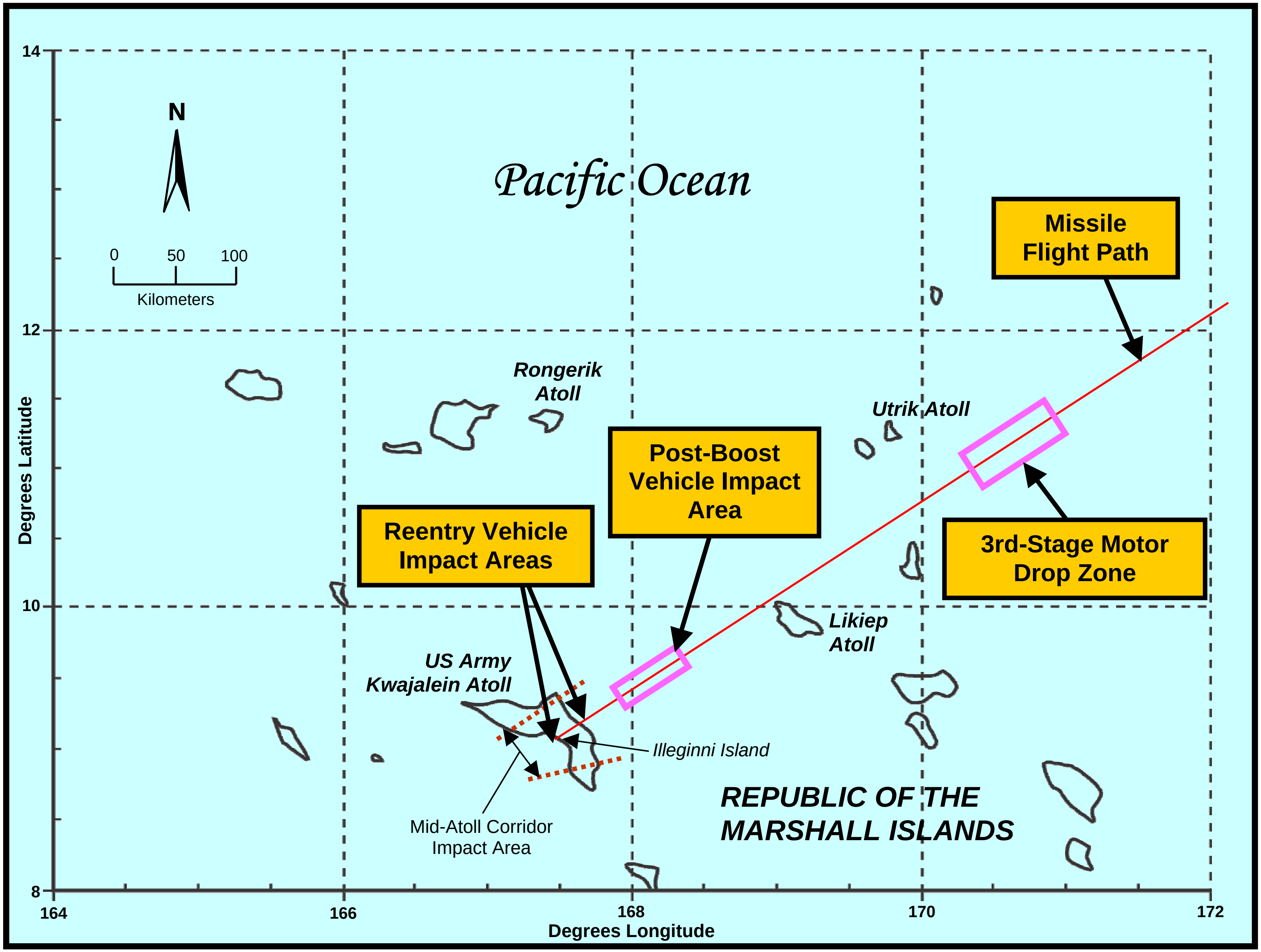


Figure 2-12. Representative Missile Flight Path and Hazard Areas for Minuteman III Tests at US Army Kwajalein Atoll

potential hazard areas that should be avoided. Radar and visual sweeps of hazard areas are accomplished immediately prior to FDE flight tests to assist in the clearance of non-critical personnel. Only mission-essential personnel are permitted in hazard areas.

The Ronald Reagan Ballistic Missile Defense Test Site (RTS) at USAKA supports MM III FDE missions by providing tracking, sensing, and other technical and logistical support. An extensive array of missile tracking radars and optical sensors are located on several of the islands. Depending on mission requirements, other auxiliary sea-based, aircraft-based, and satellite-based sensors (optical and radar systems) may be involved in tracking the missile and collecting data. Test support is provided primarily by existing Government personnel and contractors based at USAKA.

RVs that impact in the ocean beyond shallow waters are not recovered. Debris from those RVs that impact on land or in the atoll lagoon is recovered. Post-test recovery operations at Illeginni Island require the manual cleanup and removal of any RV debris, including hazardous materials (e.g., DU), followed by filling in larger craters using a backhoe or grader. Both Lawrence Livermore National Laboratory (LLNL) and USAKA personnel are usually involved in these operations.

RV recovery/cleanup operations in the lagoon and ocean reef flats, within 500 to 1,000 ft (152 to 305 m) of the shoreline, are conducted similarly to land operations when tide conditions and water depth permit. A backhoe is used to excavate the crater. Excavated material is screened for debris and the crater is usually back-filled with coral ejected around the rim of the crater. When RVs impact in the deeper waters of the atoll lagoon, a dive team from USAKA is brought in to conduct underwater searches. Using a ship for recovery operations, a remotely operated vehicle is first used to locate the debris field on the lagoon bottom. Divers in scuba gear are then able to recover the debris manually.

In general, RV recovery operations are not attempted in deeper waters on the ocean side of the atoll. Searches for debris would be attempted out to depths of 50 to 100 ft (15 to 30 m). An underwater operation similar to a lagoon recovery would be used if debris were located in this area.

The potential impacts resulting from these types of ICBM tests at USAKA—including RV impacts in the vicinity of Illeginni Island—have been previously analyzed in the *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands* (USAF, 1992a), which is summarized in Appendix A.

2.3 PROPOSED ACTION

The RS Modifications would require hardware and software modifications to existing cables, mounting hardware, connectors, testers, and trainers at LFs located within the three MM Wings, and at several other USAF and contractor facilities supporting MM III operations. The activities would include development and implementation of the following items:

- New and modified RS hardware to mount the Mark 21 RV
- New RS electronic signal generator
- Changes to software programs and data collection systems
- Modifications to system test and evaluation hardware/software
- Modifications to personnel training hardware and software packages
- Flight test and evaluation of the modified MM III missile.

Console equipment activities would involve the replacement of MM III command and control console equipment, and related software upgrades, at all operational LCCs located within the three MM Wings, and at several other USAF and contractor facilities supporting MM III ICBM operations. The program activities can be broken down into three main efforts:

- Replacement of the mechanical HDA (a high-capacity computer hard disk), with a sealed solid-state design
- Replacement of the cathode ray tube (CRT) technology VDUs with more modern units (e.g., liquid crystal displays)
- Upgrade of the COP software and replacement of the EMAD module with a unit having more internal memory.

The RS-related activities would be multi-phased, involving system development, testing, and deployment activities, while the console equipment requires only deployment. For analysis purposes, the Proposed Action is divided into a flight test and evaluation phase for the modified RS, a deployment phase for the RS modification kits and Mark 21 RVs, and additional deployment-related activities associated with the new console equipment. These actions are described in the following sections.

2.3.1 Flight Test and Evaluation of the Reentry System Modification

MM III flight tests involving use of the modification hardware/software would be conducted at Vandenberg AFB. The purpose of the initial flight tests is to resolve technical issues and identify any areas of risk associated with the proposed MM III modification. Continuation of the FDE flight test program (described earlier in Section 2.2.3) would serve to ensure system safety, gather information to support accuracy and reliability estimates, and verify the ability of the system to meet ICBM mission requirements on a long-term basis.

Flight test operations would be conducted in a manner similar to that described for the No Action Alternative in Section 2.2.3, and would occur from the same four LFs previously identified for these types of tests (see Figure 2-9). No facility modifications or construction would be required at Vandenberg AFB for these flight tests. Approximately 45 existing Vandenberg AFB personnel would be involved in missile handling and post-launch operations at the base. Just as on prior FDE flights, some of the proposed test RVs may contain varying quantities of hazardous materials including high explosives, Be, DU, and batteries.

Along with the normal FDE launches, four additional flight tests would be conducted within the June and August 2005, and February and September 2006, timeframes to verify system operation and certify the modified weapon system. Operations for the modified FDE flights would be conducted in the same manner as for current FDE launches. Table 2-2 shows the MM III launch rates planned to occur through 2010.

At the terminal end of each flight, the post-boost vehicle fragments would impact in the open ocean northeast of USAKA. Traveling slightly farther, the RVs would impact east of the Kwajalein reef or in the vicinity of Illeginni Island, within the Mid-Atoll Corridor Impact Area—the same general areas now used for FDE flights (Figure 2-12). Targets would be carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated as habitat for species of concern, under the UES, would not be targeted. Similar tracking, sensing, RV recovery, and other technical and logistical support, as previously described for the No Action Alternative in Section 2.2.4, would be provided for these flight tests.

Table 2-2. Planned MM III Launch Rates for Vandenberg AFB, California							
Planned Actions	**MM III Launches per Fiscal Year**						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Current FDE Flights	3	3	3	1	0	0	0
Modified FDE Flights	0	0	0	3	4	4	4
Additional Flight Tests	0	2	2	0	0	0	0
Total Flights Planned	**3**	**5**	**5**	**4**	**4**	**4**	**4**

= Tests incorporate RS modification kits and software upgrades, and the newer Mark 21 RV simulators or Mark 12A RV simulators. All other tests utilize older Mark 12- or 12A-related hardware/software.

In conjunction with each flight test, a replacement MM III booster would be assembled at Hill AFB and shipped to the applicable MM Wing for purposes of reactivating the affected LF. This particular action would be conducted in the same manner as previously described for the No Action Alternative in Sections 2.2.1 and 2.2.2.

2.3.2 Deployment of Reentry System Modification Kits and Mark 21 Reentry Vehicles

As described under Section 2.3, deployment efforts would include new and modified hardware for MM III RSs. The RS modification kits (including hardware for mounting Mark 21 RVs on the RS, and new electronic flight equipment), new support equipment, new and modified software, and modifications to training hardware would be shipped directly from existing contractor facilities to the MM III Wings, Vandenberg AFB, and Hill AFB starting in late 2006. Deployment of the RS modification kits onto fielded missiles at the Wings would begin in 2006 and continue through 2011, when Full Operational Capability would be reached.

At each operational LF, USAF personnel would remove the currently deployed RS from the missile and transport it back to the Wing support base for modifications using methods similar to those previously described for the No Action Alternative in Section 2.2.1. Existing base personnel would then perform system modifications, involving the replacement of RVs, RS attachment hardware, and a new electronic signal generator, before reinstalling the modified RS at the LF.

Under current USAF planning, all of the MM III RSs would receive the proposed modification to accommodate either the Mark 21 RV or the current Mark 12A RV. The US Air Force Space Command would determine the specific quantities and configurations of RVs at each missile Wing. In addition to deployment of the newer Mark 21 RVs, the older Mark 12 RVs would be removed from the operational MM III ICBM force. The long-term storage and/or disposition requirements for the Mark 12 RVs, however, represent separate actions that are not part of the proposed MM III modification.

No facility modifications or new construction would be required for these deployment activities. Once deployed, the modified RS would have little or no change to existing maintenance, sustainment, and logistics procedures for personnel and facilities.

2.3.3 Deployment of New Console Equipment

As previously described, the MM III command and control modifications involve the replacement of console equipment, and related software upgrades, at all operational LCCs located within the FE Warren AFB, Malmstrom AFB, and Minot AFB missile Wings. The replacement of console equipment and software upgrades would also occur at various trainer and support facilities at each Wing support base, Hill AFB, Vandenberg AFB, and at other USAF/contractor locations.[2]

Generally, the HDA, VDU, and EMAD modifications would be performed on each console. A breakdown of the approximate number of new console equipment components to be deployed, by location, is provided in Table 2-3. Also shown in the table is the lifetime supply of spares for selected components. At each location, new components would be stored in existing facilities until needed.

Table 2-3. Quantities of New Console Equipment to be Deployed

Deployment Location	VDU	HDA	EMAD	COP
FE Warren AFB, WY	68	16	15	17
Malmstrom AFB, MT	92	21	20	22
Minot AFB, ND	68	16	15	17
Vandenberg AFB, CA	42	6	5	7
Hill AFB, UT	10	6	12	6
Other Deployment Locations	10	5	2	5
Spare Units	44	120	20	-
Total Units	334	190	89	74

Note: Quantities shown are approximate.

Console equipment deployment at all trainer units would be completed in 2005. Operational facilities would likely receive the COP upgrade and replacement EMAD modules in 2006. Deployment of the remaining HDAs and VDUs would occur as part of routine maintenance, or by forced deployment over a 3-year period beginning at the end of 2005 or 2006. Generally, no more than two or three personnel would be required for the equipment change-out at each console location.

Following each console upgrade, the old VDUs and HDA would be declassified and turned over to the local or regional DRMO for resale, material recycling, and/or disposal as solid or hazardous waste. The old EMAD module would be placed in storage and would not undergo disposal. FE Warren AFB is the only Wing support base without an on-site DRMO. In this case, the failed equipment would be turned over to the base supply organization, which then ships it to Fort Carson's DRMO in Colorado Springs. Approximate numbers of old VDUs and HDAs to be processed at DRMOs are listed by location in Table 2-4.

As an alternative for DRMO processing, a few of the old HDAs and VDUs could be considered for placement in the USAF Museum Program. This would allow such items to be given to one or more receiving Air Force Museums across the country for historical displays and interpretive collections.

[2] Because the number of new console equipment components going to "other" individual USAF and contractor deployment locations is minimal (see Table 2-3), no further environmental analyses of those sites are necessary.

Table 2-4. Quantities of Old Console Equipment Planned for Defense Reutilization and Marketing Office Processing		
DRMO Location	**VDU**	**HDA**
Fort Carson, CO (for FE Warren AFB, WY)	78	24
Malmstrom AFB, MT	103	29
Minot AFB, ND	78	24
Vandenberg AFB, CA	44	13
Hill AFB, UT	25	79
Total Units	328	169

Note: Quantities shown are approximate.

2.4 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

As an alternative for the proposed Mark 21 deployment on MM III ICBMs, a Mark 12 RV life-extension program was considered, but eliminated as unreasonable because of excessive costs for implementing such a modification.

Though computer simulations, modeling, and other laboratory tests are used during the design and early evaluation of the MM III modification, such methods cannot provide all of the information needed to ensure that the MM III weapon system is functioning correctly. Thus, an alternative relying solely on such methods was deemed unreasonable.

No other reasonable alternative sites for conducting MM III launches were identified. Other than Vandenberg AFB, there are no other alternative launch sites within the United States and its territories that can perform MM III launches using existing facilities in a safe and secure operational-like manner. Also, USAKA is the only reasonable alternative location that is capable of tracking and monitoring RV impacts, and that can provide adequate safety and security for such missions. For potential RV land impacts, Illeginni Island is the only leased property within USAKA that does not have critical range instrumentation vulnerable to damage from such tests. Eliminating the vicinity of Illeginni Island as a target area would eliminate the few opportunities to photograph such impacts (using remote-controlled equipment) and to recover RV fragments, both of which can provide important information on weapon system performance.

Consideration was also given to a reduced number of flight tests from Vandenberg AFB. The four flight tests planned in 2005 and 2006, however, represent the minimum number of added flights necessary to validate and certify the proposed MM system modifications.

For the command and control console equipment modifications, other HDAs and VDUs were considered, but were found to be unreasonable because they did not meet form, fit, and function requirements associated with the existing MM III consoles. The replacement components must be comparable to the existing units, and they must employ logistically supportable technologies.

2.5 COMPARISON OF ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND THE NO ACTION ALTERNATIVE

Table 2-5 presents a comparison of the potential environmental consequences of the Proposed Action and the No Action Alternative for those locations and resources affected. A detailed discussion of these potential impacts is presented in Chapter 4.0 of this EA.

Table 2-5. Comparison of Potential Environmental Consequences

Locations and Resources Affected	No Action Alternative	Proposed Action
FE Warren Air Force Base, WY; Malmstrom Air Force Base, MT; and Minot Air Force Base, ND		
Health and Safety	By adhering to established and proven safety standards and procedures, the level of risk to military personnel, contractors, and the general public should be minimal. Regarding rocket motor transportation over public roads, accident rates for ongoing operations have historically been very low (e.g., 0.000002 accidents per mile for USAF vehicles driven within the FE Warren AFB Wing area). Thus, no significant impacts to public or occupational health and safety are expected to occur.	Missile handling and transportation operations would be conducted in the same manner as for the No Action Alternative, and RS modifications would be conducted during normal ongoing maintenance operations. Thus, Proposed Action activities would not substantially alter the findings identified for the No Action Alternative; namely, that no significant impacts to public or occupational health and safety are anticipated.
Hazardous Materials and Waste Management	All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Each installation has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	The same policies, procedures, and regulations followed under the No Action Alternative would apply. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to be changed. Thus, no adverse impacts from the management of hazardous materials and waste are expected.
Hill Air Force Base, UT		
Health and Safety	MM III booster operations are routine activities at Hill AFB. By adhering to established and proven safety standards and procedures, the level of risk to military personnel, contractors, and the general public would be minimal. Consequently, no significant impacts to public or occupational health and safety are expected.	The Proposed Action activities would not substantially alter the findings identified for the No Action Alternative; namely, that no significant impacts to public or occupational health and safety are anticipated.
Hazardous Materials and Waste Management	All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. The base has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the	The same policies, procedures, and regulations followed under the No Action Alternative would apply. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to be changed. Thus, no adverse impacts from the management of hazardous materials and waste are expected.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**No Action Alternative**	**Proposed Action**
	management of hazardous materials and waste are expected.	
Vandenberg Air Force Base, CA		
Air Quality	Although rocket motor exhaust emissions would be released in the lower atmosphere, they would be rapidly diluted and dispersed by prevailing winds. No violation of air quality standards or health-based standards for non-criteria pollutants is anticipated. When compared to the amount of emissions released on a global basis, the flight tests will not be statistically significant in contributing to cumulative impacts on the stratospheric ozone layer. Overall, no significant impacts to air quality would occur.	Proposed Action activities would not substantially alter the findings identified for the No Action Alternative. A review of the General Conformity Rule resulted in a finding of presumed conformity with the State Implementation Plan. Additionally, no changes to existing or new air emission permits are required. As a result, no long-term adverse impacts are anticipated.
Noise	MM III launches would generate noise levels ranging from 125 dB (unweighted) in the immediate vicinity of the launch site, to around 105 dB (unweighted) or lower in some populated areas off base. While these noise exposure levels can be characterized as very loud, they would occur infrequently, are very short in duration (about 20 seconds per launch), and would have little effect on the Community Noise Equivalent Level off base. Sonic booms generated by the missile flights would occur down range, some 25 nautical miles downrange of the launch site, and thus would not affect coastal land areas. As a result, no significant impacts to the noise environment would occur.	An increase in flight test operations for a 2-year period would not substantially alter the findings identified for the No Action Alternative; namely, that no significant impacts to the noise environment would occur.
Biological Resources	Exposure to short-term noise from MM III launches and helicopter overflights could cause startle effects in marine mammals and migratory birds. However, a NMFS incidental "take" permit is in place that authorizes incidental harassment of pinnipeds. Helicopter overflights are required to maintain minimal distances away from protected seal haul-outs/rookeries and bird roosting/nesting areas. Studies have shown that it is unlikely for the launch noise exposures documented to date to present a serious risk to seal hearing. On the basis of prior monitoring studies, the NMFS has determined that rocket launch activities have a negligible impact on marine mammal populations and stocks at Vandenberg AFB. Launch emissions have the potential to acidify nearby surface waters. However, surface water monitoring conducted for larger launch systems at Vandenberg AFB has not shown long-term acidification of surface waters. Because the MM III represents a smaller launch system producing fewer emissions, the potential for adverse effects is minimal. In addition, the constant deposition of acid-neutralizing sea salt would reduce the acidification of surface waters. The probability for an aborted MM III launch to occur is extremely low. If an early abort were to occur, base actions would immediately be taken to recover and	An increase in flight test operations for a 2-year period would not substantially alter the findings identified for the No Action Alternative; namely, that no long-term adverse impacts are anticipated.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**No Action Alternative**	**Proposed Action**
	cleanup unburned propellant and any other hazardous materials that had fallen on the beach or in shallow waters. Any propellant falling into the offshore waters would be subject to continual mixing and dilution due to the ocean waves and currents, and hence, local accumulation of perchlorates contained in the propellants is unlikely. As a result, no significant impacts on biological resources would be expected. Some temporary distress to vegetation near the launch site from launch emissions can be expected, but no long-term adverse effects would occur.	
Health and Safety	Safety procedures and practices at the base are well developed and constantly in use. Notices to mariners and airmen are published in advance to warn of launch hazard areas to be avoided. In addition, detailed flight safety analyses are conducted prior to each mission. As a result, no significant impacts to public or occupational health and safety are anticipated.	An increase in flight test operations for a 2-year period would not substantially alter the findings identified for the No Action Alternative. Thus, no significant impacts to public or occupational health and safety are anticipated.
Hazardous Materials and Waste Management	All hazardous materials would be managed in accordance with well-established policies and procedures. Hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. The base has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials. Appropriate permits are also in place and workers are trained. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	The same policies, procedures, and regulations followed under the No Action Alternative would apply. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to be changed. Thus, no adverse impacts from the management of hazardous materials and waste are expected.
Over-Ocean Launch Corridor		
Biological Resources	Sonic boom overpressures from MM III launch vehicles could be audible to protected marine species underwater. Underwater pressure waves generated by the sonic booms are expected to be less than 140 dB, which is well below the lower limit (178 dB) for inducing behavioral reactions, and the lower limit (218 dB) for inducing temporary threshold shift (TTS) in marine mammals and sea turtles, all sound pressure levels being referenced to 1 micro Pascal (µPa). Because the resulting pressures would be relatively low, and very short in duration, no long-term adverse effects are anticipated. For marine animals, the potential exists for direct contact or exposure to underwater shock/sound waves from the splashdown of spent rocket motors. However, in the open ocean, the probability of impacting protected marine mammals or sea turtles is insignificant based on statistical analyses. The MM III flight tests would occur only a few times per year, and motor impacts from each flight would likely not occur	An increase in flight tests for a 2-year period would not substantially alter the findings identified for the No Action Alternative; namely that no long-term adverse impacts are anticipated.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**No Action Alternative**	**Proposed Action**
	at the exact same locations. As a result, the impacts of spent rocket motors are not expected to cause any long-term adverse effects on marine mammals or sea turtles in the open ocean. Residual amounts of battery electrolytes, hydraulic fluid, propellants, and other materials could lead to the contamination of seawater. However, the risk of marine life coming in contact with, or ingesting, toxic levels of solutions is not considered significant because of the rapid dilution of any contaminants, and the rapid sinking of any contaminated components.	
US Army Kwajalein Atoll		
Biological Resources	The brief sonic boom overpressures associated with RV flights [estimated at 91 to 150 dB (referenced to 20 µPa)] are likely to cause startle effects in migratory birds on some islands of the Kwajalein Atoll, but the birds are not expected to abandon nests. At Illeginni Island, the migratory bird population appears to be stabilized, if not increasing, even after years of RV tests in the area. The sonic booms could also affect marine mammals and sea turtles underwater. However, at 117 to 176 dB (referenced to 1 µPa), the resulting underwater pressures would fall just below the lower limit for inducing behavioral reactions (178 dB referenced to 1 µPa), and well below the lower limit for inducing TTS (218 dB referenced to 1 µPa) in such animals. Because the resulting pressures would be relatively low, and very short in duration, no long-term adverse effects are anticipated. Like the spent MM III rocket motors, an RV impacting in the ocean or Kwajalein Atoll lagoon would result in underwater shock/sound waves, but with much higher pressure-levels being generated. At distances within a few thousand yards of an RV impact point, underwater pressure levels could induce behavioral reactions (e.g., abrupt movements, changes in surfacing, and sudden dives) in marine mammals, and possibly sea turtles. If they occur, such reactions would last for a very brief period and not result in any long-term effects. At a distance of 128 ft (39 m) from the RV splashdown site, TTS could begin to occur; and within several feet of the impact point, the pressure levels could prove to be fatal to these animals. However, the number of groups (small pods or schools) of these animals to be struck or exposed to harmful underwater shock/sound waves is estimated to be no higher than 0.000003 to 0.000009 per RV test event, depending on the number of RV simulators carried on the launch vehicle. The risk of physically injuring or killing the animals is extremely low in view of the facts that: (1) only 3 to 4 MM III launches would be conducted every year, (2) RV target locations are not always the same, and (3) the probability of impact on marine mammals and sea	An increase in RV flight tests for a 2-year period would not alter the findings identified for the No Action Alternative. Targets are normally selected to minimize damage to protected reef areas and identified wildlife habitats. As a result, no long-term significant impacts are anticipated in Kwajalein lagoon or in the vicinity of Illeginni Island. Additionally, no long-term adverse impacts are expected for ocean areas near Kwajalein Atoll.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**No Action Alternative**	**Proposed Action**
	turtles caused by underwater shock/sound waves is insignificant. In the event that an RV would directly impact on Illeginni Island or in the shallow coral reefs of Kwajalein Atoll, a crater would form. Post-test recovery and cleanup operations on Illeginni would also cause some short-term disturbance. Such impacts could potentially result in the loss of some protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting habitat, and coral reef habitat; all of which represents an irreversible or irretrievable commitment of resources. However, wildlife populations and habitat conditions would be expected to recover. Surveys have shown that bird populations and the local reef environment appear to be thriving after years of RV testing. Because the frequency of such occurrences is very low (estimated to be four to five instances over a 20-year period) and the amount of area affected would be minimal, no long-term significant impacts are anticipated. Following an airburst or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind. However, the Be and DU particles or fragments deposited by some RVs are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels. For impacts on Illeginni Island, there is the potential for migratory birds to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation. However, the relatively short-term exposures immediately following each test are unlikely to result in significant accumulations, particularly when considering the small amount of unrecovered material that may persist in the environment. As a result, no long-term significant impacts are anticipated.	
Cultural Resources	Given the extremely limited potential for any remaining traditional/ prehistoric remains on Illeginni Island, the likelihood of impacts to any resources must be considered either non-existent or extremely low. Though several buildings on the island are of the Cold War era, they currently do not meet RMI criteria for historic significance. Additionally, there is a low probability for the buildings to be impacted by RV tests. As a result, little or no impacts to cultural resources are expected.	An increase in RV flight tests for a 2-year period would not alter the findings identified for the No Action Alternative. Thus, no significant impacts to cultural resources are anticipated.
Health and Safety	Safety procedures and practices at USAKA are well developed. Notices to mariners and airmen are published and circulated to provide advance warning to personnel and natives of the Marshall Islands concerning any potential hazard area that should be	An increase in RV flight tests for a 2-year period would not alter the findings identified for the No Action Alternative. Thus, no significant impacts to public or occupational

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**No Action Alternative**	**Proposed Action**
	avoided. In addition, detailed flight safety analyses are conducted prior to each mission. As a result, no impacts to public or occupational health and safety are anticipated. Each RV test at USAKA would release hazardous and toxic materials (including Be and DU) around the impact point and some distance downwind. For a land impact on Illeginni Island, such debris would occur close to the point of impact. As a result, the major potential health concern is for workers visiting the island, and the long-term management and restoration of the island. However, modeling and post-test sampling results from prior RV flight tests have shown that air sampling levels for contaminants are far below Federal guidelines, and similar to pre-test background levels. Various post-test safety and health procedures are followed. Thus, no significant impacts to either occupational or public health and safety would occur.	health and safety are anticipated.
Hazardous Materials and Waste Management	The limited amount of hazardous materials used for RV test operations would be managed in accordance with well-established policies and procedures. Any residual fragments of RVs (including DU or high explosive materials) would be recovered from land or shallow water areas and properly disposed of in accordance with all UES and DOE/LLNL regulations and requirements. As previous sampling results have shown, levels of Be and DU contaminants in the air at Illeginni Island continue to remain at or near background levels, even after years of testing. Be and DU soil concentrations on the island can exceed background levels in the vicinity of RV impact sites. However, the Be and DU concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels. Hazardous material and waste handling capacities at USAKA would not be exceeded by RV test operations, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.	For the Proposed Action, the same policies, procedures, and regulations followed under the No Action Alternative would apply. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to be changed. Thus, no adverse impacts from the management of hazardous materials and waste are expected.

2.6 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

The USAF’s preferred alternative is the Proposed Action, as described in Section 2.3 of this EA.

3.0 AFFECTED ENVIRONMENT

This chapter describes the environmental resources at the installations and other locations identified in the Proposed Action—FE Warren, Malmstrom, Minot, Hill, and Vandenberg AFBs; the over-ocean launch corridor; and USAKA. The chapter is organized by installation/location, describing each environmental resource or topical area that could potentially be affected at that site by implementing the Proposed Action. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating impacts. Sources of data used and cited in the preparation of this chapter include available literature (such as EAs, EISs, and other environmental studies), installation and facility personnel, and regulatory agencies. A rationale for why certain environmental resources are not analyzed further is described in the introductory section for each installation/location.

This information serves as an essential part of the baseline against which the predicted effects of the Proposed Action can be compared. The potential environmental effects of the Proposed Action and No Action Alternative are discussed in Chapter 4.0.

3.1 FE WARREN, MALMSTROM, AND MINOT AIR FORCE BASES

FE Warren AFB is located in southeastern Wyoming, adjacent to the state capital, Cheyenne. Covering approximately 5,870 acres (2,375 hectares), the base currently supports 150 MM III missiles and the remaining Peacekeeper missiles (which are in the process of being deactivated), dispersed over a 12,600-square-mi (32,635-square-km) area covering portions of Wyoming, Nebraska, and Colorado (see Figure 2-3). Located next to the city of Great Falls in north-central Montana, Malmstrom AFB is approximately 4,390 acres (1,775 hectares) in area and supports 200 MM III missiles within a 23,000-square-mi (59,570-square-km) Wing area (see Figure 2-4). With a base area of approximately 5,050 acres (2,045 hectares), Minot AFB is in north-central North Dakota, about 13 mi (21 km) north of the city of Minot. The Wing for Minot supports 150 MM III missiles within an 8,500-square-mi (22,015-square-km) area (see Figure 2-5).

Rationale for Environmental Resources Analyzed

For the proposed MM III modification at FE Warren, Malmstrom, and Minot AFBs, health and safety, and hazardous materials and waste management (including pollution prevention), are the only areas of concern requiring discussion. As for other resource areas not analyzed further, the Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources, biological resources, or soils would be expected. Only a few existing base personnel would be involved; thus, there are no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts to any minority or low-income populations under Executive Order 12898 (Environmental Justice) would not occur. The proposed activities are well within the limits of current operations and permits at each of the bases. Thus, there would be no effects on airspace, land use, utilities, solid waste management, or transportation; and little or no additional impacts to noise levels, air quality, or water resources.

Because of its long military history dating back to the 1860’s, the site of FE Warren AFB includes several buildings and a historic district listed on the National Register of Historic Places (NRHP) (USAF, 2000b). Other more recent ICBM-related facilities at the base and within the Wing area [including most of the

LFs and Missile Alert Facilities[3] (MAFs)] are also eligible for listing on the NRHP because of their Cold War involvement. Under the Proposed Action, none of these facilities would undergo changes to their historic form or function, or result in changes to a piece of scientific architecture. The base has also completed a Historic American Engineering Record for the MM III system, and the museum there has preserved a complete set of LCC equipment and furnishings (Bryant, 2003). Thus, no "adverse effects," as defined by 36 CFR Part 800 (Protection of Historic Properties), would be expected.

Although MAF A-01 and LF A-06 within the Malmstrom AFB MM Wing are eligible for listing on the NRHP—because of their deterrence role during the Cuban Missile Crisis of 1962 (Ogden ALC, 2003)—neither the facility functions nor the historic property of these sites would be affected under the Proposed Action. These types of facility modifications and upgrades are already addressed in a Programmatic Agreement between the USAF and the Montana State Historic Preservation Office (SHPO) (USAF, 2003). Thus, no consultations with the SHPO are required.

3.1.1 Health and Safety

The region of influence (ROI) for health and safety is limited to the existing missile Wings and base facilities, and the US transportation network used in support of missile operations. Health and safety includes military personnel, contractors, and the general public.

Air Force Policy Directive (AFPD) 91-2 (*Safety Programs*) establishes the USAF's key safety policies, and also describes success-oriented feedback and performance metrics to measure policy implementation. More specific safety and safety-related DOD Directives (DODDs), Air Force Instructions (AFIs), and other requirements and procedures pertaining to the handling, maintenance, transportation, and storage of nuclear weapons, MM rocket motors, and related ordnance are listed below:

- DODD 3150.2 (*DOD Nuclear Weapon System Safety Program*)
- DODD 5210.41 (*Security Policy for Protecting Nuclear Weapons*)
- DOD 4540.5-M (*DOD Nuclear Weapons Transportation Manual*)
- DOD 6055.9-STD (*DOD Ammunition and Explosives Safety Standards*)
- AFPD 91-1 (*Nuclear Weapons and Systems Surety*)
- AFI 91-101 (*Air Force Nuclear Weapons Surety Program*)
- AFI 91-102 (*Nuclear Weapon System Safety Studies, Operational Safety Reviews, and Safety Rules*)
- AFI 91-114 (*Safety Rules for the Intercontinental Ballistic Missile Systems*)
- AFI 91-116 (*Safety Rules for Storage of Nuclear Weapons*)
- AFI 91-202 (*The US Air Force Mishap Prevention Program*)
- Air Force Manual 91-201 (*Explosives Safety Standards*).

In addition, the individual USAF installations will often augment these requirements to clarify local roles, responsibilities, and authorities by creating supplementary documents or operating instructions. Each Air Force Base's Safety Division or Office reviews safety issues. For example, the 90th SW Safety Office at FE Warren AFB, the 341st SW Safety Office at Malmstrom AFB, and the 91st SW Safety Office at Minot AFB have these responsibilities.

For the transportation of missile components, interstate highways are the preferred routes, although some state and local routes may be used, depending on the destination. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US

[3] Each MAF is a relatively small complex consisting of the underground LCC and an aboveground building that houses the personnel and equipment necessary for the facility to operate self-sufficiently.

DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile components is planned to occur.

The USAF has an excellent safety record of transporting missile rocket motors. During the height of Minuteman Program operations, from the early 1960's to 1990, over 11,000 Minuteman missile movements involving over 12,400 individual Minuteman rocket motors occurred by air, rail, or road. Since 1962, only three accidents have been associated with these movements, all of them transport truck rollover scenarios. In each of these three cases, however, all USAF property was safely recovered and there was no damage to the environment or to human health. In a program in which the USAF transported 150 boosters between 1995 and 1997, there were no traffic incidents. At FE Warren AFB, for example, the accident rate for USAF vehicles in the Wing area (about 0.000002 accidents per mile driven) was shown to be nearly identical to accident rates for the State of Wyoming. (USAF, 1992b, 2000b, 2001b)

3.1.2 Hazardous Materials and Waste Management

For the analysis of hazardous materials and waste management at the MM Wings, the ROI is defined as those USAF facilities on and off base supporting the handling, transportation, and storage of hazardous materials and hazardous waste.

Hazardous materials and waste management activities at USAF installations are governed by specific environmental regulations. For the purposes of the following discussion, the term hazardous materials or hazardous waste refers to those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Section 9601 et seq., as amended. In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. Regulated under the Resource Conservation and Recovery Act (RCRA), 42 USC Section 6901 et seq., hazardous waste is further defined in 40 CFR 261.3 as any solid waste that possesses any of the hazardous characteristics of toxicity, ignitability, corrosivity, or reactivity.

AFI 32-7042 (*Solid and Hazardous Waste Compliance*) and AFI 32-7086 (*Hazardous Materials Management*) implement AFPD 32-70 (*Environmental Quality*). Each installation provides procedures and guidance to personnel regarding the storage, transportation, use, and disposal of hazardous materials and waste. In accordance with AFI 32-4002 (*Hazardous Materials Emergency Response Program*), each installation also has a plan in place that provides guidelines and instructions to prevent and control accidental spills of hazardous materials, including a description of appropriate countermeasures to contain, clean up, and mitigate the effects of a spill or discharge. These plans and procedures incorporate applicable Federal, state, local, and USAF requirements regarding management of hazardous materials and hazardous waste.

A variety of hazardous materials are utilized and stored at the USAF installations to support the wide range of activities conducted. The installations operate on the pharmacy concept, which allows installation tenants to obtain hazardous materials from assigned distribution centers. Hazardous materials not obtained from the pharmacy must be registered with the pharmacy for tracking purposes. Hazardous waste at each installation is managed in accordance with RCRA requirements. Transportation of hazardous materials and waste is governed by the US DOT regulations within 49 CFR.

3.2 HILL AIR FORCE BASE

Hill AFB is located 5 mi (8 km) south of Ogden, Utah, and about 30 mi (48 km) north of Salt Lake City. As part of its mission, the 6,700-acre (2,710-hectare) installation provides systems management and logistical support for Minuteman, Peacekeeper, and other missile programs. Support for the proposed MM III modification represents routine activities at Hill AFB.

Rationale for Environmental Resources Analyzed

For the proposed MM III system support activities at Hill AFB, health and safety, and hazardous materials and waste management (including pollution prevention), are the only areas of concern requiring discussion. As for other resource areas not analyzed further, the Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources, biological resources, or soils would be expected. Only a few existing base personnel would be involved; thus, there are no socioeconomic concerns. Because there would be little or no effect to off-base populations, disproportionate impacts to any minority or low-income populations under Executive Order 12898 (Environmental Justice) would not occur. The proposed activity is well within the limits of current operations and permits at Hill AFB. As a result, there would be no effects on airspace, land use, utilities, solid waste management, or transportation; and little or no additional impacts to noise levels, air quality, and water resources.

3.2.1 Health and Safety

Regarding health and safety at Hill AFB, the ROI is limited to existing base facilities, and US transportation networks used in support of missile operations. Safety responsibilities at Hill AFB fall under the Ogden Air Logistics Safety Office. As noted in Section 3.1.1, safety managers use DOD requirements, the AFPD-91 series, AFI-91 series, and applicable Federal and state regulations to implement the safety program.

As described in Section 3.1.1, interstate highways are the preferred routes for the transport of rocket motors, although some state and local routes may be used, depending on the destination. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, the US DOT, and the DOD. The USAF coordinates on a regular basis with each state DOT whenever rocket motor transport is planned to occur. As previously discussed, the USAF has an excellent safety record of transporting missile boosters and rocket motors.

3.2.2 Hazardous Materials and Waste Management

Hazardous materials and waste management activities at Hill AFB are governed by the same specific environmental regulations identified in Section 3.1.2. The ROI is limited to the existing facilities at Hill AFB that handle hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

3.3 VANDENBERG AIR FORCE BASE

Vandenberg AFB is located in Santa Barbara County on the central coast of California, about 150 mi (240 km) northwest of Los Angeles. Covering more than 98,000 acres (39,660 hectares), it is the third-largest USAF installation. A primary mission for the base is to conduct and support space and missile launches. With its location along the Pacific coast, Vandenberg AFB is the only facility in the United States from which unmanned Government and commercial satellites can be launched into polar orbit, and land-based ICBMs are launched to verify weapon system performance.

Rationale for Environmental Resources Analyzed

For the proposed MM III modification activities at Vandenberg AFB, air quality, noise, biological resources, health and safety, and hazardous materials and waste management (including pollution prevention) are the only areas of concern requiring discussion. Surface water quality was also included in the analysis, from the standpoint of potential impacts on vegetation and wildlife. No other environmental resource areas are analyzed further for the following reasons. The Proposed Action does not require any ground-disturbing activities; therefore, no impacts to cultural resources or soils would be expected. Although eligible for listing on the NRHP under Cold War criteria (USAF, 1997a), none of the LFs used for conducting MM III launches would require modifications or changes in their current use. Installation Restoration Program (IRP) studies on base have not shown any concerns for contamination to soils or groundwater from prior launches in the Minuteman Launch Area (VAFB, 2003c). There would be little or no increase in personnel on base; thus, there are no socioeconomic concerns. Although missile launches would affect off-base populations, primarily from launch noise, the effects would occur over a wide area and would not result in disproportionate impacts to minority or low-income populations under Executive Order 12898 (Environmental Justice). With the ability for Vandenberg AFB to schedule restricted military airspace over the base and ocean range, there would be little concern for potential impacts on airspace during the proposed MM III missile launches. The proposed flight tests represent activities well within the limits of current operations and permits at Vandenberg AFB. As a result, there would be no adverse effects on land use, utilities, solid waste management, or transportation.

3.3.1 Air Quality

In California, air quality is assessed on a county and a regional basis. Air quality at Vandenberg AFB is regulated by the Santa Barbara County Air Pollution Control District (SBCAPCD), the California Air Resources Board (CARB), and Region IX of the US Environmental Protection Agency (USEPA). Stationary sources of air emissions on base typically include abrasive blasting operations, boilers, generators, surface coating operations, turbine engines, wastewater treatment plants, storage tanks, aircraft operations, soil remediation, launch vehicle fueling operations, large aircraft starting system, and solvent usage. Mobile sources at the base that result in air emissions include various aircraft, missile and spacecraft launches, and numerous Government and personal motor vehicles. (VAFB, 2000a)

For analysis purposes, the ROI for inert air pollutants (all pollutants other than ozone and its precursors) is generally limited to an area extending no more than a few miles downwind from the source. The ROI for ozone and its precursors, however, may extend much further.

The Federal Clean Air Act (CAA) authorizes the USEPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health. Standards for six criteria pollutants [i.e., ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), inhalable particulate matter (PM_{10} and $PM_{2.5}$), and lead particles] have been adopted. Table 3-1 shows ambient concentrations of the criteria pollutants as measured by monitoring stations located near the southern end of Vandenberg AFB and in the nearby community of Santa Maria. The CARB classifies areas of the state that are in attainment or nonattainment for the California Ambient Air Quality Standards (CAAQS). Both the USEPA and CARB have designated Santa Barbara County as being in attainment of the NAAQS and CAAQS for SO_2, NO_2, and CO. As the data in Table 3-1 demonstrates, the county area is in attainment with the Federal PM_{10} standard, but has been designated by the CARB to be in nonattainment with the more stringent California standard for PM_{10}. Although Federal and state standards for $PM_{2.5}$ have been set, area designations in terms of attainment and nonattainment were not expected until December 2004 (California ARB, 2004). Santa Barbara County as a whole does not meet the state ozone standard and has only recently, and by a small margin, attained the Federal ozone standard. (SBCAPCD, 2003)

Prior Vandenberg AFB emission inventory results show that missile launch emissions account for less than one percent of the total PM_{10} and total CO emissions. Since 1991, all new stationary sources of

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, California

Pollutant	2000		2001		2002		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
Ozone (ppm)									
1-hour highest[5]	0.081	0.066	0.079	0.064	0.084	0.065	0.09	0.12	Same as Primary Standard
1-hour 2nd highest	0.078	0.065	0.076	0.063	0.079	0.064	-	-	-
8-hour highest[6]	0.069	0.058	0.070	0.058	0.078	0.059	-	0.08	Same as Primary Standard
8-hour 2nd highest	0.064	0.057	0.065	0.053	0.067	0.049	-	-	-
CO (ppm)									
1-hour highest	1.0	4.0	0.7	3.5	1.3	3.1	20	35	-
1-hour 2nd highest	0.7	3.3	0.7	2.8	1.1	2.4	-	-	-
8-hour highest	0.5	2.1	0.6	1.3	0.8	1.2	9	9	-
8-hour 2nd highest	0.5	1.9	0.6	1.1	0.6	1.2	-	-	-
NO_2 (ppm)									
1-hour highest	0.033	0.049	0.049	-	0.014	0.052	0.25	-	-
1-hour 2nd highest	0.028	0.048	0.047	-	0.009	0.048	-	-	-
Annual Arithmetic Mean	0.003	0.010	0.003	-	0.003	0.011	-	0.053	Same as Primary Standard
SO_2 (ppm)									
1-hour highest	0.004	-	0.004	-	0.006	-	0.25	-	-
1-hour 2nd highest	0.004	-	0.003	-	0.006	-	-	-	-
3-hour highest	0.002	-	0.002	-	0.002	-	-	-	0.50
3-hour 2nd highest	0.002	-	0.002	-	0.002	-	-	-	-
24-hour highest	0.001	-	0.001	-	0.001	-	0.04	0.14	-
24-hour 2nd highest	0.001	-	0.001	-	0.001	-	-	-	-
Annual Arithmetic Mean	0.001	-	0.001	-	0.001	-	-	0.03	-
PM_{10} (μg/m^3)									
24-hour highest	48	53	45	66	50	48	50	150	Same as Primary Standard
24-hour 2nd highest	42	53	44	56	45	40	-	-	-
Annual Arithmetic Mean	19	26	19	27	19	24	20	50	Same as Primary Standard

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, California

Pollutant	2000		2001		2002		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
$PM_{2.5}$ (μg/m^3)									
24-hour highest	-	28.7	-	43.2	-	21.3	-	65	Same as Primary Standard
24-hour 2nd highest	-	19.3	-	23.4	-	19.4	-	-	-
Annual Arithmetic Mean	-	9.77	-	10.40	-	9.52	12	15	Same as Primary Standard

Notes:

1 California standards for ozone, carbon monoxide, sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and particulate matter are not to be exceeded values.

2 National averages (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with a maximum hourly average concentration above the standard, is equal to or less than one.

3 National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

4 National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

5 Not to be exceeded on more than an average of 1 day per year over a 3-year period.

6 Not to be exceeded by the 3-year average of the annual 4th highest daily maximum 8-hour average.

Sources: California ARB, 2003; Cordes, 2004; SBCAPCD, 2003; USEPA, 2003 (Note: SBCAPCD data was used when SBCAPCD and USEPA data was contradictory for the same pollutant measure.)

emissions (and modifications) at Vandenberg AFB have applied best available technology and offset emissions at a 1.2 to 1.0 ratio. Table 3-2 lists total annual emissions from Vandenberg AFB and Santa Barbara County.

Table 3-2. Vandenberg AFB and Santa Barbara County Total Annual Air Emissions

Emissions Source	Pollutant (tons/year)				
	VOC	NO_x	CO	SO_X	PM_{10}
2001 Emissions from Vandenberg AFB (estimated)	5.0	19.6	51.8	1.1	64.6
1999 Emissions from Santa Barbara County	44,605	19,234	95,227	1,594	9,253

Source: SBCAPCD/SBCAG, 2002; USASMDC, 2003b

For the purpose of this EA, "lower atmosphere" refers to the troposphere, which extends from ocean level to an altitude of approximately 32,800 ft (10 km). "Upper atmosphere" refers to the stratosphere, which extends from 32,800 ft (10 km) to approximately 164,000 ft (50 km) in altitude. (NOAA, 2001)

The stratosphere contains the Earth's ozone layer, which varies as a function of latitude and season. The ozone layer plays a vital role in absorbing harmful ultraviolet radiation from the sun. Over the past 20 years, concentrations of ozone in the stratosphere have been threatened by anthropogenic (human-made) gases released into the atmosphere. Such gases include chlorofluorocarbons (CFCs), which have been widely used in electronics and refrigeration systems, and the lesser used Halons, which are extremely effective fire extinguishing agents. Once released, the CFCs and Halons are mixed worldwide by the motions of the atmosphere until, after 1 to 2 years, they reach the stratosphere, where they are broken down by ultraviolet radiation. The chlorine and bromine atoms, within the respective CFC and Halon gas molecules, are released and directly attack ozone molecules, depleting them. (NOAA, 2001; WMO, 1998)

Through global compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, and its later amendments, the worldwide production of CFCs and other ozone-depleting substances has been drastically reduced, and banned in many countries. A continuation of these compliance efforts is expected to allow for a slow recovery of the ozone layer. (WMO, 1998)

There is also a growing concern regarding the potential effects of greenhouse gases on global climate. Greenhouse gases are largely transparent to solar radiation, but they do absorb long-wave radiation emitted by the earth's surface and re-radiate a portion of the energy back down to earth. This process results in a net warming effect to the lower layers of the atmosphere. Many gases exhibit "greenhouse" properties, including those that occur naturally in the atmosphere, such as water vapor, carbon dioxide, methane, and nitrous oxide; and those that are anthropogenic, such as CFCs, hydrofluorocarbons, and perfluorocarbons. Within the United States, nearly 85 percent of anthropogenic greenhouse gas emissions come from the burning of fossil fuels. (DOE, 2002)

3.3.2 Noise

Noise is most often defined as unwanted sound that is heard by people or wildlife and interferes with normal activities or otherwise diminishes the quality of the environment. Sources of noise may be transient (e.g., a passing train or aircraft), continuous (e.g., heavy traffic or air conditioning equipment), or impulsive (e.g., a sonic boom or a pile driver). Sound waves traveling outward from a source exert a sound pressure measured in decibels (dB).

The human ear is not equally sensitive to all sound wave frequencies. Sound levels adjusted for frequency-dependent amplitude are called "weighted" sound levels. Weighted measurements emphasizing frequencies within human sensitivity are called A-weighted decibels (dBA). Established by the American National Standards Institute, A-weighting significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. Typical A-weighted sound levels measured for various sources are provided in Figure 3-1.

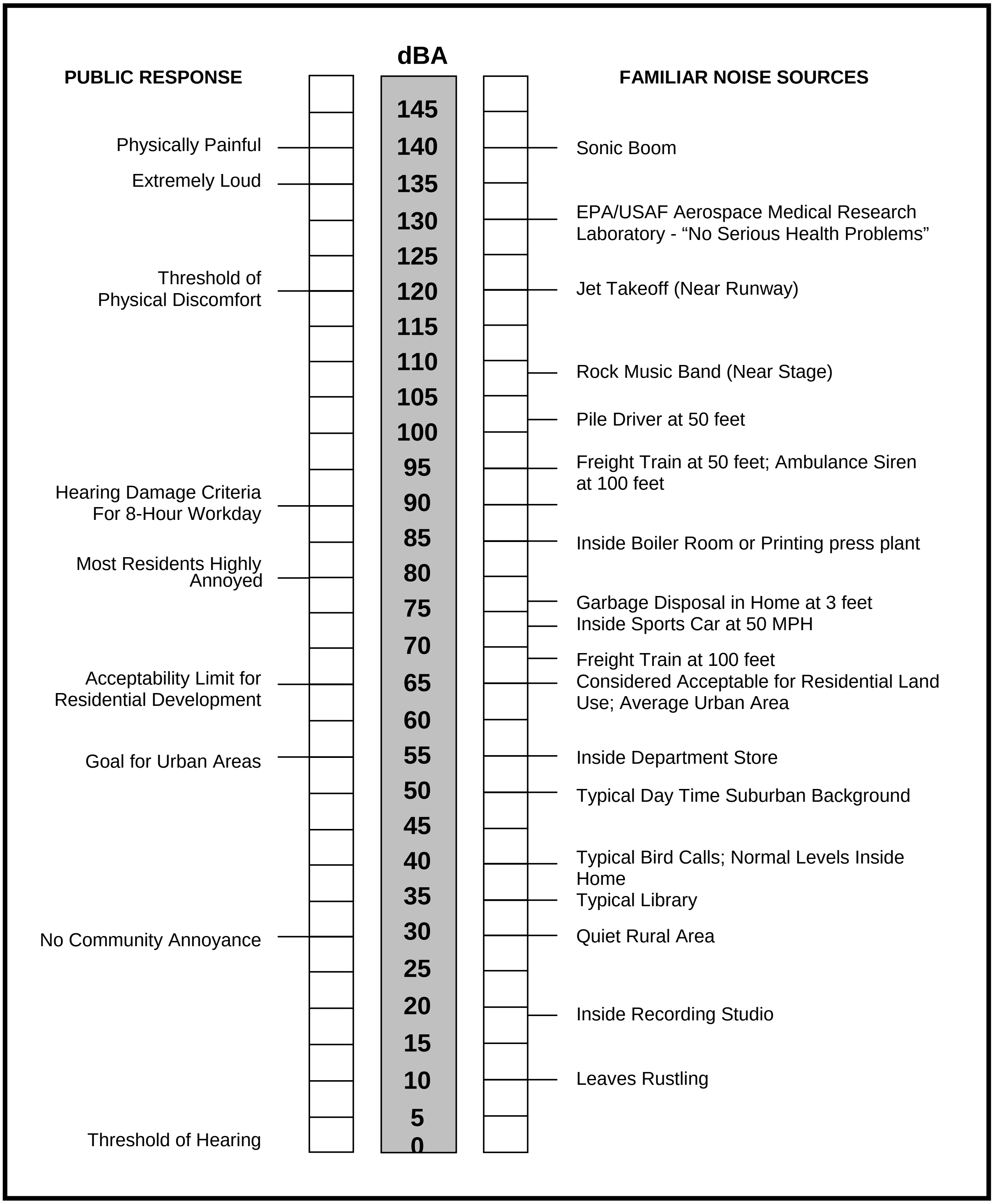
USAF standards currently require hearing protection whenever a person is exposed to steady state noise of 85 dBA or more, or impulse noise of 140 dB sound pressure level or more, regardless of duration. Use of any noise hazardous machinery, or entry into hazardous noise areas, requires personal noise protection. Air Force Occupational Safety and Health (AFOSH) Standard 161-20 and the AFI 48-20 Interim Guidance describe the USAF Hearing Conservation Program procedures used at Vandenberg AFB. Similarly, under 29 CFR 1910.95, employers are required to monitor employees whose exposure to noise could equal or exceed an 8-hour time-weighted average of 85 dBA. For off-base areas, Vandenberg AFB follows state regulations concerning noise, and maintains a Community Noise Equivalent Level (CNEL) of 65 dBA or lower. CNELs represent day-night noise levels averaged over a 24-hour period, with "penalty" decibels added to quieter time periods (i.e., evening and nighttime). As a result, the CNEL is generally unaffected by the short and infrequent rocket launches occurring locally on base.

For noise analysis purposes in this EA, the ROI at Vandenberg AFB is defined as the area within the 80-dB maximum (unweighted) sound level contours generated by proposed project activities.

Noise at Vandenberg AFB is typically produced by automobile and truck traffic, aircraft operations (approximately 32,000 per year, including landings, takeoffs, and training approaches and departures for both fixed-wing and rotary-wing aircraft), and Southern Pacific trains passing through the base (an average of 10 trains per day) (VAFB, 2000a). Existing noise levels on Vandenberg AFB are generally low, with higher levels occurring near industrial facilities and transportation routes.

The immediate area surrounding Vandenberg AFB is largely composed of undeveloped and rural land, with some unincorporated residential areas in the Lompoc and Santa Maria valleys, and Northern Santa Barbara County. The cities of Lompoc and Santa Maria, which make up the two main urban areas in the region, support a small number of industrial areas and small airports. Sound levels measured for the area are typically low, except for higher levels in the industrial areas and along transportation corridors. The rural areas of the Lompoc and Santa Maria valleys typically have low overall CNELs, normally about 40 to 45 dBA (USAF, 1998). Occasional aircraft flyovers can increase noise levels for a short period of time.

Other less frequent, but more intense, sources of noise in the region are from missile and space launches at Vandenberg AFB. These include MM III, Peacekeeper, and Delta II launches from the North Base area; and Minotaur launches, and future Atlas V and Delta IV launches, from the South Base area. Depending on the launch vehicle and launch location on the base, resulting noise levels in Lompoc and Santa Maria may reach estimated maximum unweighted sound pressure levels of 100 dB and 95 dB, respectively, and have an effective duration of about 20 seconds per launch. Equivalent A-weighted sound levels would be lower. Because launches from Vandenberg AFB occur infrequently, and the launch noise generated from each event is of very short duration, the average (CNEL) noise levels in the nearby areas are not affected. (USAF, 1997c, 1998, 2000a)



Source: Modified from USASDC, 1991

Figure 3-1. Typical Noise Levels of Familiar Noise Sources and Public Responses

Although rocket launches from Vandenberg AFB often produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth and generally do not affect the California coastal area.

3.3.3 Biological Resources

For purposes of analyzing biological resources at Vandenberg AFB, the ROI includes all of the base property from Point Sal to just south of Shuman Creek, including near-shore waters (see Figure 3-2).

Threatened, Endangered, and Other Protected Species

Vegetation. Vandenberg AFB supports a wide variety of vegetation types that are considered sensitive, including Bishop pine forest, Burton mesa chaparral, coastal dune scrub, coastal sage scrub, salt marsh, native grassland, freshwater marsh, tanbark oak forest, vernal pools, riparian willow shrublands, and seasonal wetlands. Approximately 85 percent of Vandenberg AFB vegetation is natural, with the balance either invasive vegetation that has replaced natural flora, particularly non-native annual grasslands, or plants associated with developments. (USAF, 1991b; VAFB, 2000a)

The ROI is dominated by coastal sage scrub, annual non-native grassland, and coastal dune scrub. Most of the vegetation around the Minuteman launch facilities, particularly in areas cleared to reduce fire hazard, may be characterized as non-native grassland. Vandenberg AFB continues to be an important refuge for sensitive plant species, because human activities and invasive species are controlled on the base.

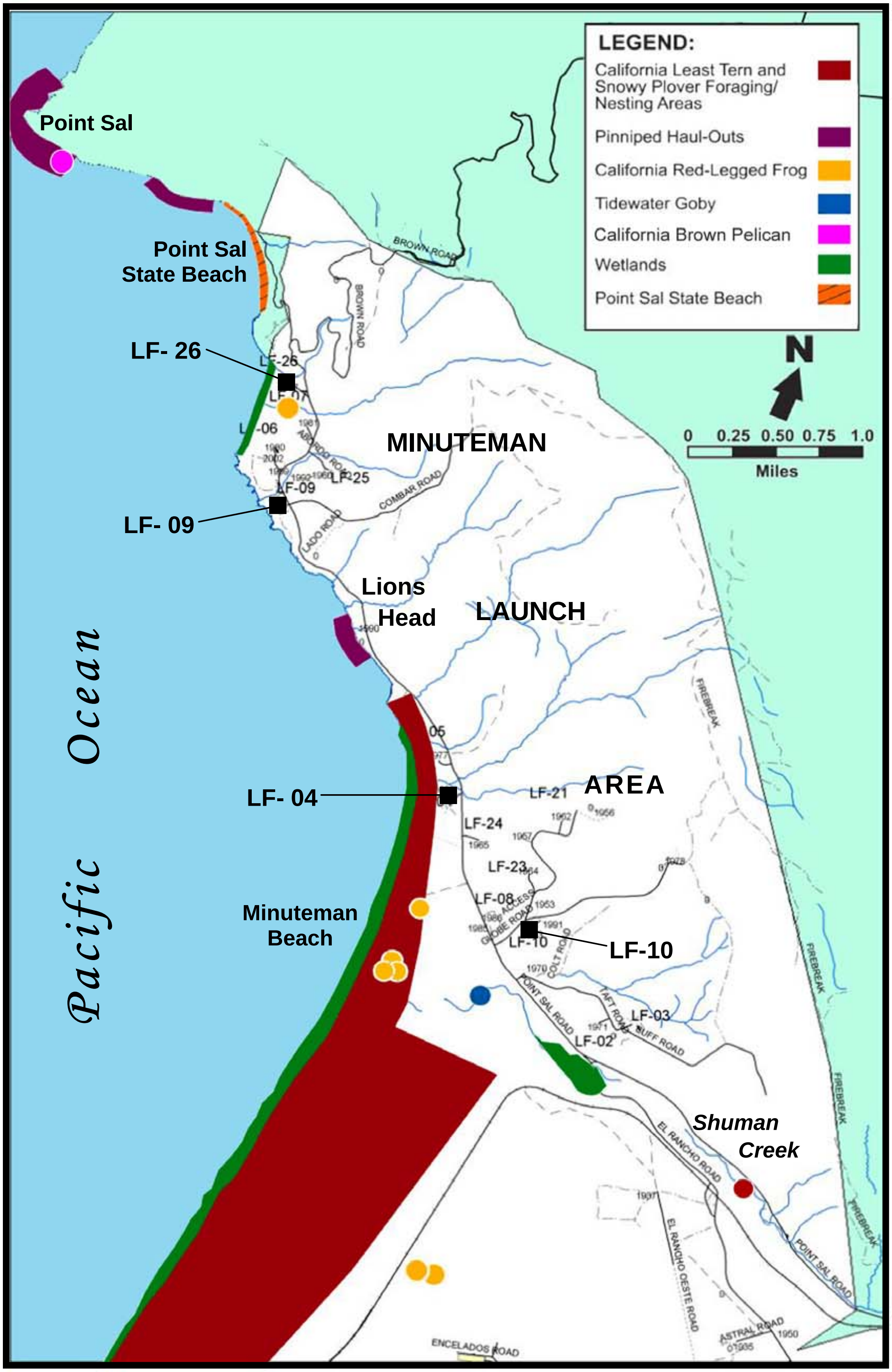
Although four Federally listed sensitive plant species are found on Vandenberg AFB, the Gaviota tarplant [*Deinandra (=Hemizonia) increscens ssp. villosa*] is the only one occurring within the ROI (VAFB, 2000a). The Gaviota tarplant is found only within a narrow band of coastal terrace grassland between the cities of Gaviota and Santa Barbara, California (USEPA, 2001), and was designated an endangered species throughout its range in March 2000 (65 FR 14888-14898). On Vandenberg AFB, it can be found at two locations; one of these locations is southeast of LF-06 in the Minuteman Launch Area (USAF, 1999; VAFB, 2000b).

Wildlife Species. Those listed and protected wildlife species occurring within the ROI are identified in Table 3-3.

The terrestrial environment of the Minuteman Launch Area is characterized by dry, steep slopes covered with annual grassland and coastal sage scrub. However, the larger drainages hold water for enough of the year to support an endangered fish, the tidewater goby (*Eucyclogobius newberryi*), and the threatened California red-legged frog (*Rana aurora draytonii)*.

The tidewater goby is a benthic species found in shallow lagoons, tidal wetlands, and the mouths of streams, tolerating fresh or brackish water year-round. Within the ROI, it has been found only in the outflow of Shuman Creek (see Figure 3-2). It also occurs in San Antonio Creek, immediately south of the ROI. Stringent land use constraints apply wherever it occurs (VAFB, 2000a).

The California red-legged frog prefers freshwater pools and ponds with arroyo willow (*Salix lasiolepis*), cattails (*Typha* ssp.), and other thick emergent aquatic vegetation (USAF, 1995). In March 2001, the USFWS designated 4.1 million acres (1.6 million hectares) in 28 California counties as critical habitat for the frog, but excluded Vandenberg AFB because its Integrated Natural Resource Management Plan (VAFB, 1997a) provided adequate management for the on-base population (Jumping Frog Research



Source: Collier et al., 2002; Robinette and Sydeman, 1999; Roest, 1995; USAF, 1997c; VAFB, 2000a, 2003a

Figure 3-2. Sensitive Habitat and Protected Species within the Minuteman Launch Area at Vandenberg AFB, California

Table 3-3. Threatened, Endangered, and Other Protected Species Occurring at Vandenberg AFB, California

Common Name	Scientific Name	Federal Status	California Status
Plants			
Gaviota tarplant	*Deinandra increscens ssp. villosa*	E	E
Fish			
Tidewater goby	*Eucyclogobius newberryi*	E	SSC
Reptiles/Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	SSC
Birds			
California brown pelican	*Pelacanus occidentalis californicus*	E	E
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SSC
California least tern	*Sterna antillarum browni*	E	E
Bald eagle	*Haliaeetus leucocephalus*	PD, T	E
American peregrine falcon	*Falco peregrinus anatum*	D	E
Western burrowing owl	*Speotyto cunicularia hypugea*	-	SSC
Marine Mammals (haul-out sites & nearshore waters)			
Guadalupe fur seal	*Arctocephalus townsendi*	T	T
Northern fur seal	*Callorhinus ursinus*	MMPA	-
California sea lion	*Zalophus californianus*	MMPA	-
Steller sea lion	*Eumetopias jubatus*	T	-
Harbor seal	*Phoca vitulina richardsi*	MMPA	-
Elephant seal	*Mirounga angustirostris*	MMPA	-
Southern sea otter	*Enhydra lutris nereis*	T	-

Notes:
E = Endangered
T = Threatened
SSC = Species of Special Concern
CE, CT = State Candidate Endangered and Threatened Species
PE, PT = Federal Proposed Endangered and Proposed Threatened Species
MMPA = Protected under the Marine Mammal Protection Act
D, PD = Delisted or Proposed for Delisting

Institute, 2001). Within the ROI, the red-legged frog occurs in Shuman Creek and the outflow of small drainages within a few hundred yards of LF-26 (Figure 3-2). Stringent land use constraints apply to these areas (VAFB, 2000a).

Raptorial birds with Federal and state status have been found within the ROI and are listed in Table 3-3. A sighting of the American peregrine falcon (*Falco peregrinus anatum*) was documented in 1989 in the Point Sal area. This raptor has been the subject of an active state reintroduction program since the 1970's (USAF, 1990), leading to its delisting at the Federal level in 1999 (64 FR 46541-46558). The bald eagle (*Haliaeetus leucocephalus*), listed at both state and Federal levels and protected by special legislation [Bald Eagle Protection Act (16 U.S.C. 668-668d, as amended)], has rarely been sighted on base. No bald eagle nesting sites are known to exist within the ROI. A California Species of Special Concern, the western burrowing owl (*Speotyto cunicularia hypugea*) has been sighted within the ROI, but only as a winter transient or migrant, and never in significant numbers (USAF, 1998; VAFB, 1997b). Golden eagles (*Aquila chrysaetos*) are not listed, but are protected from exploitation under the Bald Eagle Protection Act. They may be sighted anywhere on the base, but are not common, and none are known to nest within the ROI (USAF, 1997c; VAFB, 2000b).

Because Vandenberg AFB is near the southern limit of the breeding ranges for many seabird species, a long-term program was begun in 1999 to monitor population dynamics and breeding biology of seabirds breeding on the base annually. An estimated total of 1,200 seabirds were identified in 1999 (Robinette and Sydeman, 1999). Three listed seabirds have been found within the ROI. The endangered California brown pelican (*Pelecanus occidentalis californicus*) roosts on rocks offshore of Point Sal (Figure 3-2) (Collier, et al., 2002). Shuman Creek offers foraging habitat for the endangered California least tern (*Sterna antillarum brownii*) (Robinette and Sydeman, 1999). Least terns have also been seen nesting at Purisima Point just a few miles south of the Minuteman Launch Area. The western snowy plover (*Charadrius alexandrinus nivosus*) also nests on the coastal dunes of Minuteman Beach as far north as LF-04 (Robinette and Sydeman, 1999; VAFB, 2003a).

Regarding marine mammals, several protected or listed species of seals and sea lions (pinnipeds) are found within the ROI. They use beaches and rocky shores on the coast of Vandenberg AFB to rest, molt, or breed. Pinnipeds that may be found onshore ("hauled-out") within the ROI include the California sea lion (*Zalophus californianus*), Pacific harbor seal (*Phoca vitulina*), northern elephant seal (*Mirounga angustirostris*), and northern fur seal (*Callorhinus ursinus*). None of these species are listed as endangered or threatened, but all enjoy Federal protection from harassment or injury under the Marine Mammal Protection Act (MMPA). Two other pinniped species, the Guadalupe fur seal (*Arctocephalus townsendi*) and Steller sea lion (*Eumetopias jubatus*), are Federally listed as threatened, but are rare visitors at the base. There have been no land or near-shore sightings of Steller sea lions in the region since 1984 (Roest, 1995; 64 FR 9925-9932; 69 FR 5720-5728).

The Pacific harbor seal is found in the ROI year-round. Lions Head has been documented as a haul-out and recently as a pupping area for a small number of seals. It is the closest haul-out site to the Minuteman LFs (Figure 3-2). The highest animal counts at Lions Head, which averages 20 seals, are made between September and January during the post-breeding period. Pupping occurs in March, followed by a 4- to 6-week weaning period (Roest 1995; USAF, 1999). Harbor seals are considered particularly sensitive to disturbance during this period, when the risk of mother-offspring separation is greatest.

The California sea lion does not breed on Vandenberg AFB, but is found along the coastline during the summer (USAF, 1999). Point Sal, which is a little over a mile northwest of the base boundary (Figure 3-2), is the closest area used as a haul-out by California sea lions.

Elephant seals and northern fur seals are observed periodically on Vandenberg AFB, preferring undisturbed sections of mainland coast and offshore islands or rocks, such as at Lions Head (USAF, 1997c).

One other marine mammal occurs in close proximity to the Minuteman Launch Area, just off shore. The Federally threatened southern sea otter (*Enhydra lutris nereis*) can be observed foraging and rafting within a few hundred yards of the shore anywhere kelp beds can be found. Breeding and pupping have been observed in the area of Purisima Point (Figure 2-9) to the south (Roest, 1995; USAF, 1999). Semi-migratory individual otters also have been found in the kelp beds near Point Sal (Figure 3-2) (Friends of the Sea Otter, 2002).

Environmentally Sensitive and Critical Habitats

In cooperation with the USFWS and The Nature Conservancy, Vandenberg AFB has identified endangered, threatened, and sensitive habitats for special protection under its Integrated Natural Resources Management Plan (VAFB, 1997a). Those habitat areas found within the ROI are summarized in the following paragraphs.

The installation contains a major southern California coastal dune system that is unusually well preserved. Extensive central foredunes and coastal dune scrub are found on the North Vandenberg coast as far north as LF-04 (USAF, 1991a).

Wetlands on Vandenberg AFB support wildlife, act as water filters, and absorb floodwater runoff. Although the major wetland areas on the base occur south of the ROI, a number of small tidal wetlands are along the Minuteman Beach shoreline (Figure 3-2). A few non-tidal wetlands, ranging between 2 and 7 acres (0.8 and 2.8 hectares) in size, can also be found in the Minuteman Launch Area, supporting such typical plant species as the arroyo willow, wide-leaf cattail, California bulrush, water smartweed, and bog rush. The Shuman Creek drainage and pools are the most important of these, but even small seasonal pools at the mouths of drainages on coastal bluffs can harbor endangered wildlife. Brackish pools occur at least seasonally along the margin of Minuteman Beach, fed by both runoff from small drainages and ocean waves at high tide.

Although no USFWS designated critical habitat areas have been established on base for the Gaviota tarplant, Vandenberg AFB has made a commitment to develop and implement protective measures to be specified in its updated Integrated Natural Resources Management Plan, which is currently in revision. These measures may include establishing Sensitive Resource Protection Areas; and monitoring, survey, enhancement, and restoration activities (USFWS, 2002; VAFB, 2000a). The USFWS has also designated critical habitat for nesting snowy plovers along the beaches of Vandenberg AFB, coordinating beach closures during the snowy plover nesting season (March 1 through September 30).

Essential Fish Habitat

The Sustainable Fisheries Act (Public Law 104-297) requires regional Marine Fisheries Councils to manage fisheries to ensure stability of fish populations with support from the NMFS. Regional Marine Fisheries Councils prepare Fishery Management Plans (FMPs) that identify and protect the habitat essential to maintain healthy fish populations. Commercially important species are preferentially targeted. Threats to habitat from both fishery and non-fishery activities are identified and actions needed to eliminate them are recommended. In California, the Pacific Marine Fishery Council (PMFC) is responsible for identifying essential fish habitat (EFH).

Fishes of commercial importance found just within and downrange from the ROI include coastal pelagic schooling squids and fishes (Pacific sardine and mackerel, northern anchovy, and jack mackerel), groundfish (rockfish, shark, and cod), and large, highly migratory pelagic fishes (tuna, marlin, and swordfish). EFH identified by the PMFC for these species includes all marine and estuary waters from the coast of California to the limits of the Exclusive Economic Zone, the 200 mi (322 km) limit. Groundfish are the species of commercial importance found within the shallow waters off Vandenberg AFB. Eighty-three species of groundfish are identified in the FMP for this region (WPRFMC, 2003).

3.3.4 Health and Safety

Regarding health and safety at Vandenberg AFB, the ROI is limited to existing base facilities, off-base areas within launch hazard zones, and areas downrange along the missile flight path. Health and safety requirements at Vandenberg AFB include industrial hygiene, which is the joint responsibility of Bio-Environmental Services and the 30th Space Wing (SW) Safety Office. These responsibilities include monitoring of worker exposure to workplace chemicals and physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety includes both occupational and public safety. As noted in Section 3.1.1, safety managers use DOD requirements, the AFPD-91 series, AFI-91 series, and applicable Federal and state regulations to implement the safety program.

The 30th SW Commander, Chief of Safety, Flight Analysis, and the Mission Control Officer are responsible for ensuring safety during ballistic and space launches at Vandenberg AFB. Responsibility and final authority of the safe conduct of ballistic and space vehicle operations lies with the 30th SW Commander. Establishing and managing the overall safety program at Vandenberg AFB is the responsibility of the 30th SW Safety Office. (USAF, 1999)

The Eastern and Western Range (EWR) 127-1 (*Range Safety Requirements*) establishes range safety policy, and defines requirements and procedures for ballistic and space vehicle operations at Vandenberg AFB. Over-ocean launches must comply with DOD Directive 4540.1 (*Use of Airspace by US Military and Firings Over the High Seas*).

Prior to conducting missile flight tests, all missile operations are evaluated by the 30th SW Safety Office. For operations involving such testing, an evaluation is made to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact/debris limits. This includes a review of missile trajectories and hazard area dimensions, review and approval of destruct systems, and atmospheric dispersal modeling to ensure emission concentrations from each launch do not exceed certain levels outside controlled areas. In accordance with 30th Space Wing Instruction (SWI) 91-106 (*Toxic Hazard Assessments*), if hydrogen chloride launch emission cloud concentrations of 10 parts per million (ppm) or higher are predicted to cross outside the base land boundary, the launch is held until meteorological conditions improve.

A NOTMAR and a NOTAM are published and circulated in accordance with 30th SWI 91-104 (*Operations Hazard Notice*) to provide warning to personnel (including recreational users of the range space and controlled sea areas) concerning any potential impact areas that should be avoided. Radar and visual sweeps of hazard areas by helicopter are accomplished prior to operations to ensure evacuation of non-critical personnel. This includes the closure of nearby access roads and the evacuation of Point Sal State Beach (just north of LF-26) on average two times per year, under agreement with Santa Barbara County (VAFB, 2003b); and the coordination and monitoring of any train traffic passing through the base within a mile south of LF-10, consistent with 30th SWI 91-103 (*Train Hold Criteria*).

Vandenberg AFB possesses significant emergency response capabilities that include its own Fire Department, Disaster Control Group, and Security Police Force, in addition to contracted support for handling accidental releases of regulated hypergolic propellants and other hazardous substances.

The Vandenberg AFB Fire Department approves and maintains the business plans and hazardous material inventories prescribed by the California Health and Safety Code, which are developed by organizations assigned to or doing business on the base. Additionally, the base Fire Department conducts on-site facility inspections, as required, to identify potentially hazardous conditions that could lead to an accidental release. During launch operations, Fire Department response elements are pre-positioned to expedite response in the event of a launch anomaly. (USASMDC, 2002)

3.3.5 Hazardous Materials and Waste Management

Hazardous materials and waste management activities at Vandenberg AFB are governed by the same environmental regulations identified in Section 3.1.2. The ROI is limited to the existing facilities at Vandenberg AFB that handle hazardous materials; and collect, store (on a short-term basis), and ship hazardous waste.

Hazardous materials obtained from off base suppliers are coordinated through Vandenberg AFB's Hazmart Pharmacy. Hazardous materials are inventoried and tracked using Environmental Management System software. These procedures are in accordance with the base *Hazardous Materials Management Plan* (30^{th} SW Plan 32-7086).

Any spills of hazardous materials are handled under Vandenberg's *Hazardous Materials Emergency Response Plan* (30^{th} SW Plan 32-4002-A). This plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

For hazardous waste, the base *Hazardous Waste Management Plan* (30^{th} SW Plan 32-7043-A) describes the procedures for packaging, handling, transporting, and disposing of such wastes. If not reused or recycled, hazardous wastes are transported off base for appropriate treatment and disposal.

3.4 OVER-OCEAN LAUNCH CORRIDOR

This section describes the baseline conditions within the Pacific over-ocean launch corridor that may be affected by the proposed MM III missile launch and flight activities.

Rationale for Environmental Resources Analyzed

Because of the limited scope of the Proposed Action in the over-ocean launch corridor, only biological resources were analyzed. Water quality and noise were also included in the analysis, from the standpoint of potential impacts on marine life. For purposes of this analysis, the ROI is focused primarily on that segment of the Pacific launch corridor out 1,000 mi (1,610 km) from the California coast, and in the vicinity of the Marshall Islands, where missile drop zones occur (see Figures 2-10 and 2-12).

Other environmental resources within the ROI were not evaluated in this EA for the following reasons. With effects limited to the over-ocean corridor, there is no potential for impacts to cultural resources, land use, soils, and groundwater. Similarly, since the ROI is well removed from islands and population centers, no impacts to the human noise environment, socioeconomics, utilities, waste management, or transportation are anticipated, nor are environmental justice concerns expected. Potential effects of launch emissions on the upper atmosphere are covered in the sections for Vandenberg AFB (Sections 3.3.1 and 4.3.1). Health and safety-related issues in the launch corridor are addressed under Vandenberg AFB (Sections 3.3.4 and 4.3.4) and USAKA (Sections 3.5.3 and 4.5.3).

3.4.1 Biological Resources

The affected environment of the ocean area is described below in terms of its physical and chemical properties, biological diversity, threatened and endangered species, and other marine mammals.

Physical and Chemical Properties

The general composition of the ocean includes sodium chloride, dissolved gases, minerals, and nutrients. These components determine and direct the interactions between the seawater and its inhabitants. The most important physical and chemical properties are salinity, pH, density, dissolved gases, and temperature. Water quality in the open ocean is excellent, with high water clarity, low concentration of suspended matter, dissolved oxygen concentrations at or near saturation, and low concentrations of contaminants such as trace metals and hydrocarbons (PMRF, 1998).

Biological Diversity

Although oceans have far fewer species of plants and animals than terrestrial and freshwater environments, an incredible variety of living things reside in the ocean. Marine life ranges from microscopic one-celled organisms to the world's largest animal, the blue whale. Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, the photic zone, which extends to only about 330 ft (101 m) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths.

The depth of the ocean area within much of the ROI is well over 12,000 ft (3,660 m). Within the ROI, marine biological communities can be divided into two broad categories: pelagic and benthic. Pelagic communities live in the water column and have little or no association with the bottom, while benthic communities live within or upon, or are otherwise associated with, the bottom.

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton includes larvae of benthic species, so a pelagic species in one ecosystem may be a benthic species in another. The plankton consists of plant-like organisms (phytoplankton) and animals (zooplankton) that drift with the ocean currents, with little ability to move through the water on their own. The nekton consists of animals that can swim freely in the ocean, such as fish, squids, sea turtles, and marine mammals. Benthic communities are made up of marine organisms that live on or near the sea floor, such as bottom dwelling fish, shrimps, worms, snails, and starfish.

Threatened and Endangered Species

The over-ocean launch corridor ROI contains a number of threatened, endangered, and other protected species, including various cetacean species (whales, dolphins, and porpoises), sea turtles, pinnipeds, and sea otters. These are listed in Table 3-4, which indicates their status and months present, along with their preference for ocean depth. Many of these species can be found near the range areas proposed for conducting MM III launches and RV tests, but their occurrence near the range areas may be seasonal, in some cases, because of their unique migration patterns. Some species, particularly the larger cetaceans, can occur hundreds or thousands of miles off coastal areas.

Noise in the Ocean Environment

In the marine environment, there are many different sources of noise, both natural and anthropogenic. Although no noise measurements are known to exist for the ROI, it is expected that the loudest surface noise originates from lightning storms. Thunder, which can produce 110- to 120-dB peak sound pressure levels, can occur repeatedly as a storm passes over.

Table 3-4. Protected Marine Mammal and Sea Turtle Species Occurring in the Over-Ocean Launch Corridor

Common Name	Scientific Name	Status	Months Present[1]	Depth Preference		
				<200 (m)	200 – 2,000 (m)	> 2000 (m)
Pinnipeds						
Northern fur seal	*Callorhinus ursinus*	MMPA	May – Nov			X
Guadalupe fur seal	*Arctocephalus townsendi*	T, St	-	X	X	X
California sea lion	*Zalophus californianus*	MMPA	All	X	X	X
Harbor Seal [2]	*Phoca vitulina richardsi*	MMPA	All [3]	X	X	
Elephant seal	*Mirounga angustirostris*	MMPA	All	X	X	X
Steller sea lion[2]	*Eumetopias jubatus*	T, St	-	X	X	-
Sea Otters						
Southern sea otter	*Enhydra lutris nereis*	T, St	Apr – May Jul – Aug	X		
Small Cetaceans						
Harbor porpoise	*Phocoena phocoena*	MMPA	All	X		
Dall's porpoise	*Phocoenoides dalli*	MMPA	All	X	X	
Bottlenose dolphin	*Tursiops truncatus*	MMPA	All	X	X	X
Common dolphin	*Delphinus delphis*	MMPA	All	X	X	X
Striped dolphin	*Stenella coeruleoalba*	MMPA	All			X
Northern right whale dolphin	*Lissodelphis borealis*	MMPA	All		X	X
Risso's dolphin	*Grampus griseus*	MMPA	All		X	X
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	MMPA	All	X	X	X
Pantropical spotted dolphin	*Stenella attenuata*	MMPA	All	X	X	
Short-finned pilot whale	*Globicephala macrorhynchus*	St	All		X	X
Killer whale	*Orcinus orca*	MMPA	All	X	X	
False killer whale	*Pseudorca crassidens*	MMPA	All		X	X
Beaked Whales						
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA	All		X	X
Large Odontocetes (Toothed Whales) and Mysticetes (Baleen Whales)						
Sperm whale	*Physeter catodon*	E, St	All		X	X
Gray whale	*Eschrichtius robustus*	MMPA	Nov – Dec Apr – May [4]	X		
Humpback whale	*Megaptera novaeangliae*	E, St	Feb - Oct	X	X	
Right whale	*Balaena glacialis*	E, St	-	X	X	X
Sei whale	*Balaenoptera borealis*	E, St	July – Sept		X	X
Blue whale	*Balaenoptera musculus*	E, St	June – Nov	X	X	X
Finback whale	*Balaenoptera physalus*	E, St	All		X	X
Bryde's whale	*Balaenoptera edeni*	MMPA	All		X	X
Minke whale	*Balaenoptera acutorostrata*	MMPA	All	X	X	X
Sea Turtles						
Green sea turtle	*Chelonia mydas*	T	-			
Hawksbill sea turtle	*Eretmochelys imbricata*	E	-			
Loggerhead sea turtle	*Caretta caretta*	T	-			
Olive ridley sea turtle	*Lepidochelys oliveacea*	T	-			
Leatherback sea turtle	*Dermochelys coriacea*	E	-			

Notes:
MMPA = Protected under the Marine Mammal Protection Act
St = Strategic stock under the MMPA (average human-caused mortality may not be sustainable)
E = Endangered (also depleted under the MMPA)
T = Threatened (also depleted under the MMPA)

[1]For ocean water off the California coast
[2]Currently being considered for Endangered status
[3]Breeds on VAFB late Feb through April; pups born in March and early April. Period from 1 Feb to 31 May considered sensitive.
[4]Cows with calves present offshore of VAFB February - May

While measurements for sound pressure levels in air are referenced to 20 µPa, underwater sound levels are normalized to 1 µPa at 3.3 ft (1 m) away from the source, a standard used in underwater sound measurement. Within the ROI, some of the loudest underwater sounds are most likely to originate from ships and some marine mammals. A humpback whale (*Megaptera novaeangliae*), for example, can produce moaning sounds up to 175 dB (referenced to 1 µPa); while dolphins are known to produce brief echolocation signals over 225 dB (referenced to 1 µPa). Motors from a passing supertanker may generate 187 dB (referenced to 1 µPa) of low frequency sound. (Boyd, 1996; Nachtigall, et al., 2003)

3.5 US ARMY KWAJALEIN ATOLL

The USAKA is located in the RMI, approximately 2,000 nautical miles (3,706 km) southwest of Hawaii (see Figure 2-10). It consists of all or portions of 11 of the 100 coral islands that enclose a large lagoon. Since the late 1950's, the Kwajalein Atoll has served as a primary site for testing ICBMs, sea-launched ballistic missiles, and antiballistic missiles. Today, USAKA is home to the RTS, which continues to support these and other DOD programs.

Because of international agreements between the RMI and the United States, all activities at USAKA must conform to specific compliance requirements, coordination procedures, and environmental standards identified in the UES.

The baseline conditions described in this section are based on information contained in the UES, various surveys conducted at USAKA, and the *Final Supplemental Environmental Impact Statement for Proposed Actions at US Army Kwajalein Atoll* (USASSDC, 1993). This EIS provided a detailed analysis of ongoing and future operations in support of antiballistic missile defense tests and other defense testing. It also identifies the use of Kwajalein Atoll as a target area for ICBM FDE types of tests. As appropriate, other sources of information used to develop this section are also referenced.

Rationale for Environmental Resources Analyzed

For the proposed MM III flight test activities at USAKA, biological resources, cultural resources, health and safety, and hazardous materials and waste management (including pollution prevention) are the only areas of concern requiring discussion. Noise and water quality were also included in the analysis, from the standpoint of potential impacts on vegetation and wildlife. As for other resource areas not analyzed further, the proposed flight test activities would not require any new construction or extensive ground-disturbing activities; therefore, no impacts to soils would be expected. Mostly existing base personnel would be involved; thus, there are no socioeconomic concerns. Since impacts would be confined to the vicinity of Illeginni Island (an uninhabited island), open water areas in the Mid-Atoll Corridor Impact Area, and/or open ocean areas off Kwajalein Atoll, there would be no impacts to the human noise environment. The proposed activity is well within the limits of current operations at USAKA. As a result, there would be no adverse effects on land use, utilities, solid waste management, or transportation; and little or no additional impacts to air quality, or airspace use.

3.5.1 Biological Resources

For purposes of analyzing biological resources at USAKA, the ROI includes the missile impact area, consisting of the Mid-Atoll Corridor, the broad open ocean area offshore of Kwajalein Atoll, and Illeginni Island (see Figure 2-12).

The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.

Both the reef rock from which the atoll is built, and the sands and sediments of its beaches and lagoon bottom, are formed entirely from the remains of calcium-secreting marine organisms such as coral, coralline algae, calcareous algae, mollusks, and foraminiferans. The tops of the reefs are a thin veneer of actively growing organisms that accrete over the remains of prior generations of reef organisms and add to the reef structure. The reef-building organisms are sensitive to sedimentation, burial, and changes in circulation caused by human activities.

The descriptions of biological resources provided in the paragraphs that follow are based largely on past surveys conducted by the USFWS and NMFS. In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA (USASMDC, 2003a). In providing support to USAKA, USFWS and NMFS personnel normally conduct the biennial biological resource inventories at all islands leased from the RMI, which includes those areas on and adjacent to Illeginni Island. These surveys were initiated in 1996 and continue to be conducted on a regular basis every 2 years. The last survey was conducted in Fall 2004; however, the 2004 survey report will not be available until sometime in 2005 at the earliest. It is important to note that the USAKA survey data is qualitative in nature, so data gathered at other geographical locations [i.e., Pacific Missile Range Facility (PMRF), Hawaii], with known species densities, were used to determine risks to marine mammals in Chapter 4.0. Although the population sizes of marine mammals in the vicinity of Illeginni are not known, the surrogate data used in the analysis is considered to be conservative since marine mammal densities at Kwajalein Atoll are not expected to exceed densities in areas of Hawaii, where marine mammals have been documented for many years. For sea turtles, however, no comparable data existed, so the probability for habitat destruction was evaluated since the habitat details are known.

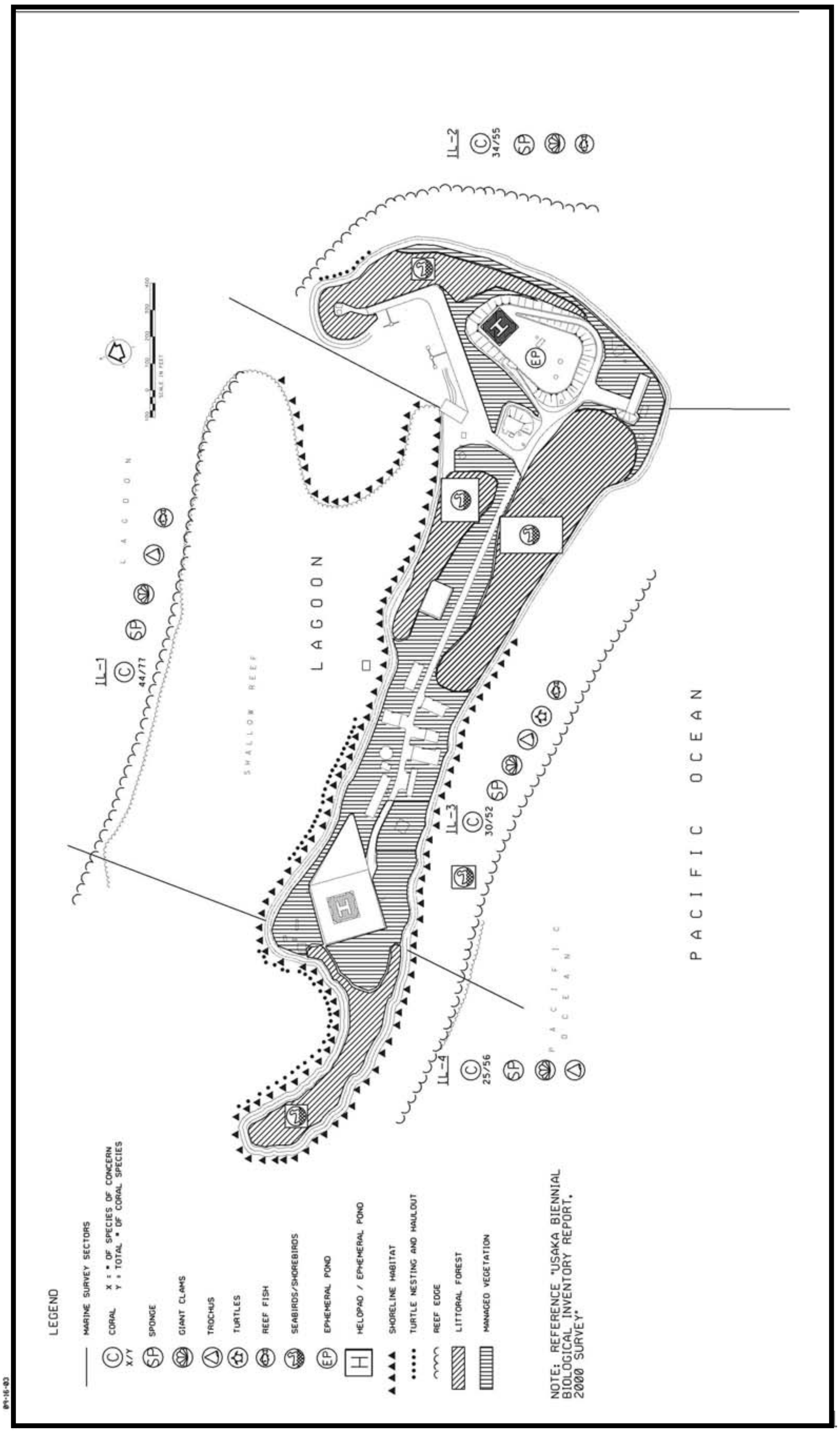
Vegetation

Illeginni is a 31-acre (12.5-hectare) island consisting of managed vegetation (primarily grassy lawns) surrounding buildings and other facilities, and four relatively large patches of native vegetation (see Figure 3-3). The native vegetation present on the island consists of one patch of herbaceous strand and several patches of littoral (near shore) forest. The forest areas are made up primarily of *Pisonia*, *Intsia*, *Tournefortia*, and *Guettarda* trees. Some littoral shrubland can also be found mostly on the western end of the island. (USFWS/NMFS, 2002)

Threatened, Endangered, and Other Protected Species

Within the area of Kwajalein Atoll, the UES provides protection for all of the following:

- Any threatened or endangered species that may be present
- Any species proposed for designation, candidates for designation, or petitioned for designation to the endangered species list that could be affected by USAKA activities
- All species designated by the RMI under applicable RMI statutes, such as the RMI Endangered Species Act of 1975, Marine Mammal Protection Act of 1990, Marine Resources (Trochus) Act of 1983, and the Marine Resources Authority Act of 1989



Source: Modified from USASMDC, 2003a

Figure 3-3. Wildlife Habitats at Illeginni Island

- Marine mammals designated under the US Marine Mammal Protection Act of 1972 that may be affected by USAKA activities
- Bird species pursuant to the Migratory Bird Conservation Act that are potentially present in the RMI
- Species in the RMI that are protected by the Convention on International Trade in Endangered Species, or mutually agreed on by USAKA, USFWS, NMFS, and the RMI Government as being designated as protected species. (USASMDC, 2003a)

The Kwajalein Atoll lagoon, reefs, and surrounding ocean waters are home to a number of threatened, endangered, and other protected species. As shown in Table 3-5, endangered marine mammals that may occur in and around Kwajalein Atoll include some of the same baleen and toothed whales found off the Hawaiian Islands [e.g., the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter catodon*)]. These are open-water, widely distributed species and are not likely to be found in the lagoon area. Near Illeginni, a group of up to 12 sperm whales has been seen consistently to the west of the island, on the ocean side, several hundred yards offshore. Because calves have been seen with females, the group could represent a "nursery pod" of related females and their young. Further verification of this is needed. (Naughton, 2003; USFWS/NMFS, 2002)

Table 3-5. Threatened, Endangered, and Other Protected Species Occurring at US Army Kwajalein Atoll

Common Name	Scientific Name	Status
Marine Mammals		
Dugong	*Dugong dugon*	E
Blue Whale	*Balaenoptera musculus*	E
Finback Whale	*Balaenoptera physalus*	E
Humpback Whale	*Megaptera novaengliae*	E
Sperm Whale	*Physeter catodon*	E
Offshore Spotted Dolphin	*Stenella attenuata attenuata*	RS
Coastal Spotted Dolphin	*Stenella attenuata graffmani*	RS
Eastern Spinner Dolphin	*Stenella longirostris orientalis*	RS
Whitebelly Spinner Dolphin	*Stenella longirostris longirostris*	RS
Costa Rican Spinner Dolphin	*Stenella longirostris centroamericana*	RS
Common Dolphin	*Delphinus delphis*	RS
Striped Dolphin	*Stenella coeruleoalba*	RS
Spinner Dolphin	*Stenella longirostris*	MMPA
Pacific Bottlenose Dolphin	*Tursiops gilli*	MMPA
Risso's Dolphin	*Grampus griseus*	MMPA
Bottlenose Dolphin	*Tursiops sp.*	MMPA
Pygmy Sperm Whale	*Kogia breviceps*	MMPA
False Killer Whale	*Pseudorca crassidens*	MMPA
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	MMPA
Melon Headed Whale	*Peponocephala electra*	MMPA
Pygmy Killer Whale	*Feresa attenuata*	MMPA

Table 3-5. Threatened, Endangered, and Other Protected Species Occurring at US Army Kwajalein Atoll

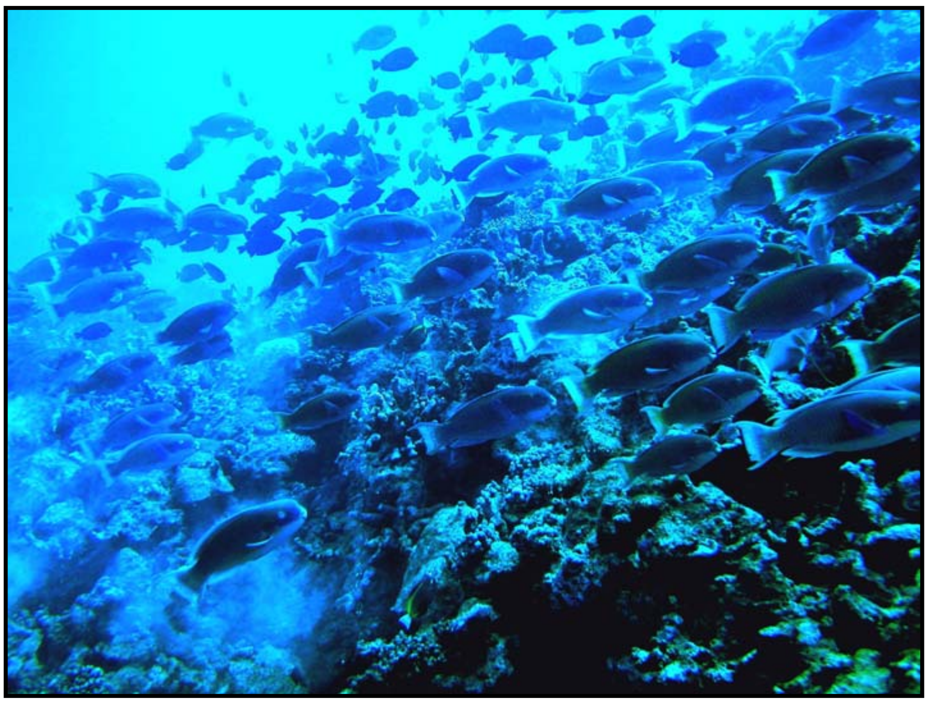
Common Name	Scientific Name	Status
Killer Whale	*Orcinus orca*	MMPA
Blainville's Beaked Whale	*Mesoplodon densirostris*	MMPA
Sea Turtles		
Green Sea Turtle	*Chelonia mydas*	T
Loggerhead Sea Turtle	*Caretta caretta*	T
Olive Ridley Sea Turtle	*Lapidochelys olivacea*	T
Leatherback Sea Turtle	*Dermochelys coriacea*	E
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E
Mollusks Observed at Illeginni Island		
Top-Snail Shell	*Trochus niloticus*	RS
Giant Clam	*Tridacna maxima*	CITES
Giant Clam	*Tridacna gigas*	CITES
Giant Clam	*Tridacna squamosa*	CITES
Giant Clam	*Hippopus hippopus*	CITES
Sponges Observed at Illeginni Island		
Various sponge species identified in Table 13 of the Year 2000 Species Inventory for USAKA (USFWS/NMFS, 2002)		RS
Coral Species Observed at Illeginni Island		
Various coral species identified in Table 12(g) of the Year 2000 Species Inventory for USAKA (USFWS/NMFS, 2002)		CITES
Migratory Birds Observed at Illeginni Island		
Pacific Reef Heron	*Egretta sacra*	MBCA
Pacific Golden Plover	*Pluvialis fulva*	MBCA
Wandering Tattler	*Heteroscelus incanus*	MBCA
Tattler species	*Heteroscelus sp.*	MBCA
Whimbrel	*Numenius phaeopus*	MBCA
Bristle-Thighed Curlew	*Numenius tahitiensis*	MBCA
Godwit species	*Limosa sp.*	MBCA
Ruddy Turnstone	*Arenaria interpres*	MBCA
Brown Booby	*Sula leucogaster*	MBCA
Black-Naped Tern	*Sterna sumatrana*	MBCA
Brown Noddy	*Anous stolidus*	MBCA
Black Noddy	*Anous minutus*	MBCA
White Tern	*Gygis alba*	MBCA
Great Crested Tern	*Sterna bergii*	MBCA

Notes:
E = Endangered
T = Threatened
RS = Protected under RMI Statute
MMPA = Protected under the Marine Mammal Protection Act
CITES = Protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora
MBCA = Protected under the Migratory Bird Conservation Act

Source: USASMDC, 2003a; USFWS/NMFS, 2002

Also listed in Table 3-5, several threatened and endangered species of sea turtles can be found in the lagoon and ocean waters surrounding USAKA. These include the hawksbill sea turtle (*Eretmochelys imbricata*) and green sea turtle (*Chelonia mydas*). A hawksbill sea turtle was observed in the lagoon just north of Illeginni Island in 2002, while an adult green sea turtle was seen on the seaward side of the island in 1996 (Foster, 2004; USFWS/NMFS, 2000).

The marine environment surrounding Illeginni supports a community of corals, fish, and invertebrates including the following protected species: mollusks, such as giant clams (including *Tridacna maxima* and *Hippopus hippopus*) and top-snail shell (*Trochus niloticus*); close to 20 species of sponges (includes the genera *Adocia*, *Chelonaplysilla*, *Druinella*, *Ianthella*, *Pericharax*, and *Stylinos*); and over 75 species of coral (includes the genera *Acropora*, *Favia*, *Fungia*, *Millepora*, *Pavona*, and *Pocillopora*) (USFWS/NMFS, 2002). Figure 3-3 shows areas where various protected species can be found at Illeginni Island. A small sample of the coral cover and fish populations along the reef can be seen in the following photograph (Figure 3-4), taken from the ocean side of Illeginni.



Source: Naughton, 2004

Figure 3-4. Underwater View of the Reef Environment at Illeginni Island

On Illeginni, a number of protected migratory seabirds and shorebirds have been seen either breeding, roosting, or foraging on the island. They include the black-naped tern (*Sterna sumatrana*), brown noddy (*Anous stolidus*), black noddy (*Anous minutus*), white tern (*Gygis alba*), pacific golden plover (*Pluvialis fulva*), wandering tattler (*Heteroscelus incanus*), whimbrel (*Numenius phaeopus*), bristle-thighed curlew (*Numenius tahitiensis*), and the ruddy turnstone (*Arenaria interpres*). (USFWS/NMFS, 2002)

Other Species

Within the waters surrounding Illeginni, various non-listed species of coral, mollusks, and other invertebrates (e.g., sea stars, sea urchins, and crinoids) can also be found. Some of the reef fish species observed in the area include surgeonfishes (*Acanthurus olivaceus*), snappers (*Lutjanus bohar* and *L. gibbus*), groupers (*Plectropomus areolatus* and *Anyperodon leucogrammicus*), grey reef sharks (*Carcharhinus amblyrhynchos*), and parrotfishes (*Scarus rubroviolaceus*). (USFWS/NMFS, 2002)

Terrestrial species observed on Illeginni include rats and three species of ants (USFWS/NMFS, 2002). These non-native species were accidentally introduced to the island some years earlier.

Environmentally Sensitive and Critical Habitat

No designated essential fish habitat is identified for the Marshall Islands. However, 250 species of reef fish are located in the atolls of the Marshall Islands. Because food cultivation on the islands is limited, fish and other sea life are of important dietary value to the Marshallese people (Pacific Island Travel, 2002). In an effort to protect the fisheries, the multilateral fisheries agreement between the United States and South Pacific island governments, including the Marshall Islands, have adopted a treaty (United Nations Agreement on Highly Migratory Fish Stocks and Straddling Fish Stocks) that promotes the long-term sustainable use of highly migratory species, such as tuna, by balancing the interests of coastal states and states whose vessels fish on the high seas. (US Department of State, 2002)

Illeginni Island has marine and terrestrial habitats of significant biological importance, as defined in the UES and shown in Figure 3-3. The terrestrial habitats of significant importance include the mixed broadleaf (littoral) forest, seabird colonies, and the shorebird sites around the island. Sea turtle nesting and haul-out areas have been identified along some shorelines. The marine habitats considered biologically important are the lagoon-facing reef slope and reef flat, the inter-island reef flat, the lagoon floor, the ocean-facing reef slope and reef flat, the intertidal zone, and the reef pass. All of these habitats are considered important because of the presence or possible presence of protected species. (USASMDC, 2003a; USFWS/NMFS, 2002)

Based on prior surveys conducted around the island, coral cover is moderate to high in most areas. Mollusks are abundant in the lagoon north of the island, while marine life in general is abundant and diverse on the ocean side south of the island. Towards the southwestern side of the island, the water column was previously shown to be moderately turbid. Further west and south of the helipad, there is a marked degradation of the coral cover. During surveys conducted in 2000, coral mortality in this area was observed to an approximate depth of 82 ft (25 m). Live coral cover appeared to be low, and the benthic substrate was dominated by rubble. (USFWS/NMFS, 2002)

Island surveys have shown shorebirds to use the managed vegetation throughout the island's interior. Pooled water on the helipad attracts both wintering shorebirds and some seabirds. White terns have been observed in trees at the northwest corner and southwest quadrant of the island. The shoreline embankment and exposed inner reef provides a roosting habitat for great crested terns and black-naped terns. Seabirds have been seen concentrated in the island's southeast quadrant where the littoral forest supports the second-largest nesting colony of black noddies in the USAKA islands; nearly 150 nests were identified in 2000. There are also signs of black-naped tern nesting on the western tip of the island. (USFWS/NMFS, 2002)

As shown in Figure 3-3, suitable sea turtle haul-out/nesting habitat exists along the shoreline northwest and east of the helipad on the lagoon side of Illeginni (USFWS/NMFS, 2002). During surveys conducted in 1996, sea turtle nest pits were observed near the western end of the island (USFWS/NMFS, 2000).

3.5.2 Cultural Resources

Buildings and other facilities at Illeginni are situated primarily in the central and eastern portions of the island (see Figure 3-3). Most of them are no longer used and have been abandoned in place. Previous investigations identified almost all of the buildings as having potential eligibility for nomination to the US NRHP because of their Cold War-era historic importance (USASSDC/TBE, 1996). However, with implementation of the 2001 Historic Preservation Plan for USAKA, NRHP eligibility is no longer the standard for assessing historic structures at USAKA (USASMDC, 2001).

The buildings determined to be potentially eligible for the US NRHP have since been examined to determine their eligibility for listing in the RMI List of Cultural and Historic Properties. None of the sites on Illeginni meet any of the 11 criteria listed in RMI Land Modification Regulations (Part III, Section 5, Criteria for Recognition as a Cultural and Historic Property) (RMI, 1991). Further classification of site significance, under Section 6 of the same regulation, found that all of the sites qualify as “insignificant” under subsection (d)(iv) because: (1) the resource is abundant on the atoll concerned; (2) it does not form part of an ensemble of sites or features; and (3) sufficient, well-preserved examples of the resource remain intact.

Some studies have identified the possibility of buried traditional or prehistoric remains on Illeginni (Carucci, 1997; USASSDC, 1996). In all probability, any remains that might have survived the construction of the remote launch site on the east side of the island, and subsequent use of the island as an RV impact site, are buried under significant amounts of modern fill. Limited subsurface testing on the island found that disturbance to the original land surface was severe, especially along the lagoon-facing shoreline; most of which had been bulldozed (Craib, et al., 1989). Although some stands of vegetation exist, they are relatively young. No indigenous cultural materials or evidence of subsurface deposits have been found (Craib, et al., 1989). Midden-associated charcoal that was noted along the lagoon shoreline (USASSDC, 1996) is most likely a modern intrusion (USASMDC, 1997).

3.5.3 Health and Safety

Since USAKA will be used during flight tests only as the target area, no health and safety issues related to launch safety, launch hazards, or fuels handling apply. The relevant issue is post-boost vehicle and RV impact area safety.

The ROI for health and safety at USAKA includes all areas where the RVs impact in the Mid-Atoll Corridor, and the ocean waters near USAKA—the same general area now used for ICBM FDE flights. This includes the hazard area outside the atoll, where post-boost vehicle fragments sometimes impact.

USAKA has the unique mission of serving as the target for a wide variety of missile launch operations from Vandenberg AFB, California, and the Pacific Missile Range Facility in Hawaii. These missions are conducted with the approval of the USAKA Commander. A specific procedure is established to ensure that such approval is granted only when the safety requirements for proposed test activities have been adequately addressed.

All program operations must receive the approval of the USAKA Safety Directorate. This is accomplished through presentation of the proposed program to the Safety Directorate. All safety analyses, standard operating procedures, and other safety documentation applicable to those operations affecting the USAKA must be provided, along with an overview of mission objectives, support requirements, and schedule. The Safety Directorate evaluates this information and ensures that all USAKA safety requirements specified in the UES, and supporting regulations, are followed. (USASSDC, 1995)

Prior to operations that may involve missile impacts within the range, an evaluation is made to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact limits (i.e., the hazard area). A NOTMAR and a NOTAM are published and circulated in accordance with established procedures to provide warning to personnel, including residents of the Marshall Islands, concerning any potential hazard area that should be avoided. Radar and visual sweeps of hazard areas are accomplished immediately prior to operations to assist in the clearance of non-critical personnel. Only mission-essential personnel are permitted in hazard areas. (USASSDC, 1995)

In operations that involve the potential for RV debris near inhabited islands, precautions are taken to protect personnel. In hazard areas, where an island has an unacceptably high probability of impact by debris, personnel are evacuated. In caution areas, where the chance of debris impact is low, precautions may consist of evacuating nonessential personnel and sheltering remaining inhabitants. Sheltering is required for RV missions impacting the Mid-Atoll Corridor at USAKA. The Mid-Atoll Corridor is declared a caution area when it contains a point of impact. Remaining inhabitants of Kwajalein Atoll islands in this corridor are required to seek shelter. (USASSDC, 1993)

Prior to flight operations, proposed trajectories are analyzed and a permissible flight corridor is established. A flight that strays outside its corridor is considered to be malfunctioning and to constitute an imminent safety hazard. A destruct package, installed in all flight vehicles capable of impacting inhabited areas, is then activated. Activating the destruct package effectively halts the continued powered flight of the hardware, which falls to the ocean along a ballistic trajectory. (USASSDC, 1995)

3.5.4 Hazardous Materials and Waste Management

As a requirement of the UES, the Army has prepared the *Kwajalein Environmental Emergency Plan* (KEEP) for responding to releases of oil, hazardous material, pollutants, and other contaminants into the environment (USAKA/RTS, 2003). The KEEP is substantively similar to the spill prevention, control, and countermeasure plan often required in the United States. As part of the KEEP, a *Hazardous Materials Management Plan* (HMMP) has been prepared to address USAKA’s import, use, handling, and disposal of hazardous materials. This Plan includes maintaining an inventory of hazardous materials routinely imported and used at USAKA. As part of pollution prevention, recycling, and waste minimization activities, each revision of the HMMP includes both a description of the steps taken to reduce the volume and toxicity of the generated waste, and a description of the changes in volume and toxicity of waste achieved since the last revision.

Commonly used hazardous materials (e.g., cleaning solvents, paints, and petroleum products) are managed and distributed through the base supply system. Tenants, construction contractors, program offices, and other recipients importing activity-specific hazardous materials into USAKA are required to submit— within 15 days of receiving the material or before actual use, whichever comes first—a separate Hazardous Materials Procedure to the Commander, USAKA, for approval. Such procedures outline requirements for material storage, use, transportation, and eventual disposal.

Hazardous or toxic waste treatment or disposal is not allowed at USAKA under the UES. Hazardous waste, whether generated by USAKA activities or by range users, is handled in accordance with the procedures specified in the UES. Hazardous wastes are collected at individual work sites in waste containers. Containers are kept at the point of generation accumulation site until they are full, or until a specified time limit is reached. Containers are then collected from the generation point and transported to the USAKA Hazardous Waste 90-Day Storage Facility on Kwajalein Island. Wastes are then shipped off-island by barge for treatment and disposal in the continental United States.

Training programs play an integral and active part in the USAKA environmental management program to ensure that the installation complies with all environmental requirements. The installation contractor continually updates training programs so employees are fully aware of procedures and policies associated with the following topics:

- Hazardous waste management/reduction
- Methods of testing and ensuring proper operation of equipment
- Hazardous materials handling
- Spill prevention, control, and response
- Countermeasures to contain, clean up, and mitigate the effects of a spill or discharge.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences of the No Action Alternative and the Proposed Action, described in Chapter 2.0 of this EA, when compared to the affected environment described in Chapter 3.0. The amount of detail presented in each section of the analysis is proportional to the potential for impact. Because environmental issues associated with the proposed MM III modification vary widely, not all of the same resources are analyzed for each location or for all activities. For example, the proposed test and/or deployment activities for RS modifications affect all sites and all resources analyzed; however, the replacement of command and control console equipment affects only hazardous materials and waste management at the five AFBs. A breakdown of the resources analyzed in detail, by location, is shown in Table 4-1, along with the section numbers where the respective No Action Alternative and Proposed Action discussions can be found.

Table 4-1. Resources Analyzed in Detail by Location

Location	Air Quality	Noise	Biological Resources*	Cultural Resources	Health & Safety	Hazardous Materials & Waste Management
FE Warren, Malmstrom, & Minot AFBs					Sect. 4.1.1	Sect. 4.1.2
Hill AFB					Sect. 4.2.1	Sect. 4.2.2
Vandenberg AFB	Sect. 4.3.1	Sect. 4.3.2	Sect. 4.3.3		Sect. 4.3.4	Sect. 4.3.5
Over-Ocean Launch Corridor			Sect. 4.4.1			
US Army Kwajalein Atoll			Sect. 4.5.1	Sect. 4.5.2	Sect. 4.5.3	Sect. 4.5.4

*Noise and water quality are included in the analysis, from the standpoint of potential impacts on vegetation and wildlife.

In the discussions that follow, both *direct* and *indirect* impacts[4] are addressed where applicable. In addition, any *cumulative* effects that might occur are identified later in Section 4.6. Appropriate mitigation measures are also identified, where necessary, and summarized in Section 4.7. A list of all agencies and other personnel consulted, as part of this analysis, is included in Chapter 7.0.

4.1 FE WARREN, MALMSTROM, AND MINOT AIR FORCE BASES

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at FE Warren AFB, WY; Malmstrom AFB, MT; and Minot AFB, ND.

4.1.1 Health and Safety

4.1.1.1 No Action Alternative

[4] *Direct* impacts are caused by the action and occur at the same time and place. *Indirect* impacts occur later in time or are farther removed in distance, but are still reasonably foreseeable.

Missile System Maintenance

Removal of the RS, the solid propellant booster, or the entire MM III missile from remote LFs—followed by their transportation back to the main base, maintenance, system checks, parts replacement, occasional system upgrades, and booster motor change-outs—are all routine activities at all three Wings. All applicable Federal, state, and local health and safety requirements, such as Occupational Safety and Health Administration (OSHA) regulations within 29 CFR, are followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors and other missile ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.1.1, the level of risk to military personnel, contractors, and the general public would be minimal.

Between the LFs and each Wing support base, the RS containing operational RVs is transported in a specialized payload transporter, while the booster motor is transported in a TE, both of which provide environmental protection and physical security of the missile components. When the boosters are used for flight tests at Vandenberg AFB (normally three or four per year), or require other maintenance work at Hill AFB, they are transferred to a heavily constructed MT trailer for the long haul over public roads and highways. All transportation and handling requirements for the RS, the booster, and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As previously described in Section 3.1.1, accident rates for ongoing operations involving missile rocket motor transportation have historically been very low.

Consequently, no significant impacts to health and safety are expected.

4.1.1.2 Proposed Action

Under the proposed action, the number of boosters needed for flight tests at Vandenberg AFB would increase by only four in the FY 2005 and 2006 timeframe. Handling and transportation requirements for MM III boosters and other missile components would be conducted in the same manner as for the No Action Alternative, in accordance with Federal, state, local, DOD, USAF, and DOT regulations. Transportation requirements for the additional boosters would have virtually no effect on the frequency of vehicular accidents on public roads and highways.

The reconfiguration of the MM IIIs to carry the newer Mark 21 RV and warhead—requiring hardware and software modifications to the RS, and other support equipment—would be conducted during normal ongoing maintenance operations. The hardware components and software installation would not present a health hazard when systems are removed, installed, maintained, or in storage. The hardware and software components would be constructed and packaged to eliminate or minimize safety risks to an acceptable level for operators, maintainers, and support personnel. The system components would be marked with appropriate warnings and cautions to prevent injury to the operators and maintainers. All facilities involved would comply with OSHA, DOD, and DOT health and safety standards.

Consequently, no significant impacts to health and safety are expected.

4.1.2 Hazardous Materials and Waste Management

4.1.2.1 No Action Alternative

Missile System Maintenance

The removal of MM IIIs from remote LFs, transportation to the support base, maintenance, system checks, parts replacement, occasional system upgrades, and booster motor change-outs are all routine activities at the three Wings. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed console equipment at the LCCs in the Wing areas would not involve the direct handling of hazardous materials or wastes, since any materials in the units are sealed inside. However, failed HDA and VDU units that cannot be repaired would be declassified and turned over to the Defense Reutilization and Marketing Service (DRMS), which manages excess and surplus DOD property, including electronics.

Electronic products can contain a variety of toxic constituents. Computer monitors with cathode ray tubes, printed wiring boards, and other electronic components often contain hazardous constituents such as lead, phosphorus, and cadmium. DRMS manages the disposal of equipment and other military property containing hazardous material and/or waste, which is handled according to the same priorities as other property: (1) reutilization within DOD, (2) transfer to other Federal agencies, (3) donations to qualified state and nonprofit organizations, and (4) sale to the public, including recyclers. This process maximizes the use of each item and minimizes the environmental risks and the costs associated with disposal. Such equipment or other property that cannot be reused or sold is disposed of through commercial service contracts that must comply with applicable Federal, state, and local environmental laws and regulations, including the RCRA, which requires “cradle to grave” management of hazardous materials and wastes. Any hazardous components would be stored in Conforming Storage Facilities (CSFs) located at local DRMO complexes. CSFs meet state and Federal requirements, and provide safe, temporary storage during the disposal cycle (DRMS, 2003). As a result, no adverse impacts from the management of hazardous materials and waste are expected.

4.1.2.2 Proposed Action

At each Wing, the reconfiguration of the MM IIIs to carry the newer Mark 21 RV and warhead would require hardware and software modifications to the RS, and other support equipment. The hardware components would come pre-assembled, contained, or packaged in sealed units, and personnel would not handle or become exposed to any hazardous materials they may contain. Little or no hazardous wastes would be generated from the RS modifications and installation of the Mark 21 RVs. Any hardware or software that is faulty would be returned to the manufacturer for repair or recycling in its standard industrial packaging.

As part of the process of modifying the MM III RSs, all of the older Mark 12 RVs would be removed. The long-term storage and/or disposition requirements for the Mark 12 RVs are not part of the proposed MM III modification. Decisions to be made on these actions by the USAF, in cooperation with the DOE, would be supported, as necessary, by additional environmental analyses separate from this EA.

The replacement of MM III command and control console equipment, and related software upgrades, would occur at all operational LCCs in the Wing areas. Upgrading computer software and replacement of

EMAD modules would not involve the handling of hazardous materials—with the possible exception of small amounts of solvent to clean electrical contacts. The old EMAD cards that are removed would be returned to storage as spares and would not go to the DRMOs for disposition.

Deployment of the remaining HDAs and VDUs, occurring as part of routine maintenance or by force deployment, would similarly not involve the handling of hazardous materials—with the possible exception of electrical contact cleaners—since any hazardous materials would be sealed inside the units. The removal and disposal of old console equipment, however, would generate hazardous waste. Each HDA contains trace amounts of cadmium and lead in solder, and each VDU contains approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium. Table 2-4 identifies the approximate numbers of each item that would be processed at each DRMO location.

Just as under the No Action Alternative, old console equipment would be turned over to the local DRMO, which manages excess and surplus DOD property, including electronics. The proposed disposal of old console equipment would represent approximately 2 to 4 percent of current and ongoing DRMO work at Fort Carson (the location of the DRMO for FE Warren AFB), approximately 5 percent at Malmstrom AFB, and approximately 1 percent at Minot AFB (Ogden ALC, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change.

Overall, there should be no adverse impacts on current hazardous materials and waste management operations at any of the Wings or DRMO facilities.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. Because the equipment would remain intact, there would be no release of hazardous or toxic materials. Thus, no adverse impacts are expected from this particular action.

4.2 HILL AIR FORCE BASE

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at Hill AFB in Utah.

4.2.1 Health and Safety

4.2.1.1 No Action Alternative

Rocket Booster Logistical Support

MM III booster disassembly, reassembly, and maintenance operations are all routine activities at Hill AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA, DOD, and DOT regulations, are followed, as well as all applicable DOD and USAF regulations. By adhering to the established and proven safety standards and procedures identified in Section 3.1.1, the level of risk to military personnel, contractors, and the general public would be minimal. Consequently, no significant impacts to health and safety are expected.

Potential impacts resulting from the transportation of boosters to and from Hill AFB are addressed in Section 4.1.1.1.

4.2.1.2 Proposed Action

In FYs 2005 and 2006, personnel at Hill AFB would assemble two additional MM III replacement boosters per year, in addition to the three or four boosters normally assembled each year because of FDE program launches. These activities would be conducted in the same manner as for the No Action Alternative, in accordance with Federal, state, local, DOD, USAF, and DOT regulations. Consequently, no significant impacts to health and safety are expected.

4.2.2 Hazardous Materials and Waste Management

4.2.2.1 No Action Alternative

Rocket Booster Logistical Support

MM III booster disassembly, reassembly, and maintenance operations are all routine activities at Hill AFB. During these operations, all hazardous materials and associated wastes (i.e., adhesives, sealers, solvents, and contaminated rags) would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed MM III command and control console equipment at the SMIC on Hill AFB would not involve the direct handling of hazardous materials, but, as discussed in Section 4.1.2.1, would generate hazardous waste. However, through the local DRMO, equipment and other property containing hazardous materials or wastes are stored in facilities that ensure personnel protection, prevent accidents, and reduce the risk of environmental spills. The DRMS has in place programs for safety and training, storage and inspection, and special handling requirements that minimize risks to workers and the general public (DRMS, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are anticipated.

4.2.2.2 Proposed Action

At Hill AFB, the quantity of hazardous materials used and hazardous wastes generated from the assembly of four additional MM III boosters in the FYs 2005 and 2006 timeframe would be minimal. Moreover, they would be similar to current materials and wastes used and generated from current booster assembly operations, and would not result in any procedural changes in the existing hazardous materials and waste management plans already in place at the base.

The replacement of MM III command and control console equipment, and related software upgrades, would occur at the SMIC on Hill AFB. Just as described for the Minuteman Wings in Section 4.1.2.2, the old EMAD cards would be returned to storage as spares and would not go to the on-site DRMO for disposition. For deployment of the new HDAs and VDUs, removal and disposal of the old units would generate hazardous waste consisting of trace amounts of cadmium and lead solder in each HDA, and approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium, in each VDU. Table 2-4 identifies the approximate numbers of each console item that would be processed at the local DRMO. The proposed disposal of old console equipment would represent less than 1 percent of current and ongoing DRMO work at Hill AFB (Ogden ALC, 2003).

Overall, there should be no adverse impacts on current hazardous materials and waste management operations on base or at the DRMO facility.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. However, no adverse impacts are expected from this particular action.

4.3 VANDENBERG AIR FORCE BASE

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at Vandenberg AFB, CA.

4.3.1 Air Quality

4.3.1.1 No Action Alternative

Pre-Flight Preparations

Preparations for the MM III FDE flight tests are conducted in compliance with all applicable SBCAPCD rules and regulations, including those that cover the use of any organic solvents (Rule 317), architectural coatings (Rule 323), or sealants (Rule 353). There are no requirements to add liquid propellants to the PSRE, since it arrives at the base already fueled. Emissions from the limited number of trucks and other vehicles used to support test operations occur intermittently. As a result, there should be no violation of air quality standards or health-based standards of non-criteria pollutants during pre-launch activities.

Flight Activities

Lower Atmospheric Effects. Launch activities for FDE flights must also comply with all applicable SBCAPCD rules and regulations. Under the No Action Alternative, up to four MM III launches per year would continue to occur as part of the current MM FDE flight test program. The total quantity of missile exhaust emissions for four MM III launches is provided in Table 4-2. Only 1st-stage rocket emissions would normally occur within the ROI for Vandenberg AFB.

Table 4-2. Exhaust Emissions for Four Minuteman III Launches

Pollutant	1st Stage (tons/year)	2nd Stage (tons/year)	3rd Stage (tons/year)	Total (tons/year)
CO	0.0101	0.00303	0.00161	0.0147
NO_X	0.448	0.135	0.0715	0.655
PM_{10}[1]	5.03	1.51	0.803	7.34
$PM_{2.5}$[1]	3.52	1.06	0.562	5.14
Hydrogen Chloride	3.93	1.18	0.62	5.73
Other[2]	0.000671	0.000202	0.000107	0.000980

[1] All PM emissions are assumed to be aluminum oxide (Al_2O_3).

[2] Includes combined amounts of polycyclic aromatic hydrocarbons, benzene, formaldehyde, vinyl chloride, antimony, arsenic, cadmium, hexavalent chromium, lead, manganese, and nickel.

Source: HAFB, 2001

During missile flight out over the ocean, rocket emissions from all three stages are rapidly dispersed and diluted over a large geographic area. Because the launches are short-term, discrete events, the time between launches allows the dispersion of the emission products. No violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

In the event of an in-flight problem or malfunction that resulted in either intentional or accidental destruction of the MM III missile, the rocket motor casing would be split open, releasing internal pressure and terminating propellant combustion, thus minimizing further emissions.

Upper Atmospheric Effects. The exhaust emissions from the MM III motors contain chlorine compounds, produced primarily as hydrogen chloride at the nozzle. Through high temperature "afterburning" reactions in the exhaust plume, the hydrogen chloride is partially converted to atomic chlorine. These more active forms of chlorine can contribute to localized ozone depletion in the wake of the launch vehicle and to overall global chlorine loading, which contributes to long-term ozone depletion. Studies have shown that the hydrogen chloride remains in the stratosphere for about 3 years and then diffuses down to the troposphere. (Brady, 2002; USAF, 2001a)

Because of the large air volume over which these emissions are spread, and because of rapid dispersion by stratospheric winds, the active chlorine from the MM III flight tests should not contribute to localized depletion of the ozone layer. On a global scale, this represents a very small fraction of chlorine released.

Two other types of substances, aluminum oxide (Al_2O_3) and nitrogen oxide (NO_x) species, also are of concern with respect to stratospheric ozone depletion. The Al_2O_3, which is emitted as solid particles, has been the subject of study with respect to ozone depletion via reactions on solid surfaces. The studies indicate that Al_2O_3 can activate chlorine. The exact magnitude of ozone depletion that can result from a buildup of Al_2O_3 over time has not yet been determined quantitatively, but is considered insignificant based on existing analyses. (USAF, 2001a)

Nitrogen oxide, like certain chlorine-containing compounds, contributes to catalytic gas phase ozone depletion. The production of NO_x species from solid rocket motors is dominated by high-temperature "afterburning" reactions in the exhaust plume. As the temperature of the exhaust decreases with increasing altitude, less NO_x is formed (Brady, 2002). Because diffusion and winds would disperse the NO_x species generated, no significant effect on ozone levels is expected.

In summary, the combined release of hydrogen chloride, Al_2O_3, and NO_x emissions into the stratosphere from up to four MM III launches per year should be insignificant because of the rapid dispersion predicted for such small quantities of substances. Thus, they should not have a significant impact on stratospheric ozone.

Until recent years, the MM III missile used Halon 2402 for the TVC fluid injection on the 2nd stage motor. The Halon gas, a Class I ozone-depleting substance, has since been replaced with perfluorohexane, which is a perfluorocarbon. In some applications, the release of perfluorocarbons would be a cause for concern in terms of added effects to global warming. In this application, however, the perfluorohexane undergoes combustion in the exhaust plume and is not released into the atmosphere. (Dhooge and Nimitz, 2000)

Post-Launch Operations

Post-launch refurbishment activities for FDE test operations will continue to use paints that meet all applicable SBCAPCD rules, including Rule 323 (Architectural Coatings) for volatile organic compounds (VOCs). No air emission permits are required for these operations. With the exception of some minor, localized increases in particulate matter from the occasional brushing of blast residues from the walls and components in and around the launch tube, no adverse effects on air quality are expected.

4.3.1.2 Proposed Action

For purposes of verifying and certifying use of the newly modified RS, two test launches per year would be conducted at Vandenberg AFB in FYs 2005 and 2006, in addition to the current number of MM III FDE missions. Then, beginning in FY 2007, the FDE flights would start using the modified RS. The total number of annual FDE flights, however, would not change. Operations and tests would be conducted in the same manner and in the same facilities as those used for the FDE flights described for the No Action Alternative. Although there would be slight increases in the use of paints (in accordance with all applicable SBCAPCD rules) and vehicular emissions over the FYs 2005 and 2006 period, there would be no violation of air quality standards or health-based standards of non-criteria pollutants during pre-flight preparations or for post-launch operations. Thus, little or no additional impacts on air quality would be expected.

Flight test activities, involving two additional launches per year, would result in a 50 to 67 percent increase in annual MM III emissions over the FYs 2005 and 2006 time period (when compared to the current three to four FDE launches conducted every year). The missile exhaust emission levels for two MM III launches per year are shown in Table 4-3.

Table 4-3. Exhaust Emissions for Two Minuteman III Launches

Pollutant	1st Stage (tons/year)	2nd Stage (tons/year)	3rd Stage (tons/year)	Total (tons/year)
CO	0.00503	0.00151	0.000803	0.00734
NO_X	0.224	0.0674	0.0358	0.327
PM_{10}[1]	2.51	0.757	0.402	3.67
$PM_{2.5}$[1]	1.76	0.53	0.28	2.57
Hydrogen Chloride	1.96	0.591	0.314	2.87
Other [2]	0.000335	0.000101	0.0000536	0.000490

[1] All PM emissions are assumed to be aluminum oxide (Al_2O_3).

[2] Includes combined amounts of polycyclic aromatic hydrocarbons, benzene, formaldehyde, vinyl chloride, antimony, arsenic, cadmium, hexavalent chromium, lead, manganese, and nickel.

Source: HAFB, 2001

Federal conformity rules require that all Federal actions conform to an approved State Implementation Plan or Federal Implementation Plan. Conformity means that an action will not: (1) cause a new violation of the NAAQS, (2) contribute to any frequency or severity of existing NAAQS, or (3) delay the timely attainment of the NAAQS. Conformity applies only to areas that are not in attainment with the Federal standards. Because Santa Barbara County has, until recently, been a nonattainment area for the Federal ozone NAAQS, conformity must be considered for nitrogen oxide (NO_x) and VOC emissions, which are ozone precursors. In accordance with the CAA, a general Conformity Determination is required when total emissions from the Proposed Action exceed 50 tons (45 metric tons) per year of NO_x or VOC, or the Proposed Action results in more than 10 percent of the County emissions inventory.

Conformity applicability analyses previously conducted for target missile launches at Vandenberg AFB—in support of the Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR)—showed all operations to meet *de minimis* requirements and not represent a regionally significant action (USASMDC, 2003b). The GMD ETR analyses assumed up to five launches per year, including MM II and/or Peacekeeper target launch vehicles. These particular launch vehicles are similar in size to (MM II), or larger than (Peacekeeper), the MM III system, and use the same or similar propellants as the MM III booster.

Table 4-3 shows rocket exhaust emissions from the two additional MM III launches, including both NO_x and VOCs (represented by some of the "Other" pollutants). Contributions from Pre-Flight Preparations and Post-Launch Operations (e.g., ground vehicle exhaust emissions) for the two additional launches per year would represent a fraction (~2/5) of the emissions associated with five of the GMD ETR target launch missions. Just as for GMD ETR launch operations, total emissions associated with two additional MM III launches would not exceed the Federal *de minimis* annual limits. In addition, they would not exceed more than 10 percent of the Santa Barbara County emissions identified in Table 3-2. Therefore, further CAA conformity analyses pursuant to 40 CFR Part 51, Subpart W, are not required, and this action does not require a new CAA Conformity Determination. Conformity does not have to be considered for PM_{10} because the area is in attainment with the Federal PM_{10} NAAQS, even though the area is in nonattainment for the more stringent state PM_{10} standard.

Just as with the current FDE flight tests, rocket emissions from all three MM III stages would be rapidly dispersed and diluted over a large geographic area. Because the launches are short-term, discrete events, the time between launches would allow the dispersion of the emission products. No violation of air quality standards or health-based standards for non-criteria pollutants would be anticipated.

In terms of upper atmospheric effects, the combined release of hydrogen chloride, Al_2O_3, and NO_x emissions into the stratosphere from the four additional test launches would be insignificant because of the rapid dispersion predicted for such small quantities of substances. Thus, they would not have a significant impact on stratospheric ozone.

Under the proposed MM III modification, activities at Vandenberg AFB and at other locations would generate additional greenhouse gases (e.g., carbon dioxide and NO_x from motor vehicle emissions). Because the United States releases approximately 5,800 million metric tons of greenhouse gases annually (USEIA, 2003), the relatively small contribution of gases from the MM III modification would have an insignificant effect on global climatic change.

As part of the proposed deployment activities, electronic test and support equipment used during MM III flight test operations would be modified accordingly. The changes in equipment are minor and do not affect building or facility structures at Vandenberg AFB in any way. Therefore, no adverse effects on air quality would be expected from these activities.

4.3.2 Noise

4.3.2.1 No Action Alternative

Pre-Flight Preparations

Noise exposure from pre-flight activities is minimal. The noise generated during FDE pre-flight preparations comes primarily from the use of trucks and other load handling equipment. Any noise exposure levels must comply with USAF Hearing Conservation Program requirements, as described earlier in Section 3.3.2.

Flight Activities

For the three to four FDE MM III flight tests conducted every year, noise levels generated from each launch have minor variations resulting from changes in weather conditions, launch location, and launch trajectory. Figure 4-1 depicts the predicted maximum noise-level contours for a MM III launch from LF-26, the northernmost launch site used for Minuteman tests. The modeling results depicted in the figure represent a maximum predicted scenario that does not account for variations in weather or terrain. As shown in Figure 4-1, the noise levels generated can range from 125 dB (or higher) in the immediate vicinity of the launch site, to around 80 dB near Lompoc. Santa Maria can experience maximum noise levels of approximately 95 dB, while the community of Guadalupe may be exposed to maximum noise levels of around 105 dB. Because the noise levels shown in Figure 4-1 represent unweighted sound pressure levels, equivalent A-weighted sound levels would be substantially lower.

While these noise exposure levels can be characterized as very loud, they occur infrequently, are very short in duration (about 20 seconds per launch), and have little effect on the CNEL in these areas. Any USAF personnel and contractors working near the area at time of launch are required to wear adequate hearing protection in accordance with USAF Hearing Conservation Program requirements. In addition, public access areas near the Minuteman Launch Area are usually restricted at time of launch to ensure public safety and minimize unnecessary exposures. The helicopters used to verify that beach areas and near offshore waters are clear of non-participants generally limit their flights to the areas around the North Base, thus limiting the noise effects on local communities.

Sonic booms generated by the MM III missile typically start reaching the surface some distance downrange of the launch site. These sonic booms generally occur well off the coast over ocean waters, and so are not an issue affecting coastal land areas or the Channel Islands to the south. In addition, the sonic booms are typically audible for only a few milliseconds.

Based on this analysis, the ongoing actions of conducting up to four FDE launches per year would have no significant impact on ambient noise levels. The potential for launch noise and sonic boom impacts, on protected wildlife species and sensitive habitats, is discussed in Sections 4.3.3 and 4.4.1.

Post-Launch Operations

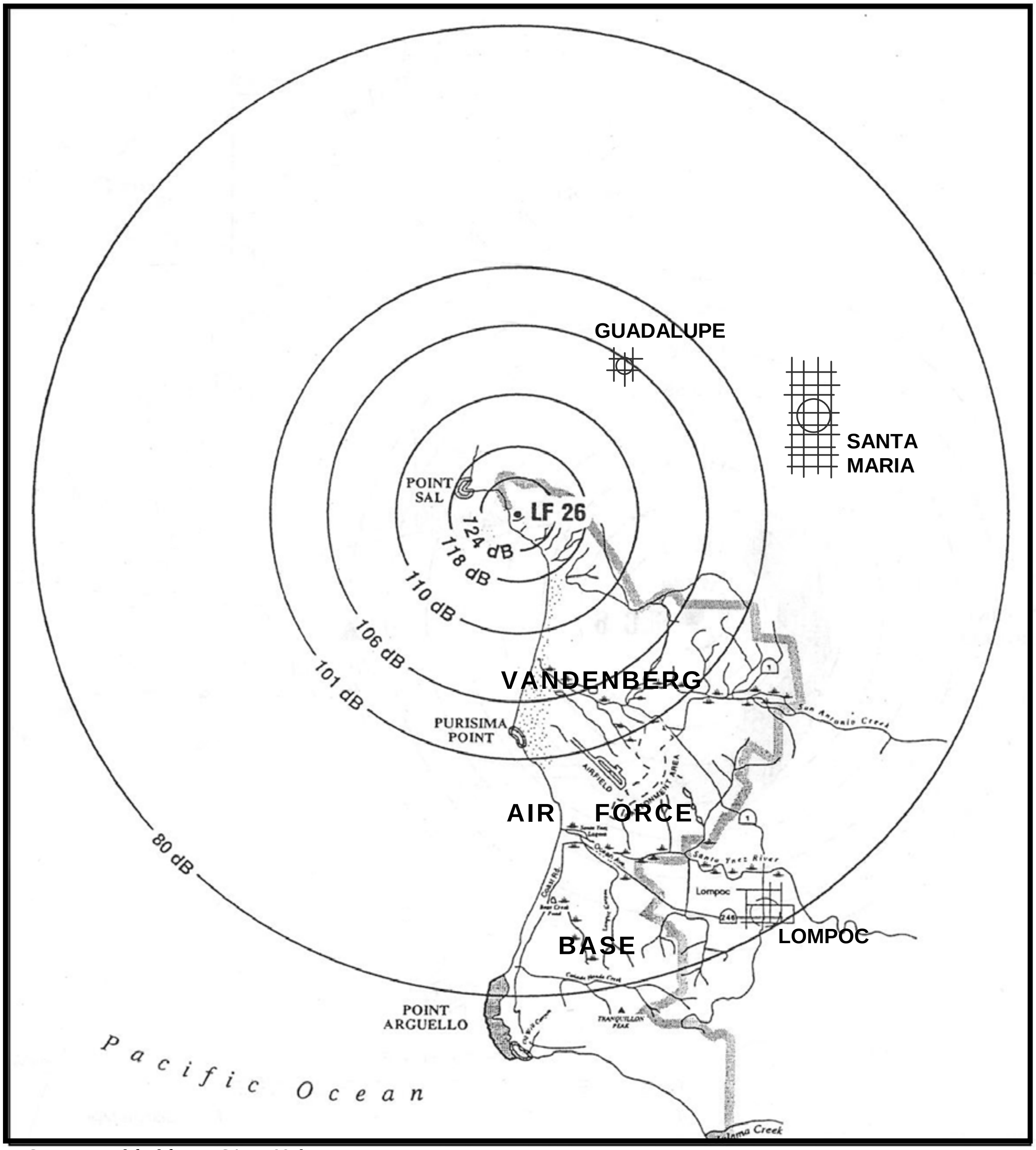
Because of the limited activities associated with post-launch operations, limited amounts of noise would be generated. Thus, no impacts to ambient noise levels are expected.

4.3.2.2 Proposed Action

The Proposed Action would involve a continuation of MM III launches from Vandenberg AFB. With the exception of two additional launches per year in FYs 2005 and 2006, operations and tests would be conducted in the same manner and at the same facilities as those used for the FDE flights described for the No Action Alternative. Any noise exposure levels would comply with USAF Hearing Conservation Program requirements. As a result, no impacts to ambient noise levels are expected during pre-flight preparations or for post-launch operations.

Proposed MM III launches would generate noise levels similar to those resulting from current FDE flight tests. This would include the use of helicopters to help clear non-participants from the area. Because the launch events are infrequent, discrete activities, ambient noise levels would not be affected substantially on an annual basis. Any noise impacts would be short term and not significant.

Just as with the current FDE flight tests, sonic booms resulting from the proposed flight tests would not affect coastal land areas or the Channel Islands to the south. Thus, no impacts on ambient noise levels in these areas would result.



Source: Modified from USAF, 1997b

Figure 4-1. Predicted Maximum Noise-Level Contours for a Minuteman Missile Launch

In addition, the equipment changes associated with the deployment activities would have no adverse effect on the noise environment.

4.3.3 Biological Resources

4.3.3.1 No Action Alternative

Pre-Flight Preparations

For pre-flight preparations at Vandenberg AFB, the intermittent movement of trucks and other load-handling equipment would not produce substantial levels of noise, and vehicles would normally remain on paved or gravel areas. Thus, it is expected that no adverse impacts on local wildlife or vegetation would occur from these limited activities.

Flight Activities

Under the No Action Alternative, three to four MM III FDE flight tests would continue to occur at Vandenberg AFB every year. Potential issues associated with normal launch operations include wildlife responses to helicopter activity, wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Vandenberg AFB are described in the paragraphs that follow.

<u>Helicopter Overflights.</u> Base helicopters are flown over the ROI on the day of launch and possibly the day before to ensure launch hazard areas are clear of non-participants. Helicopter overflights have the potential to disturb marine mammals and birds, causing potential loss of eggs when birds fly from nests; separation of pinniped mothers from their offspring; and abandonment of favored resting, feeding, or breeding areas.

Under the terms of the MMPA, as amended, short-term behavioral effects on marine mammals must be considered. According to the MMPA, “harassment” means any act of “pursuit, torment, or annoyance” that has the potential to injure or disturb. MM III and other system launches at Vandenberg AFB have the potential to harass marine mammals. To address this issue, base personnel initiated a consultation with NMFS to obtain an annual letter of authorization (LOA) for these harassments, which are classified as a small number of “takes” incidental to activities (USAF, 1997b). A 5-year take permit was originally issued to Vandenberg AFB in 1997, and was later re-issued in February 2004 (69 FR 5720-5728). The incidental take permit allows the base to expose pinnipeds, including breeding harbor seals, to missile and rocket launches, and aircraft flight tests. The permit also authorizes incidental harassment of pinnipeds from helicopter overflights.

Prior observations of helicopter overflights in the launch hazard area have shown them to be a greater source of disturbance than the launches themselves (Bowles, 2000). Under the current NMFS permit and LOA, helicopters and other aircraft are required to maintain a minimum distance of 1,000 ft (305 m) from recognized seal haul-outs and rookeries (e.g., Point Sal and Lions Head) (69 FR 5720-5728). Because of Federal Endangered Species Act requirements, helicopters and other aircraft must also maintain a slant distance of not less than 1,900 ft (579 m) from California least tern and Western snowy plover nesting areas (from March 1 through September 30), and a year-round minimum 500 ft (152 m) slant distance from all identified Western snowy plover habitat areas on base (VAFB, 2002). These requirements can be modified only in emergencies, such as during search-and-rescue and fire-fighting operations. When helicopter flight restrictions are observed, there are negligible impacts on marine mammals and listed birds.

<u>Launch Noise.</u> Most of the energy in launch noise lies in the range below 1,000 Hertz (Hz), and often below 100 Hz. At low frequencies, pinniped hearing becomes progressively less sensitive (Kastak, et al.,

1999), forming the bottom of a "U" shaped curve that is typical of mammal hearing. For humans, the best measures of exposure account for this "U" shape by passing sounds through a filter called A-weighting, which removes low- and high-frequency noise before the level is calculated. The A-weighting function outperforms other functions as a filter where comparisons have been made (e.g., Sullivan and Leatherwood, 1993). It is not known whether similar weighting functions will be good measures of dosage for animals, but the technique has been tested using the harbor seal auditory threshold function and monitoring data being collected at Vandenberg AFB (SRS, 2000a). Because weighted measures for seals cannot yet be related to seal responses, it is not clear whether the method will be equally effective.

Noise levels produced by three MM III missile launches have been measured at varying distances from launch sites (Table 4-4). The closest monitoring site was 0.58 mi (0.94 km) from LF-26, which resulted in the highest unweighted noise measurement recorded during the three launches—133.6 dB. All three MM III launches occurred at night when few harbor seals were present on haul-out sites, and thus immediate behavioral responses could not be recorded. Three to four daily counts of seals were used to document occupancy on haul-out sites. After the June 7, 2002, launch, counts were comparable to those on previous days (pups were no longer present on the beach at the time) (SRS, 2002). Similar results have been found during launches of other systems. On the basis of prior monitoring studies, the NMFS has determined that rocket launch activities have a negligible impact on pinniped populations and stocks at Vandenberg AFB (67 FR 2820-2824).

Table 4-4. Summary of Minuteman III Launch Noise Measurements

Launch Date	Launch Facility	Distance from Monitoring Site to LF [mi (km)]	Unweighted Peak Sound Level (dB)	A-weighted Peak Sound Level (dBA)
November 13, 1999	LF-26	0.58 (.94)	133.6	130.5
May 24, 2000	LF-09	9.69 (15.60)	117.6	93.9
June 7, 2002	LF-26	1.96 (3.15)	121.2	117.1

Source: SRS, 2002

In terms of impacts on other wildlife species, counts before and after launches from Vandenberg AFB also have been used to document reactions of western snowy plovers, California brown pelicans, and southern sea otters. No evidence of mother-pup separation in southern sea otters, or abandonment of snowy plover nest sites, has been found during these studies. For example, monitoring studies conducted for a prior Atlas IIAS launch in 2001 showed no interruption of activities, nor any evidence of abnormal behavior or injury, for flocks of snowy plovers and brown pelicans. Therefore, a continuation of MM III launch noise is not expected to drive threatened and endangered species away from favored sites or to cause other significant behavioral disruptions. (SRS, 2000b, 2001a, 2001b)

Temporary changes in the animals' hearing threshold [temporary threshold shift (TTS)] are also possible as a result of launch noise. In a study at Vandenberg AFB, TTS was measured in three harbor seals using electrophysiological techniques after the seals were exposed to a Titan IV launch (SRS, 2000b). One hour after the launch, no TTS could be detected. Measurements were not made within a few minutes of the launch, so it is not known whether small shifts occurred initially or whether the seals would have experienced shifts at higher exposure levels. Similar results were obtained for Taurus launches from the base (69 FR 5720-5728).

As a means of assessing potential long-term effects of launch noise on pinnipeds, Vandenberg AFB will continue biological monitoring for all launches during the harbor seal pupping season (March 1 to June 30). A report detailing the results of each launch—including species, number of animals observed, behavior, reaction to launch noise, time to return to haul-out sites, and any adverse behavior—is then submitted to the NMFS. (69 FR 5720-5728)

Launch Emissions. The atmospheric deposition of launch emissions has the potential to harm nearby vegetation and acidify surface waters. The types and quantities of emissions products released from MM III launches are discussed in Section 4.3.1. The principal combustion product of concern is hydrogen chloride gas, which forms hydrochloric acid when combined with water.

As previously mentioned, areas immediately around the LFs are kept clear of vegetation in order to minimize the risk of brush and grass fires. Although localized foliar spotting from launch emissions is possible, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause long-term damage to vegetation (USAF, 2000a).

The acidification of surface waters in some of the small drainages and wetland areas, such as around Shuman Creek, could present harmful conditions for aquatic wildlife and some protected species. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing minerals. However, the close proximity of the LFs to the ocean, combined with the prevailing onshore winds, causes the deposition of acid-neutralizing sea salt. The alkalinity derived from sea salt should neutralize the acid falling on soil, thus eliminating the potential for acid runoff. Surface water monitoring conducted for larger launch systems on Vandenberg's South Base has not shown long-term acidification of surface waters (USAF, 2000a). Because the MM III represents a smaller launch system producing fewer emissions, the potential for adverse effects is minimal.

Launch Failure or Early Flight Termination. In the unlikely event of a MM III failure during launch, or an early termination of flight, the missile would most likely fall into the ocean reasonably intact, along with some scattered debris. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Of particular concern is the ammonium perchlorate. Once in the water, it can slowly leach out of the solid propellant resin binding-agent. Studies have shown that the rate of perchlorate extraction is a function of water temperature and salinity, with the highest rates observed at the highest temperature and lowest salinity (Lang, et al., 2002).

Effects of perchlorate on primary and secondary aquatic production, and on decomposition processes in sediments, wetland peat, and soil material, have recently been subject to laboratory studies. Aquatic primary production was affected only by perchlorate concentrations of 1,000 ppm, and this effect was minimal compared to control samples. Bacterial production was not adversely affected, except at very high levels in seawater samples. Since coastal waters are constantly circulating through wave action and currents, it is unlikely that phytoplankton or bacterioplankton would encounter such high levels of perchlorate for more than a few minutes. (Hines, et al., 2002)

It was also determined from these studies that respiration in marine and freshwater sediments, and wetland peat, was not adversely affected by perchlorate concentrations as high as 1,000 ppm. However, soil samples exhibited significant decreases in respiration activity in the presence of perchlorate at levels between 100 and 1,000 ppm. Therefore, it is possible that the deposition of perchlorate on coastal soils, following an aborted flight, could decrease the rate that material is decomposed in soil, which could adversely affect the recycling of nutrients and eventual plant growth. (Hines, et al., 2002)

The presence of potassium perchlorate at concentrations up to 10 ppm, and perchlorate concentrations nearing 30 ppm in laboratory aquariums containing solid propellant, had no effect on unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) mating or the birth and growth of fry. Fry mortality occurred in all treatments, but none were statistically different from controls. It is possible for the fry to experience morphological or behavioral abnormalities, but further studies would be needed. The laboratory study did demonstrate that perchlorate accumulated in both fish and the algal/bacterial community. Although no severe effects of perchlorate stress were detected, it is likely that the continued accumulation of perchlorate would lead to deleterious effects at some level. (Hines, et al., 2002).

In addition to solid propellants in the rocket motors, 13.2 gal (50 L) of liquid propellants contained in the PSRE could also be released on impact, assuming they have not been used for propulsion or vaporized during the destruct action. The toxicology of monomethylhydrazine and nitrogen tetroxide with marine life is not well known. Nitrogen tetroxide almost immediately forms nitric and nitrous acid on contact with water, and would be very quickly diluted and buffered by seawater; thus, would have little potential for harm to marine life. With regard to hydrazine fuels, these highly reactive species quickly oxidize, forming amines and amino acids, which are beneficial nutrients to simple marine organisms. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. (NASA, 2002)

A lesser hazard may also exist from small amounts of battery electrolyte carried on the MM III missile. However, the risks from electrolytes are much smaller than the risks from propellants, due to the presence of smaller quantities, lower toxicity, and the use of more rugged containment systems for batteries (NASA, 2002).

The probability for an aborted MM III launch to occur is extremely low. If an early abort were to occur, base actions would immediately be taken for the recovery and cleanup of unburned propellants, and any other hazardous materials, that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks. Any recovery from deeper coastal water would be treated on a case-by-case basis. Any liquid or solid propellant falling into the offshore waters would be subject to continual mixing and dilution due to the ocean waves and currents, and hence, local accumulation of perchlorates contained in the propellants is unlikely. As a result, no significant impacts on biological resources would be expected.

Post-Launch Operations

The intermittent movement of trucks and any repair/cleanup/waste handling equipment would not produce substantial levels of noise, and vehicles normally would remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no adverse impacts on local wildlife or vegetation.

4.3.3.2 Proposed Action

For pre-flight preparations and post-launch operations, the intermittent use of trucks and equipment would occur, just as for the No Action Alternative. Thus, no impacts on biological resources are expected.

Currently, three to four MM III FDE launches are conducted from Vandenberg AFB every year. Under the Proposed Action, the FDE flights would continue, along with two additional launches per year in FYs 2005 and 2006. USFWS regulations for threatened and endangered species do not place a limit on the number of launches, as long as significant effects do not accrue as a result of additional launches. The NMFS permit authorizes marine mammal incidental takes for Vandenberg AFB launch programs, including MM launches from the North Base LFs.

Increases in the level of helicopter activity, as a result of additional MM III launches in FY 2005 and 2006, would be modest. Because helicopter approach restrictions established by the USFWS and NMFS already serve to protect bird and marine mammal species along the Vandenberg AFB coast, no change in risk is expected as a result of the launch operations.

The proposed flight tests would be indistinguishable in acoustic properties from MM III FDE flights already occurring at Vandenberg AFB. Therefore, no increase in noise effects on coastal marine birds or marine mammals would be expected.

The types of combustion products released, and the quantities released for each launch event, would be the same as that for the No Action Alternative. Emissions would be expected to dissipate quickly, and not result in any long-term effects on surface waters.

Additionally, the equipment changes associated with the deployment activities would have no adverse effect on biological resources.

Based on the overall analysis results, it has been determined that Section 7 consultation, under the Endangered Species Act, is not required for proposed activities at Vandenberg AFB.

4.3.4 Health and Safety

4.3.4.1 No Action Alternative

Pre-Flight Preparations

In preparation for flight tests, booster inspections, system checks, and the addition of test RVs and destruct packages are all routine activities at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Sections 3.1.1 and 3.3.4, the level of risk to military personnel, contractors, and the general public should be minimal. Consequently, no significant impacts to health and safety are expected.

Flight Activities

Adherence to the policies and procedures identified in Sections 3.1.1 and 3.3.4 protects the health and safety of on-site personnel. The establishment of Launch Hazard Areas (LHAs), impact debris corridors, beach and access road closures, and the coordination and monitoring of train traffic passing through the base, in addition to the NOTMARs and NOTAMs published for mariners and pilots, serves to protect the public health and safety. A safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to Range Safety. LHAs and impact debris corridors would be updated to provide MM III-specific parameters based on vehicle and payload configurations. As a result, no significant impacts to health and safety are expected.

Post-Launch Operations

Post-launch refurbishment and blast residue removal are routine operations at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Sections 3.1.1 and 3.3.4, the level of risk to military personnel, contractors, and the general public should be minimal. Consequently, no significant impacts to health and safety are expected.

4.3.4.2 Proposed Action

Pre-flight preparations, flight tests, and post-launch operations for the proposed MM III flight tests would be conducted in the same manner as described in Section 4.3.4.1, above, for the No Action Alternative. For the same reasons, no significant impacts to health and safety are anticipated.

4.3.5 Hazardous Materials and Waste Management

4.3.5.1 No Action Alternative

Pre-Flight Preparations

The motor inspections, system checks, and addition of test RVs and destruct packages are all routine activities at Vandenberg AFB. During pre-flight preparations, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of in accordance with all Federal, state, local, DOD, and USAF regulations.

Flight Activities

Flight activities normally would not utilize any hazardous materials or generate any hazardous waste. If an early launch abort were to occur, base actions would immediately be taken to remove unburned propellant and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any of the nearby freshwater creeks. Any recovery from deeper water would be treated on a case-by-case basis. Any waste materials collected would be properly disposed of in accordance with applicable regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Post-Launch Operations

The post-launch refurbishment and blast residue removal are all routine activities at Vandenberg AFB. During this process, all hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.2. All hazardous and non-hazardous wastes would be properly disposed of, in accordance with all Federal, state, local, DOD, and USAF regulations. Consequently, no adverse impacts from the management of hazardous materials and waste are expected.

Console Equipment Maintenance

The replacement of aging or failed MM III command and control console equipment at Vandenberg AFB would not involve the direct handling of hazardous materials, but, as discussed in Section 4.1.2.1, would generate hazardous waste. However, through the local DRMO, equipment and other property containing hazardous materials or wastes are stored in facilities that ensure personnel protection, prevent accidents, and reduce the risk of environmental spills. The DRMS has in place programs for safety and training, storage and inspection, and special handling requirements that minimize risks to workers and the general public (DRMS, 2003). Hazardous material and waste handling capacities would not be exceeded, and management programs would not have to change. As a result, no adverse impacts from the management of hazardous materials and waste are anticipated.

4.3.5.2 Proposed Action

Pre-flight preparations, flight tests, and post-launch operations for the proposed MM III flight tests would be conducted in a manner similar to that identified in Section 4.3.5.1, above, for the No Action Alternative. A slight increase in hazardous waste generated from post-launch refurbishment and cleanup for the additional launches in FY 2005 and 2006 would not exceed waste handling capacities or exceed permitted levels. Thus, for the same reasons as described for the No Action Alternative, no impacts from the management of hazardous materials and waste are anticipated.

The replacement of command and control console equipment, and related software upgrades, would occur at the MM III training and launch control facilities at Vandenberg AFB. Just as described for the Minuteman Wings in Section 4.1.2.2, the old EMAD cards would be returned to storage as spares and would not go to the on-site DRMO for disposition. For deployment of the new HDAs and VDUs, removal and disposal of the old units would generate hazardous waste consisting of trace amounts of cadmium and lead solder in each HDA, and approximately 4 lb (1.8 kg) of lead, and trace amounts of cadmium and barium, in each VDU. Table 2-4 identifies the approximate numbers of each console item that would be processed at the local DRMO. The proposed disposal of old console equipment would represent approximately 1 percent of current and ongoing DRMO work at Vandenberg AFB (Ogden ALC, 2003).

Overall, there should be no adverse impacts on current hazardous materials and waste management operations on base or at the DRMO facility.

As an alternative for DRMO processing, a few of the HDAs and VDUs could be considered for placement in the USAF Museum Program. However, no adverse impacts are expected from this particular action.

4.4 OVER-OCEAN LAUNCH CORRIDOR

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action within the Pacific over-ocean launch corridor.

4.4.1 Biological Resources

Neither the current MM III FDE flight tests nor the proposed launches could have a discernible or measurable impact on benthic or planktonic organisms, because of their abundance, their wide distribution, and the protective influence of the mass of the Pacific Ocean around them. However, the potential exists for impacts to larger vertebrates in the nekton, particularly those that must come to the surface to breathe (i.e., marine mammals and sea turtles). Potential impacts on these species have been considered in this analysis and include the effects of acoustic stimuli produced by launches (sonic booms), and non-acoustic effects (splashdown of launch vehicle stages, and release of propellants or other contaminants into the water). Potential acoustic effects include behavioral disturbances, and temporary or permanent hearing impairment. Potential non-acoustic effects include physical impact by falling debris, and contact with or ingestion of debris or hazardous materials, particularly unexpended fuels. The resulting impact of a large, fast-moving object, such as the spent casing of a rocket motor, could cause either type of effect.

4.4.1.1 No Action Alternative

Launches from land have the potential to cause injury in the open ocean environment. Launch noise will decline rapidly as MM III missiles ascend to the stratosphere, becoming indistinguishable from passing commercial jet noise within 5 minutes of launch. As the missile accelerates to supersonic speeds, it will produce a sonic boom that reaches the ocean surface. When spent motor stages and other debris fall to the ocean surface, there is an extremely small probability that marine mammals or sea turtles could be struck, or injury could occur from the shock/sound wave that propagates through the water away from the site of impact. If the vehicle fails or is terminated during its flight, unburned fuel could also be deposited at sea. These issues are further discussed in the following paragraphs.

Sonic Boom Overpressures

A recent noise study of the MM III launches from Vandenberg AFB modeled the sonic boom levels generated downrange (Tooley, et al., 2004). The modeling results show that sonic boom overpressures at the ocean surface are typically near their maximum level at a distance of about 25 nautical miles (46 km) due west of the launch site. The surface footprint of the sonic boom can extend outward several miles on each side of the flight path, but it quickly dissipates with increasing distance downrange. At the ocean surface, peak overpressures were estimated to be in the 3.5 to 9.2 psf [138 to 149 dB (referenced to 20 µPa)] range in air, based on typical atmospheric wind conditions. The duration of these overpressures is less than 250 milliseconds.

The propagation of sonic booms underwater could affect the behavior and hearing sensitivity in marine mammals (primarily cetaceans), sea turtles, and other fauna. If the sounds were to be strong enough, they might cause animals to quickly react, altering (briefly) their normal behavior. Such behavioral reactions might include startle or annoyance responses, and brief changes in surfacing and/or diving activities. Studies have shown such reactions to occur in small cetaceans at underwater pressures as low as 178 dB (referenced to 1 µPa). (Richardson, et al., 1995; Schlundt, et al., 2000)

As mentioned earlier, TTS shifts are decreases in hearing sensitivity that recover over time. When measured within a few minutes of exposure, small TTS values can be used as a lower estimate of the threshold for unsafe exposures to acoustic pressures. At higher pressure levels, TTS reaches a maximum, above which permanent hearing loss may occur. In defining pressure levels that initiate TTS in marine mammals, research has shown the onset of TTS (from a single underwater pulse) to occur within a range of approximately 12 to 23 pounds per square inch (psi) peak pressure, or 218 to 224 dB (referenced to 1 µPa) (Finneran, et al., 2002; Ketten, 1995). The 12-psi peak underwater pressure level has also been used by the NMFS as a criterion for determining Level B acoustic harassment for all marine mammals[5], in accordance with the MMPA (69 FR 2333-2336; 69 FR 29693-29696).[6] (For further discussions on criteria for behavioral reactions and TTS, refer to Section 4.5.1.1 in this EA.)

Theoretical models for sonic booms generated by a large space launch vehicle (Titan IV) have shown that peak underwater pressures are likely to be on the order of 130 to 140 dB (referenced to 1 µPa), or less than 0.0015-psi peak pressure (HKC Research, 2001), well below the 178-dB and 218-dB (12-psi peak

[5] Level B acoustic harassment is defined as the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (69 FR 29693-29696).

[6] Interpreting the effects of noise on marine mammals and sea turtles depends on various parameters, including the sound exposure level and duration, the sound frequency, and the animals hearing ability. In recent years, biological literature on marine mammals and acoustic effects has tended to use (1) peak pressure levels expressed in either psi, or dB referenced to 1 µPa; (2) the average or root-mean-square level over the duration of the sound, also expressed in dB referenced to 1 µPa; and/or (3) the sound energy flux density, which is the average rate of flow of sound energy over an appropriate time, such as the duration of the first positive pressure, expressed in dB referenced to 1 micro Pascal-squared·seconds ($\mu Pa^2 s$). Because the expected underwater noise levels from sonic booms represent single pulses that are relatively low in acoustic strength, and very short in duration (less than 250 milliseconds), peak pressure levels were used for analysis purposes.

pressure) lower limits for inducing behavioral reactions and TTS (respectively) in marine mammals.[7] Because sonic boom underwater pressures caused by the smaller MM III vehicle are expected to be less than those of larger space launch vehicles, the sonic booms should not result in any long-term adverse effects to marine mammals. This is particularly evident when considering the following:

- Sonic booms generated by MM III launch vehicles are very short in duration (lasting less than 250 milliseconds).
- MM III flight tests occur only 3 or 4 times per year.
- The probability for marine mammals to be within the sonic boom footprint out in the open ocean is reasonably low.

As for sea turtles, no specific behavioral reaction or TTS data has been identified, and the potential for effects on their hearing is still unknown. However, turtles are less sensitive with respect to hearing than birds and mammals as a group. If peak overpressure levels are considered safe for marine mammals, then they should not pose a risk to sea turtles. (USN, 2001b; Wever, 1978)

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

At the velocity of their normal descent, the spent rocket motors would each hit the ocean surface at speeds ranging from 195 to 230 ft (59 to 70 m) per second (Tooley, et al., 2004). Weighing between 1,105 and 4,902 lb (501 and 2,224 kg) each, the three expended MM III motors would have considerable kinetic force. Upon impact, this transfer of energy to the ocean water would cause a shock wave (low-frequency acoustic pulse) similar to that produced by explosives. Recent modeling studies for MM III flight tests have shown that underwater noise pulse levels would be on the order of 0.4 to 0.8 psi at a range of 164 ft (50 m) from the motor's impact point (Tooley, et al., 2004). In the water, this would feel like a "sharp push." At such distances, the resulting shock wave is not expected to cause any injuries to marine mammals and sea turtles. However, for distances that are much closer to the impact point, the shock wave might injure internal organs and tissues, or prove fatal to the animals. These findings are consistent with other studies that agree fairly closely on an approximate 240-dB (referenced to 1 μPa and equal to 145 psi) baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would occur only within several feet of the rocket motor impact points. With increasing distance from the impact point, pressure levels would decrease, as would the risk for injury to animals.

If any portion of the MM III launch vehicle were to strike a protected marine mammal or sea turtle near the water surface, the animal would most likely be killed. However, risks of injury to any marine mammal or sea turtle by direct impact or shock wave would be extremely small. Analyses conducted at the Point Mugu Sea Range off the coast of Southern California (USN, 2002) have determined that there is a very low probability for marine mammals to be killed by falling boosters, targets, or other missile debris, or from the resulting shock wave of a missile impacting the water. These studies show the cumulative number of animals expected to be injured or killed ranged from 0.0006 for US territorial waters to 0.0016 for non-territorial waters, for all related missile operations conducted over 1 year. The probability calculations were based on the densities of marine mammals in the ocean areas where activities are conducted, the number of activities, and the area of influence of the activity (NAWCWPNS

[7] In determining when the onset of behavioral reactions and TTS might occur in marine mammals, acoustical pulse criteria were based largely on studies with small odontocetes (toothed whales). Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] are not available, the analysis conducted in this EA assumed that the behavioral reaction and TTS data collected for small odontocetes are applicable to other whale species.

Point Mugu, 1998). The numbers are low enough that the probability for animal injuries from falling debris can be considered negligible.

Another potentially adverse effect of the underwater shock waves caused by the spent rocket motors is that the acoustical pulse generated may induce behavioral reactions or TTS in protected marine mammals, and possibly in threatened and endangered sea turtles as well. As mentioned earlier, studies have shown that behavioral reactions in marine mammals can occur at pressure levels as low as 178 dB (referenced to 1 µPa), while the onset of TTS can occur within the range of 218 to 224 dB (referenced to 1 µPa), or 12- to 23-psi peak pressure.[8, 9] Underwater pressure levels capable of inducing behavioral reactions in marine mammals are not expected to occur much beyond a few hundred yards from the motor impact points, particularly for the heavier 1st-stage motor. Pressure levels for inducing TTS, however, would only occur within a few yards of the motor impact points. In the open ocean, the probability of impacting protected marine mammals and sea turtles is insignificant, based on statistical analyses. The MM III flight tests would occur only 3 to 4 times per year, and motor impacts from each flight would likely not occur at the exact same locations. As a result, the noise pulses generated from the impacts of spent rocket motors are not expected to cause any long-term adverse effects on marine mammals or sea turtles in the open ocean.

Contamination of Seawater

When the spent rocket motors impact in the ocean, no solid propellant would be remaining in them. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns. Though the batteries carried onboard the rocket motors would be spent (discharged) by the time they impact in the ocean, they would still contain small quantities of electrolyte material. These materials, along with residual amounts of hydraulic fluid and strontium perchlorate contained in the 1st- and 3rd-stage motors (respectively), may mix with the seawater, causing contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.

The National Aeronautics and Space Administration (NASA) previously conducted a thorough evaluation of the effects of rocket systems that are deposited in seawater. It concluded that the release of hazardous materials, carried onboard launch vehicles, would not be significant. Materials would be rapidly diluted in the seawater and, except for the immediate vicinity of the debris, would not be found at concentrations identified as producing adverse effects (PMRF, 1998). Ocean depths in the ROI reach thousands of feet and, consequently, any impacts from hazardous materials are expected to be minimal. The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to rocket debris deposited on the ocean floor. Consequently, no significant impacts to biological resources are expected from the contamination of seawater.

Failed or Terminated Launch

In the unlikely event of a missile system failure during launch, or an early termination of flight, the missile would fall to the ocean intact or as debris scattered over a large area. It is expected that the falling

[8] For similar reasons explained in footnote 6, peak pressure levels were used in the analysis of underwater shock/sound waves generated by spent rocket motors impacting in the open ocean.

[9] See footnote 7.

missile and its debris would not have a significant impact on biological resources because of the large expanse of the ocean area and the very low probability of striking a marine mammal or sea turtle.

Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure and terminating propellant combustion. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate, which can slowly leach out of the solid propellant resin binding-agent once the propellant enters the water. However, as previously described in Section 4.3.3.1, it is unlikely that perchlorate concentrations would accumulate to a level of concern. The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any pieces of propellant expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.

The liquid propellants (monomethylhydrazine and nitrogen tetroxide) contained in the PSRE could also be released in the ocean waters on impact, assuming they have not been used for propulsion or vaporized during the destruct action. Wave actions and ocean currents would quickly mix and dilute the liquid propellants, in addition to them being buffered or oxidized in the seawater, thus eliminating potentially toxic concentrations (see Section 4.3.3.1). Should the sealed propellant assemblies within the PSRE survive ocean impact intact, they would sink to great depths and settle on the ocean floor. There, they could potentially leak propellants into the water over time. As with the solid propellants, the liquid propellants would be beyond the reach of most marine life. Though it is possible for deep ocean, benthic species to be adversely affected by any remaining contaminants, such impacts would be very localized, occurring within a short distance to launch vehicle debris deposited on the ocean floor.

In summary, missile flight test flights would have no discernible effect on the ocean's overall physical and chemical properties, and thus should have no impacts on the overall marine biology of the ROI. Missile flight tests would result in minimal risk of hitting or otherwise harassing marine mammals or sea turtles. Moreover, such tests would have no discernible effect on the biological diversity of either the pelagic or benthic marine environment. Consequently, no significant impacts to biological resources in the ROI would be anticipated.

4.4.1.2 Proposed Action

Though the MM III launch rate would increase in FYs 2005 and 2006, launches would still occur at an average rate of one launch every 2.4 months. Therefore, the potential for damage in the over-ocean launch corridor from proposed launch activities would not be much different than that of the No Action Alternative.

Launch Noise and Sonic Boom Overpressures

The proposed MM III launches would not produce sonic boom peak overpressures that are any greater than those generated by current MM III FDE launches. Therefore, no change in the risk of injury in the over-ocean launch corridor is expected.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

When compared to the MM III FDE launches under the No Action Alternative, the additional launches proposed would only slightly increase the risk of injury to marine mammals over the FYs 2005 and 2006 timeframe. Splashdown locations would still be confined to deep ocean waters, as is the case for current FDE launches.

Contamination of Seawater

Initially, the proposed launches would marginally increase the risk of seawater contamination and risks to the marine environment for a 2-year period. However, as with the No Action Alternative, the area affected by the slow dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life.

Launch Failure or Termination

Under the Proposed Action, the risk of launch termination would not be significantly greater than that for current MM III FDE launches. Effects of a launch failure, should one occur, would also be the same as for an FDE launch.

In summary, the effects of the additional MM III flight tests on protected marine mammals, sea turtles, and other marine life would not be much different than those already described for the No Action Alternative in Section 4.4.1.1. Thus, no significant impacts to biological resources in the ROI would be anticipated.

4.5 US ARMY KWAJALEIN ATOLL

The following sections describe the potential environmental consequences of the No Action Alternative and the implementation of the Proposed Action at USAKA in the RMI. This analysis of the proposed RV tests at USAKA expands on an earlier analysis contained in the *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands* (USAF, 1992a), which is summarized in Appendix A.

4.5.1 Biological Resources

4.5.1.1 No Action Alternative

Currently, MM III RVs impact in the deep ocean waters east of Kwajalein Atoll or in the vicinity of Illeginni Island, as indicated on Figure 2-12. A sonic boom and the acoustic component of the splashdown shock wave have the potential to cause impacts both above and below the water in the immediate vicinity of the impact site. The force of an RV impacting directly on Illeginni or in the shallow reefs nearby can produce a crater, and harm nearby wildlife and marine resources. The release of Be, DU, and other contaminants from some RV tests is also considered.

Sonic Boom Overpressures

As each descending test RV approaches Kwajalein Atoll at hypersonic velocity, sonic booms are initially generated over a very broad area of the open ocean northeast of the Atoll and continue in a southwesterly direction towards the point of impact, where the sonic boom footprint narrows to just a few miles on either side of the flight path. At the ocean surface, the sound pressure levels for the sonic booms would vary from 91 dB (referenced to 20 µPa) at the eastern-most range and increase to 150 dB (referenced to 20 µPa) at the western-most range, close to the point of impact (Moody, 2004b). For those RVs that impact east of the Kwajalein reef, the sonic boom footprint would occur almost entirely over open ocean. For those RVs targeted in the vicinity of Illeginni Island, the sonic boom footprint would overlap most of the Mid-Atoll Corridor, including several islands of the Atoll. The duration for sonic boom overpressures produced by the RVs ranges from 40 milliseconds where the boom is strongest to 124 milliseconds where it is weakest (Moody, 2004b).

Migratory seabirds and shorebirds forage, roost, and nest on some of the barrier islands of Kwajalein Atoll. At Illeginni Island, the migratory bird population appears to be stabilized, if not increasing. As has been reported at other sites (Awbrey, et al., 1991; Schreiber and Schreiber, 1980), birds exposed to repeated sonic booms can become habituated. Birds in the general area may exhibit brief flight responses, but they are not expected to abandon nests.

In terms of underwater impacts, the sonic booms would generate peak underwater pressures ranging from 117 dB (referenced to 1 µPa) at the eastern end of the sonic boom footprint to 176 dB (referenced to 1 µPa) at the western end of the footprint, near the point of impact (Moody, 2004b).[10] Though the sonic booms generated by the RVs are expected to be audible or perceived by marine mammals in the affected area, later discussions will show that no long-term adverse effects are anticipated.

Exposure to intense sound can cause behavioral reactions in marine mammals and sea turtles, which may include cessation of resting, feeding, or social interactions; changes in surfacing, respiration, or diving cycles; and avoidance reactions, such as vacating an area. Higher sound level exposures for these animals may increase the hearing threshold to a new level where, as at the new post-exposure threshold, any sound must be stronger than before in order to be heard. If this hearing threshold shift returns to the pre-exposure level after a period of time, the threshold shift is referred to as a TTS resulting from a recoverable loss of hearing function. TTS can be characterized by a short-term impairment in the ability for marine mammals and other fauna to communicate, navigate, forage, and detect predators. If the threshold shift does not return to the pre-exposure level, it is a permanent threshold shift (PTS) caused by a permanent loss of hearing function. (68 FR 17909-17920; Kastak, et al., 1999; Richardson, et al., 1995)

Single or occasional occurrences of mild TTS do not cause permanent auditory damage in terrestrial mammals, or in marine mammals. However, very prolonged exposure to sound strong enough to cause a TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals. The magnitude of TTS depends on the sound pressure level and duration of noise exposure, among other factors. For single, short duration sound impulses, higher pressures may be tolerated before the onset of a TTS occurs, when compared to longer duration pulses or repeated sound exposures at lower pressures. (68 FR 17909-17920; Finneran, 2004; Finneran, et al., 2002; Kastak, et al., 1999; Nachtigall, et al., 2003; and Schlundt, et al., 2000)

In determining behavioral reactions in marine mammals, prior studies of humpback whales (*Megaptera novaeangliae*) have generally showed no strong reactions to acoustic pulses of approximately 150 dB (referenced to 1 µPa) resulting from large explosions 1.15 mi (1.85 km) away. It is uncertain, however, whether the whales had become habituated to the blasting activities before observations began. In another study, captive false killer whales (*Pseudorca crassidens*) showed no obvious reaction to small explosions producing single noise pulses of approximately 185 dB (referenced to 1 µPa). When exposed to intense 1-second tones in a netted enclosure, bottlenose dolphins (*Tursiops truncatus*) began to exhibit altered behavior at levels of 178 to 193 dB, while white whales (*Delphinapterus leucas*) displayed altered behavior at 180 to 196 dB. The behavioral reactions, in this case, were defined as deviations from the animals' trained behaviors, which included startle or annoyance responses. (Richardson, et al., 1995; Schlundt, et al., 2000)

The noise level associated with the onset of TTS is often considered to be the level below which there is no danger of injury to animals (68 FR 17909-17920). Though only a few data on sound levels and

[10] See footnote 6.

durations necessary to elicit mild TTS have been obtained for marine mammals (68 FR 17909-17920), a review of literature from earlier studies has shown 210 to 220 dB (referenced to 1 µPa and equal to 5 to 15 psi, respectively) as the lower limit for inducing mild TTS in marine mammals (Ketten, 1998). Consistent with these pressure levels, the NMFS, in defining Level B acoustic harassment criteria for all marine mammals, has used 218 dB (referenced to 1 µPa and equal to 12 psi peak underwater pressure) [cited by Ketten (1995)] as associated with a safe outer limit for minimal, recoverable auditory trauma (i.e., TTS) (69 FR 2333-2336; 69 FR 29693-29696).

More recently, extensive threshold studies conducted on the white whale have shown no substantial TTS when exposed to multiple, short duration acoustic pulses at 221 dB (referenced to 1 µPa) peak pressure. At 224 dB (referenced to 1 µPa and equal to 23 psi), however, TTS did occur, resulting in a 6- to 7-dB temporary reduction in hearing ability. Similar studies of the bottlenose dolphin have shown no TTS at peak pressure levels up to 226 dB (referenced to 1 µPa and equal to 30 psi) (Finneran, et al., 2002). Both bottlenose dolphins and white whales have been used for such studies because they have hearing ranges and sensitivities equivalent to or better than many marine mammals. Thus, these two animals may be representative of other species with broad auditory bandwidth and high sensitivity (Finneran, et al., 2000).[11]

As for permanent hearing loss, no published data for the occurrence of PTS in marine mammals is currently available. Experiments conducted with small cetacean species—where low-level threshold shifts (less than 10 dB) occurred—did not result in PTS. Though PTS has been observed in terrestrial animals, the level of single-sound exposures must be far above the TTS threshold for any risk of permanent hearing damage. For example, studies of terrestrial animals exposed to single noise impulses have shown that threshold shifts of up to 40 dB may be fully recoverable (i.e., with no PTS). (68 FR 17909-17920; Finneran, et al., 2000, 2002; Richardson, et al., 1995; Schlundt, et al., 2000)

Based on the above information, an acoustical pulse of 178 dB (referenced to 1 µPa) was used to represent the lower limit for inducing behavioral reactions in marine mammals (cetaceans and dugongs), while 218 to 224 dB (referenced to 1 µPa and equal to 12 to 23 psi peak underwater pressure, respectively) was used in this analysis for determining when the onset of TTS might occur.[12] As a result, the peak underwater pressures produced by RV sonic booms [117 to 176 dB (referenced to 1 µPa)] would fall just below the lower limit for inducing behavioral reactions (178 dB), and well below the lower limit for TTS (218 dB). Thus, no PTS or other long-term adverse impacts on protected marine mammals are expected. As discussed earlier in Section 4.4.1.1, threatened and endangered sea turtles also should not be adversely affected at these pressure levels. These findings are more evident when considering the following RV test characteristics:

- Sonic booms generated by RVs are very short in duration, lasting only a fraction of a second
- RV flight tests occur only 3 or 4 times per year
- RV flight paths and targeting areas are not always the same.

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[11] As an example of how longer duration, steady-state sound exposures can affect TTS levels in marine mammals, bottlenose dolphins exposed to 179 dB (referenced to 1 µPa) for up to 54 minutes experienced TTS levels averaging 11 dB (Nachtigall, et al., 2003). Because the underwater shock/sound waves generated by sonic booms or falling missile components are single, short duration pulses (measured in milliseconds), sound pressure levels necessary to induce TTS in marine mammals are expected to be much higher.

[12] It is important to note that the acoustical pulse criteria used for determining the onset of behavioral reactions and TTS are based largely on studies with small odontocetes (toothed whales). Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] and some other marine mammal groups [e.g., sirenians (including dugongs)] are not available, the analysis conducted in this EA assumed that the behavioral reaction and TTS data collected for small odontocetes are applicable to other whale species and dugongs occurring at USAKA.

Chemical Release

Following an airburst or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind. However, the DU and Be particles or fragments deposited by some RVs are very insoluble. The rates of dilution for DU and Be are significantly greater than their rates of dissolution in water, which ensures that the concentrations would not exceed background levels. Fine particles would eventually be distributed in the sediment and be of no consequence to marine species, while any larger fragments would be recovered from the lagoon or from shallow ocean waters for proper disposal (see Section 4.5.4). (USAF, 1992a)

The batteries carried onboard an RV would be spent (discharged) by the time the vehicle impacts land or water at USAKA and, thus, would also be of little concern. For the batteries carried on each test RV, the quantity of electrolyte material would amount to no more than 2.13 ounces (64 milliliters) of potassium hydroxide. Some test RVs would also contain about 0.2 lb (0.09 kg) of lithium compounds in other batteries. Considering the small quantities of hazardous materials contained in the batteries, and the dilution and mixing of the ocean and lagoon waters, the battery materials released during an airburst or at impact should be of little consequence to marine life in the area. Any battery fragments found in the lagoon or in other shallow waters, during recovery and cleanup operations, would be removed.

Though no cleanup or recovery operations would be conducted for an ocean impact in deeper water [depths greater than 50 to 100 ft (15 to 30 m)], the small amounts of hazardous materials released would result in little or no adverse impacts to marine life. This is particularly true when considering the wide dispersal of materials following impact, the rapid dilution of battery electrolytes in the ocean water, and the low solubility of the Be and DU materials.

Potential ecological effects on Illeginni Island can be assessed on the basis of deposition and concentration patterns observed from prior RV tests on land. Debris and ejecta occur close to the point of impact, mostly within a 328-ft (100-m) radius. It is expected that very little of the RV battery materials would survive impact. For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind. An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF, 1992a). For comparison purposes, this concentration falls in the low end of the range of naturally occurring Be found in soils in the United States, which ranges from 0.1 to 40 ppm (ANL/DOE, 2002). The Be remains bound to the soil within the environmental pH range of 4 to 8 and does not dissolve in water, thus preventing release to ground water (USEPA, 1998). Furthermore, Be is not likely to be found in natural water (within normal pH ranges) in greater than trace amounts, because of the extreme insolubility of the material (NAS-NRC, 1977).

For the DU particles deposited on the ground, studies have shown that low levels of soluble U will travel very slowly through soil and are subject to adsorption as they pass through the soil (DOD, undated; Stegnar and Benedik, 2001). The transport of U with rainwater runoff is limited because of its low solubility and high density (DOD, undated). Even under extreme hydraulic conditions within a laboratory, the probability for significant surface water transport of DU from soil appears to be low (WRRC, 1995). Possible DU contamination of ground water from vertical migration has also been shown to be highly unlikely (DOD, undated).

The concentrations of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 ppm soluble Be (USAF, 1992a). Plants also do not readily absorb U from soil (Stegnar and Benedik, 2001). In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Be and DU must be in the dissolved form to be absorbed by plants and animals. Since the Be and DU concentrations in the dissolved form would be below background levels, no significant impacts on plants and animals are expected. Though there is the potential for migratory birds on the island to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Airburst tests would be performed entirely over water. The MM III flight test RVs would be targeted farther away from Illeginni Island in order to minimize the drift of debris and fine particulates from the airbursts toward Illeginni, and to ensure that their impacts on plants and animals in the vicinity of the island would be insignificant.

Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Island, and along the shorelines and shallow marine environments of the lagoon and ocean side of the island. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

An RV impacting in the ocean or USAKA lagoon would result in underwater shock/sound waves comparable to the splashdown of the MM III rocket motors described earlier in Section 4.4.1.1, but with much greater force because of the vehicle’s hypersonic velocity at the time of impact. Whether or not the test RV contains a high explosives package makes little difference in the formation of shock/sound waves. The resulting underwater waveform in either case would last only about 10 to 30 milliseconds. (Moody, 2004a; Tooley, et al., 2004)

As described earlier, behavioral reactions in marine mammals can begin to occur at pressure levels as low as 178 dB (referenced to 1 µPa), while the onset of TTS has been determined to occur at peak pressure levels of about 218 to 224 dB (referenced to 1 µPa and equal to 12 to 23 psi, respectively), depending on the species and only for occasional, short-term exposures.[13] Based on the underwater acoustic impulse produced by an RV impact, minimum pressure levels for inducing behavioral reactions in some marine mammals could occur within a few thousand yards of the impact point. As the distance to the impact point decreases, resulting pressure levels would increase and, thus, increase the potential for altered behavior to occur. For any marine mammals in this area, reactions might include abrupt movements, changes in surfacing, and sudden dives. These behavioral reactions, if they occur, would last for a very

[13] See footnote 12.

brief period and not result in any long-term affects. For reasons described in Section 4.4.1.1, it is expected that sea turtles would be less affected in terms of behavioral reactions.

In regards to potential TTS, distances from RV impacts for when the onset of TTS might occur in marine mammals are presented in Table 4-5. As the table shows, this distance ranges from 62 to 128 ft (19 to 39 m), depending on which sound pressure level is used. For this analysis, it is presumed that sea turtles would also fall within this range for TTS occurrence.

Table 4-5. Reentry Vehicle Impact Distances for the Onset of Temporary Threshold Shift (TTS) in Marine Mammals

Sound Pressure Level (dB ref to 1 μPa)	Equivalent Underwater Peak Pressure (psi)	Radial Distance from the Point of RV Impact [1] [ft (m)]	Reference for Pressure Level
218	12	128 (39)	69 FR 2333-2336 69 FR 29693-29696 Ketten (1995)
224	23	62 (19)	Finneran, et al. (2002)

Notes:
[1] Radial distances were calculated in accordance with methods described in Moody (2004a).

At distances less than 62 ft (19 m) from the RV impact point, it can be expected that marine mammals and sea turtles might suffer PTS and/or other injuries. An underwater pressure level of approximately 240 dB (referenced to 1 μPa and equal to 145 psi) is considered the baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would only occur within several feet of the RV impact point. With increasing distance from the RV impact point, pressure levels would decrease, as would the risk for injury to animals. The ranges of impact distances for the onset of TTS, and for determining physical injury/death, are illustrated in Figure 4-2. Because the 218-dB (referenced to 1 μPa) level represents the lowest pressure level for when TTS might occur, it can be considered the outermost limit for potential harm to marine mammals, as well as for sea turtles.

Because the USAKA survey data described in Section 3.5.1 is qualitative in nature, probabilities for determining potential underwater shock/sound wave impacts on protected marine mammals were based on surrogate data from the sea range at PMRF, Hawaii, which has higher species densities than the Illeginni Island vicinity. Using the sound pressure levels identified earlier in Table 4-5, probabilities for the number of groups (pods or schools) of marine mammals that could potentially be impacted by a single RV are presented in Table 4-6 for the onset of TTS, and for physical injury/death. As the results show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the resulting probabilities for impacts on them would be even less.

Because of the higher-pressure levels generated underwater by RV impacts, energy flux density values were also calculated and are presented in Table 4-6 for comparison purposes. By including both pressure and duration, energy flux density determines the cumulative energy over time from a noise source for its entire duration. Thus, longer sound durations generally result in higher total energy levels than similar

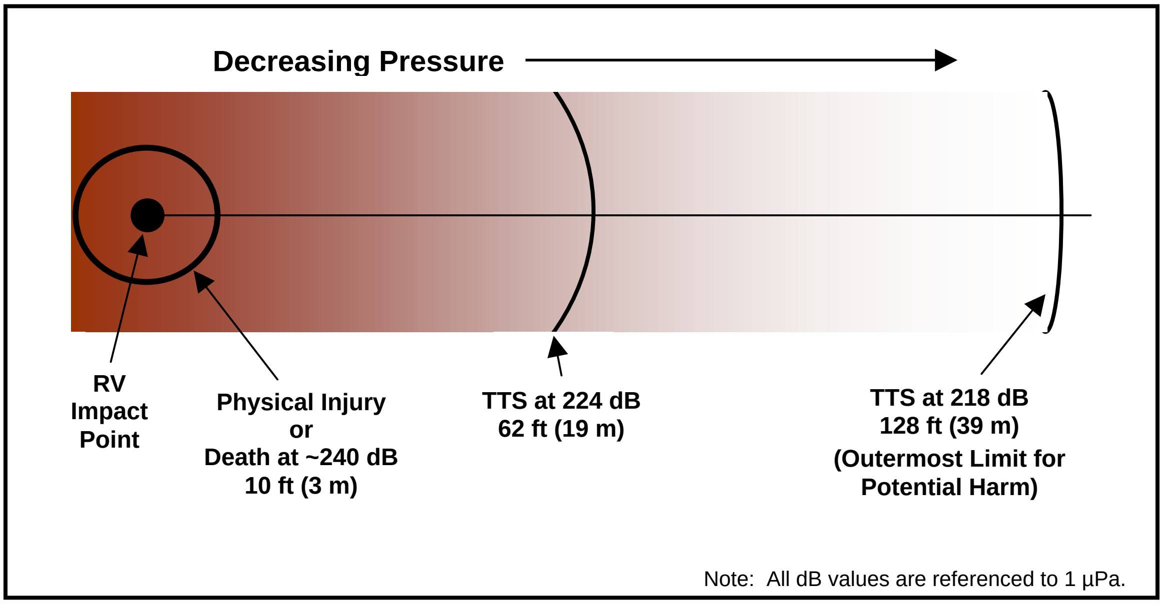


Figure 4-2. Illustration of Predicted Ranges for Underwater Shock/Sound Wave Impacts on Marine Mammals

Table 4-6. Number of Groups[1] of Marine Mammals that May Experience Temporary Threshold Shift (TTS), or Suffer Physical Injury or Death, from a Reentry Vehicle Impact

Sound Pressure Level (SPL) (dB ref to 1 µPa)	Sound Energy Flux Density[2] (dB ref to 1 $\mu Pa^2 s$)	Radial Distance from the Point of RV Disintegration [ft (m)]	Potential Effect	Number of Groups of Marine Mammals Exposed[3]
218	203	128 (39)	TTS [original limit by Ketten (1995)]	3.01E-06
224	209	62 (19)	TTS [new limit by Finneran, et al. (2002)]	4.52E-07
240	225	10 (3)	Physical Injury or Death	2.19E-07

Notes:

[1] Marine mammals occur in groups (pods or schools), and aerial and shipboard sightings of marine mammals are reported in units of groups rather than of individuals. Hence, group density rather than the density of individuals is the appropriate basis for estimating the risk of RV impacts to marine mammals. For analysis purposes, a single group is assumed to contain 10 to 12 animals.

[2] Sound energy flux density values were calculated in accordance to USN (2001b) and are described as: SPL + [10 x log(time in seconds)]. A conservative value of 30 milliseconds was used for the positive phase exposure duration.

[3] Estimations of TTS, physical injury, and death impacts are fully described in Ramanujam (2004), which can be found in Appendix B of this Final EA. Probabilities are based on marine mammal population densities for the PMRF sea range provided in Tytula (1998).

sound pressure levels of shorter duration. In the case of an RV impact, the resulting underwater shock/sound wave represents a single pulse of very short duration, having a maximum waveform rise time of about 30 milliseconds (Moody, 2004a).

When considering that (1) only three to four MM III launches are conducted every year, (2) RV target locations are not always the same, and (3) the probability for marine mammals and sea turtles to be impacted by underwater shock/sound waves is extremely low, the risk of animals being injured or killed is minimal. The fact that no dead or injured whales or other marine mammals have been reported to USAKA officials over the years of RV testing is evidence of this. To help ensure that marine mammals are not impacted by future RV tests, LLNL personnel will monitor the vicinity of Illeginni Island for marine mammals during helicopter flights to and from the island in the days and weeks leading up to each RV flight test. These results will then be reported to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch.

As previously mentioned, airburst tests are performed at some altitude over water. The impact of the resulting RV fragments in the ocean or lagoon waters would present a much lower risk to marine life than an RV whole-body impact in the water. Additionally, the test RVs would be targeted farther away from Illeginni Island in order to minimize the drift of debris and fine particulates from the airbursts toward Illeginni, and to ensure that their impacts on plants and animals in the vicinity of the island would be insignificant.

In the event that an RV would directly impact on Illeginni Island or in the shallow coral reefs, a crater would form. Prior RV tests have resulted in craters on land averaging 20 to 25 ft (6.1 to 7.6 m) across and 15 ft (4.6 m) deep, depending on the type of substrate. Whether or not the test RV contains a high explosives package makes little difference in crater formation. Post-test operations on Illeginni require the manual cleanup and removal of any RV debris, including hazardous materials, followed by backfilling in larger craters on the island with soil (ejected around the rim of the crater) using a backhoe or grader. For impact craters along the shoreline, wave action will rapidly fill them in. (USAF, 1992a)

On Illeginni Island, RV impacts occur most often in cleared or maintained areas in the middle portion of the island, thus reducing the potential for migratory bird nesting areas to be adversely affected. Should an RV impact either an area occupied by migratory seabirds and shorebirds, any of the patches of littoral forest, or on sea turtle nesting habitat along the shoreline, birds and any other wildlife close to the point of impact could be killed, bird nests or sea turtle nests might be destroyed, and small areas of nesting habitat lost. Though other birds on the island would be startled and may flee the vicinity of the impact site, reactions are expected to be temporary, and nearby nests are not likely to be abandoned. Such impacts do not appear to be having any long-term effects on the migratory bird populations on the island. As mentioned before, bird populations on the island are thriving and may be increasing in numbers. The effects on sea turtle nesting sites is more difficult to predict, considering that few nest pits have been identified during surveys over the last several years (USFWS/NMFS, 2002).

Post-test cleanup and repair operations would also cause some additional, but short-term, disturbance in the area. Should an RV or RV debris impact within a littoral forest area or in other valuable habitats on Illeginni Island, the cleanup and backfilling of the crater would be accomplished utilizing protocols or best management practices developed by the USAKA, in consultation with appropriate agencies, to avoid and/or minimize additional impacts to such resources during the cleanup activities. For example, there would be no unnecessary disturbance of bird nesting sites, and in such areas, the least possible amount of vegetation and habitat would be disrupted.

If an RV impacts in the shallow reef flats near Illeginni, the resulting crater and post-test operations can damage the coral substrate and potentially harm reef fish and various marine invertebrates protected under the UES. In addition to the crater of up to 10 to 15 ft (3.0 to 4.6 m) in diameter, observations made by LLNL personnel at Illeginni have identified damage to the coral base up to 5 ft (1.5 m) beyond the rim of the crater in certain rare instances (Lindman, 2004). Any marine life in the immediate area would be killed or injured by the force of impact and blast-like effects. This would include the loss of both protected and non-protected species of coral, and any protected mollusks (e.g., top-snail shell and giant clam species) and sponges that might have existed at or adjacent to the crater site. However, after years of RV testing in the vicinity of Illeginni Island, most areas of the local reef appear to be thriving with moderate to high coral cover, and abundant numbers of invertebrates and fish present (USFWS/NMFS, 2002).

For RV impacts on the reef that result in craters being formed, USAKA, in consultation with USFWS and NMFS, would develop protocols to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef. Post-test recovery and cleanup operations in shallow waters could require the movement of a backhoe or other equipment out onto the reef flats to the impact site. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. For deeper waters in the ocean or lagoon, a ship with divers is used. Because craters form only in shallow waters less than 15 ft (4.6 m) deep, and no other damage to coral formations has been observed below 20 ft (6.1 m) (Lindman, 2004), RV impacts and post-test recovery operations in the deeper waters of the atoll lagoon and on the ocean side are much less damaging. In all cases, recovery and cleanup operations would be conducted in a manner to minimize any further impacts.

Though such impacts could potentially result in the loss of small areas of island and reef habitats, and some individuals of a protected species—an irreversible or irretrievable commitment of resources—the frequency of such occurrences would be very low (estimated to be four to five instances over a 20-year period), and the effects are considered to be temporary. Wildlife populations and habitat conditions would be expected to recover. A maximum of four MM III flights per year are targeted in the vicinity of Illeginni Island, and few test RVs ever impact directly on land or on the coral reef. In addition, targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated a habitat for species of concern, under the UES, would not be targeted. Considering the targeting accuracy and low frequency of such events, combined with implementation of those mitigation measures identified, no significant impacts to biological resources are anticipated.

In their biological opinion regarding effects on nesting habitat for green sea turtles (see Appendix D), the USFWS determined that the Proposed Action (along with reasonable and prudent measures, and conservation measures) is not likely to jeopardize the continued existence of the species. No critical habitat has been designated for this species; therefore, none will be affected. To compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni, the USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island. Eniwetak was selected on the basis of (1) the presence of active turtle nesting sites, and (2) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. For the protection of turtle nesting habitat, specific measures to be implemented at Eniwetak and Illeginni Islands, by USAKA and the USAF, are provided in the biological opinion. In their Incidental Take statement included in the biological opinion, the USFWS anticipates a loss of no more than three green sea turtle nests, or injury or loss of up to 300 hatchlings, per year as a result of project-related RV impacts at Illeginni Island. Though such losses are not likely to occur, it is expected that they would be offset by the implementation of conservation measures for turtle nesting habitat at Eniwetak.

While not planned or expected to occur, there is the slight possibility for RV impacts to occur on other uninhabited islands near Illeginni. Should such impacts ever occur, they would be similar in nature to those in the vicinity of Illeginni. In such cases, the same post-test cleanup and mitigation actions used at Illeginni would be applied.

As part of the DEP process described earlier in Section 1.7, the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, USEPA (Region IX), and the RMIEPA, to clarify current mitigation measures and determine whether any additional mitigation measures are warranted.

4.5.1.2 Proposed Action

Sonic Boom Overpressures

The additional flight tests would be indistinguishable in acoustic properties from the RV flight tests already being conducted at USAKA. Consequently, the potential for impacts from sonic booms would be essentially identical to that described earlier for the No Action Alternative. Thus, no significant impacts to biological resources are anticipated.

Chemical Release

The potential impacts from the release of Be, DU, and other contaminants from the RV test components would be essentially the same as those identified for the No Action Alternative. As a result, no significant impacts to biological resources are expected.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

The proposed RV and post-boost vehicle splashdowns, and RV land impacts, would have essentially the same impacts as those described earlier for the No Action Alternative. As previously described in Section 4.5.1.1, the probability of marine mammals or sea turtles to be harmed by the resulting underwater shock/sound wave of an RV impact is minimal. Additionally, the loss of any protected species or habitat at Illeginni Island would be minimal and a temporary occurrence. Consequently, no significant impacts to biological resources are anticipated.

Under the Proposed Action, those mitigation measures identified in Section 4.5.1.1 for the No Action Alternative would be implemented. Additionally, consultations with the USFWS, NMFS, USEPA, and RMIEPA would continue as part of the DEP process.

4.5.2 Cultural Resources

4.5.2.1 No Action Alternative

Given the amount of fill and the extremely limited potential for any remaining traditional/prehistoric remains on Illeginni Island, the likelihood of impacts to any resources must be considered either non-existent or extremely low. In addition, there is little potential for Cold War-era buildings on Illeginni to be impacted by RV tests. Though not on the RMI List of Cultural and Historic Properties, the buildings have been well documented with photographic and written historical records as a pre-mitigation action (USASSDC/TBE, 1996), should any of them ever be altered or damaged as a result of RV tests or any other activities. As a result, little or no impact to cultural resources at Illeginni Island is expected.

4.5.2.2 Proposed Action

The proposed RV flight tests would not increase the level of impact on cultural resources at Illeginni Island. Just as with the No Action Alternative, little or no impact is expected.

4.5.3 Health and Safety

4.5.3.1 No Action Alternative

RVs launched from Vandenberg AFB would impact in the Mid-Atoll Corridor, either in the vicinity of Illeginni Island (an uninhabited island), or in the deep ocean waters east of USAKA. For these tests, safety procedures are in place and are practiced at USAKA with successful results.

Debris Hazards

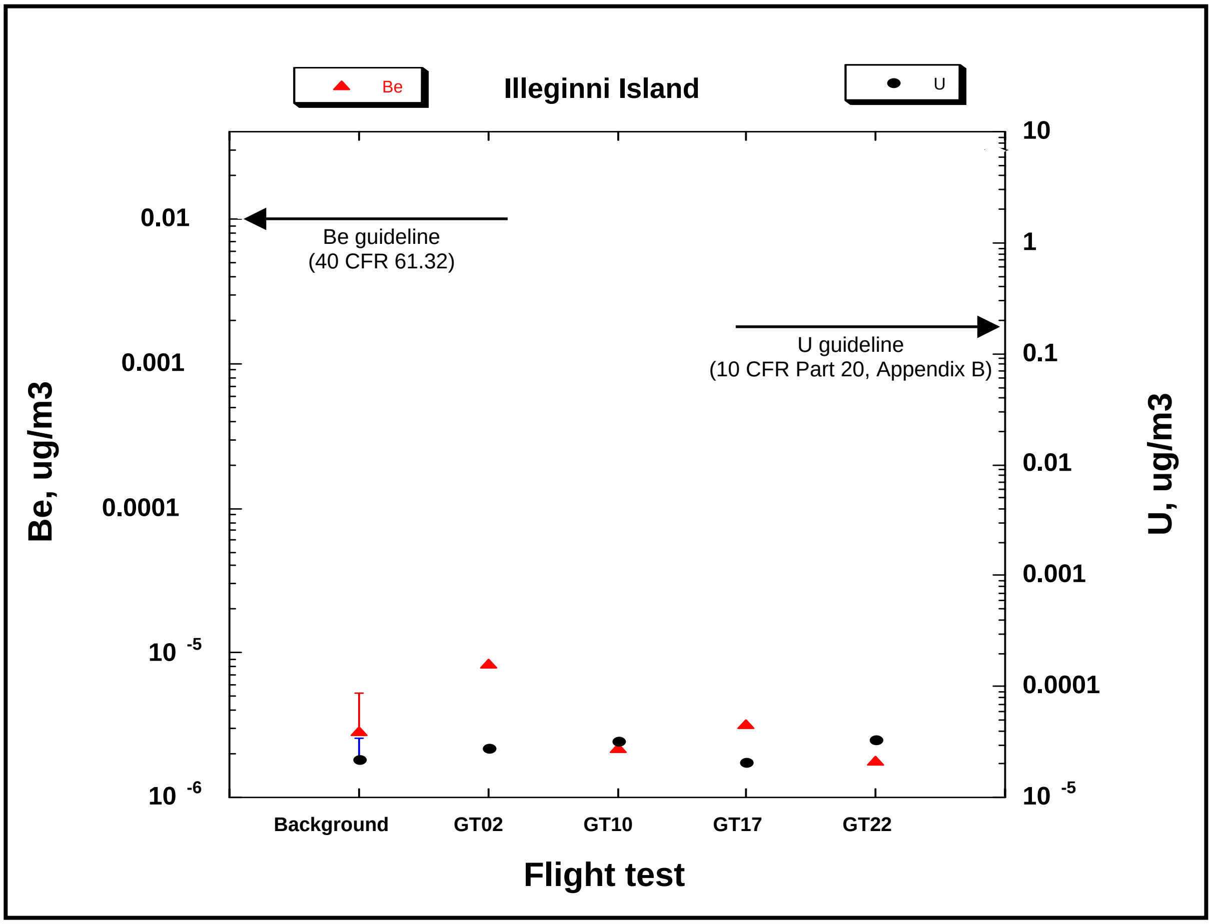
Protective measures would include sheltering inhabitants of "Take Cover" islands, evacuation of non-essential personnel from "Evacuation" islands, and evacuation of all personnel from "Debris Hazard" islands. A NOTMAR and a NOTAM would be published and circulated in accordance with established procedures to provide warning to personnel, including residents of the Marshall Islands, concerning any potential hazard area that should be avoided. Radar and visual sweeps of hazard areas would be accomplished immediately prior to operations to assist in the clearance of non-critical personnel. Only mission-essential personnel would be permitted in hazard areas (USASSDC, 1995), though all personnel are excluded from the vicinity of Illeginni Island during RV tests in that area. Because of the safety procedures that are in place, that each MM III test flight would be preceded by flight safety analyses (as described in Section 3.5.3), and that the sensing and tracking of test RVs at USAKA has been previously analyzed (USASSDC, 1993), no significant impacts to health and safety are anticipated.

Release of Hazardous and Toxic Materials

As described previously, an airburst or ocean/lagoon impact by some test RVs would disseminate on-board hazardous and toxic materials—primarily Be and DU—around the impact point and some distance downwind. For a land impact on Illeginni, such debris occurs close to the point of impact, mostly within a 328-ft (100-m) radius. As a result, the major potential health concern of these tests is the subsequent effects on USAKA workers, and other agency and contractor personnel, whose occupations require visits to the island, and the long-term management and restoration of the island. The concentration of Be and DU in the air is elevated for only a brief period of time following the RV impact. Direct measurements of previous test results have provided sufficient information to conclude that there would be no potential health effects in the immediate vicinity of the tests, and that no air quality criteria would be exceeded anywhere for surface impacts or airburst tests. The long-term concentrations in air from resuspension is more than a factor of 10,000 lower than the 30-day emission standard for Be, and the 1-year standard for Uranium (U)[14]. (USAF, 1992a)

Long-term environmental sampling and monitoring of RV tests at Illeginni have shown that there would be no potential health effects in the immediate vicinity of the surface impact or airburst tests, and that no air quality criteria for Be and U would be exceeded. Figure 4-3 shows the post-test air sampling results for Be and U from four RV flight tests conducted in the vicinity of Illeginni Island from 1992 to 1995, compared to USEPA and US Nuclear Regulatory Commission guidelines, and background levels recorded prior to the flight tests. Post-test values shown represent maximum averages taken using an array of air samplers over an approximate 6-week period.

[14] See footnote 1.



Source: Lindman, 2004; Terrill, 2003

Figure 4-3. Reentry Vehicle Post-Test Air Sampling Results for Beryllium and Uranium at Illeginni Island (1992–1995)

For the post-test recovery and cleanup of RV debris from Illeginni Island or in the shallow waters of the lagoon, USAKA personnel and contractors follow established safety procedures. When tests are conducted using DOE-developed RV simulators, representatives from LLNL in California are also involved to support recovery and cleanup operations for any remaining hazardous materials, in particular, Be and DU. In such cases, special safety procedures, identified in LLNL Operational Safety Procedure 161 [*Joint Test Assembly (JTA) 300 Series Flight Test*], are applied. These procedures detail safety controls for personnel before, during, and after recovery operations. They include personnel training; securing the impact area and areas immediately downwind from inadvertent helicopter, boat, or vehicle traffic until the soil deposition is stabilized by wetting, and the helipad has been washed or swept; use of personal protective equipment; sampling; and environmental monitoring (Lindman, 2004). A list of mitigation measures that have previously been applied to pre- and post-test monitoring, recovery, and cleanup activities at Illeginni is included in Appendix A. An expanded list of mitigation measures for all future testing is presented in Section 4.7.

4.5.3.2 Proposed Action

Debris Hazards

For each flight test, the RV would impact in the same general area used for current FDE launches under the No Action Alternative (Figure 2-12). The safety procedures conducted at USAKA would be identical to those conducted for ongoing activities. As with the No Action Alternative, each RV test flight would be preceded by flight safety analyses, as described in Section 3.5.3. Thus, no significant impacts to health and safety are anticipated.

Release of Hazardous and Toxic Materials

The proposed RV flight tests would have essentially the same impacts as those described earlier for the No Action Alternative. Just as with prior tests, air concentrations of Be and U would not exceed US Federal guidelines, and should remain near natural background levels following each test. The same safety procedures previously described for post-test recovery and cleanup operations would be followed for all proposed RV tests at USAKA.

4.5.4 Hazardous Materials and Waste Management

4.5.4.1 No Action Alternative

Other than fuels and lubricants for operating transportation and cleanup equipment, there is limited use of hazardous materials at USAKA in support of the MM III flight tests. For the use of such common materials, the procedures identified in Section 3.5.4 are followed. The impacts of RV simulators from ICBM flight tests, however, represent unique missions with special hazardous material and waste management requirements.

Though it is very unlikely for buildings on Illeginni Island to be impacted by RV tests, the USAKA has removed any remaining hazardous materials and wastes [e.g., asbestos, polychlorinated biphenyls (PCBs) in old light ballasts, and cans of paint] from the abandoned buildings as a pre-mitigation action (Sims, 2004). This action eliminates any concerns for the potential release of such materials into the environment during RV tests or any other activities conducted there.

Depending on mission requirements and system design, some test RVs may contain varying quantities of DU, Be, high explosives, and other hazardous materials. A specific design may contain any combination of these materials or none. Also, some materials may be classified. For the post-test recovery and cleanup of such hazardous materials from the vicinity of Illeginni Island, procedures identified in LLNL's *JTA 300 Series Recovery Plan for US Army Kwajalein Atoll, Illeginni Island* (1992) are used (Lindman, 2004). Specific procedures in this plan address:

- Surveying the impact crater
- Use of recovery equipment, including screens and heavy machinery
- Collecting visible debris
- Documenting recovery data
- Characterization and mitigation of residual levels of DU and Be.

Near the impact crater, precautions are taken to secure the area from inadvertent traffic until recovery is completed, protect workers from respiratory exposure, and recover any metal fragments. Normally, such cleanup operations are conducted by LLNL and USAKA personnel over an approximate 2-day period.

Should any residual high explosive materials be found, all activity is halted until the USAKA explosives ordnance disposal team is brought in to remove or mitigate the hazard. (Lindman, 2004)

Any RV fragments collected are packaged in one or more 55-gal (208-L) drums. The drums are transported to Kwajalein Island and then shipped directly to LLNL in California via USAF air cargo transport and LLNL ground transportation. There, the debris is evaluated and then disposed of in accordance with DOE/LLNL regulations and procedures. Specific requirements for the packaging, handling, staging, and transportation of the resulting debris are provided in LLNL's *JTA 300 Series Recovery Shipping Procedure* (1992). (Lindman, 2004)

For attempts made to recover both MM III and Peacekeeper RV debris at USAKA between 1990 and 2003, the approximate quantities of materials collected are shown in Table 4-7. Because of the hypersonic velocity of RVs at impact, DU components are broken into small fragments and/or aerosolized. All of the Be-containing components are aerosolized because of the composition of the material; thus, no Be has been recovered. No attempts have been made to recover RV debris from deep ocean waters. (Lindman, 2004)

Table 4-7. Recovered Debris from Reentry Vehicle Impacts in the Vicinity of Illeginni Island (1990–2003)

Debris Recovery Location	DU Fragments lb (kg)	Other Fragments* lb (kg)
Land (including shallow lagoon and ocean reef flats)	176 (80)	124 (56)
Atoll Lagoon (north of Illeginni)	97 (44)	31 (14)

*Includes heat shield, metal alloys, and other non-DU fragments. No Be fragments have been collected.

Source: Lindman, 2004

A few weeks after each RV test, following the completion of all recovery and cleanup operations, LLNL personnel would set up air samplers, as necessary, to determine the presence of any Be and DU contaminants in the air. Air samplers are usually operated over a period of 6 to 8 weeks to demonstrate that there has not been a net change to the environment at Illeginni. Factors determining air-sampling requirements are impact location, wind direction at the time of impact, and the type of RV design. LLNL also continues to monitor the concentrations of Be and DU in the soil on Illeginni. Removal of the top 0 to 2 inches [0 to 5 centimeters (cm)] of soil would be required if concentrations exceeded established standards. As previous sampling results have shown, levels of Be and DU contaminants in the air at Illeginni Island continue to remain at or near background levels, even after years of conducting RV tests in the area. Be and DU soil concentrations on the island can exceed background levels in the vicinity of RV impact sites. However, the Be and DU concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels.

For the reporting of sampling efforts, LLNL will transmit the test results on Be and DU concentrations in the air and soil to the USAKA Environmental Management Office within 6 weeks from the date of sampling. USAKA is then responsible for transmitting the records to the RMI Government within 2 weeks from the date of receipt, through the established channels approved by the US State Department.

Because of the regulations and procedures in place at USAKA, and since little or no accumulation of hazardous materials in the air and soils from RV tests has occurred on Illeginni Island, no adverse impacts from the management of hazardous materials and waste at USAKA are expected.

The targeting of RVs in the vicinity of Illeginni Island is highly accurate and reliable. As previously mentioned, it is unlikely that RV flight tests would impact other uninhabited islands near Illeginni. Should such impacts ever occur, they would be similar in nature to those at Illeginni. In such cases, the same post-test cleanup and mitigation actions, as previously described for Illeginni, would be applied.

4.5.4.2 Proposed Action

For proposed MM III FDE flight tests, post-test RV recovery and cleanup operations at USAKA would be conducted in a manner similar to that identified in Section 4.5.4.1, above, for the No Action Alternative. Also, the four additional RV flight tests planned in the FYs 2005 and 2006 timeframe would not exceed current waste recovery or handling capacities, and are not expected to cause any increase in Be or DU levels in the soil at Illeginni Island. As a result, there would be no adverse impacts from the management of hazardous materials and waste.

4.6 CUMULATIVE EFFECTS

Cumulative effects are considered those resulting from the incremental effects of an action when considering past, present, and reasonably foreseeable future actions, regardless of the agencies or parties involved. In other words, cumulative effects can result from individually minor, but collectively potentially significant, impacts occurring over the duration of the Proposed Action and within the same geographical area.

The potential for cumulative impacts to occur at each of the locations proposed for use during the MM III modification is discussed in the following paragraphs.

FE Warren, Malmstrom, and Minot Air Force Bases

The transportation and handling for four additional boosters over 2 years, in support of flight tests at Vandenberg AFB, would not result in a substantial increase in risk to the public or to USAF personnel, nor would it have any measurable affect on the frequency of vehicular accidents on public roads and highways. Also at FE Warren AFB, the overall risk to the public and to USAF personnel is expected to decrease once the Peacekeeper ICBMs are all deactivated from service in 2005. In regards to the deployment of RS modification kits and Mark 21 RVs at all three Wings, activities would be conducted during normal ongoing maintenance operations, within existing facilities established for such operations. Because no additional health and safety issues would result, and established safety procedures and regulations would continue to be followed, no significant health and safety cumulative effects are anticipated.

Similarly, no significant additional or new hazardous materials would be handled or hazardous wastes generated during this RS modification process, nor would the replacement of command and control console equipment at the LCCs exceed waste handling capacities at each base. Thus, no significant hazardous materials or waste cumulative effects are anticipated.

Hill Air Force Base

Assembly of the replacement MM III boosters at Hill AFB would be conducted within existing facilities, in the same manner as for the No Action Alternative. In addition, similar operational support requirements for the Peacekeeper ICBM program would end in 2005, following system deactivation. As a result, no significant cumulative impacts to health and safety are anticipated.

Likewise, no significant additional or new hazardous materials would be handled or hazardous wastes generated during assembly of the replacement MM III booster. The replacement of command and control console equipment also would not exceed current waste handling capacities at Hill AFB. Consequently, no significant hazardous materials and waste cumulative effects are anticipated.

Vandenberg Air Force Base

The proposed MM III flight tests at Vandenberg AFB would be conducted in a manner similar to current flight tests. Moreover, they would occur from the same four LFs that are routinely used now. Table 4-8 shows that the four additional MM III flight tests would represent a 33 percent increase in FY 2005, and a 29 percent increase in FY 2006, over launches forecasted for ongoing programs. Launch rates for other years would not change as a result of the Proposed Action.

Table 4-8. Ballistic (Non-Orbital) Missile Launch Rate Forecast for Vandenberg AFB

Launch Program	Fiscal Year							
	2003	2004	2005	2006	2007	2008	2009	2010
MM III FDE*	3	3	3	3	4	4	4	4
Additional MM III Flight Tests*	0	0	2	2	0	0	0	0
Peacekeeper FDE*	1	1	1	0	0	0	0	0
BMDS**	3	2	2	4	2	2	2	2
Total Launches	**7**	**6**	**8**	**9**	**6**	**6**	**6**	**6**

Notes:
FDE = Force Development Evaluation
BMDS = Ballistic Missile Defense System
MM = Minuteman
*All program launches would be conducted from the Minuteman Launch Area on North Vandenberg AFB.
**Most program launches would be conducted from the Minuteman Launch Area on North Vandenberg AFB.
Sources: Ogden ALC, 2003; SMC, 2003

The projected increase in launch activity at Vandenberg AFB has the potential for additive, cumulative air quality impacts over the 2005 to 2006 period. However, launch vehicle exhaust products, and other launch operation emissions, do not accumulate because winds quickly and effectively disperse them between missions. In terms of upper atmospheric effects, emissions released into the upper atmosphere would add to the overall global loading of chlorine and other gases that contribute to long-term ozone depletion. However, the amount of emissions released from rocket motors is negligible compared to losses of ozone from other global sources. Because the emissions would represent an extremely small percentage of total loading, they should not significantly contribute to the cumulative impact on stratospheric ozone. Consequently, no significant cumulative impacts to air quality are anticipated.

The projected increase in launch activity at Vandenberg AFB has the potential for cumulative impacts to the noise environment. However, despite the relatively high percentage increase in launches from North Vandenberg, the increase in the rate of launches—from six to eight launches in FY 2005, and from seven to nine launches in FY 2006—would not have any perceptible impact on cumulative noise metrics, such as the CNEL.

For biological resources at Vandenberg AFB, the increase in noise exposure from more launches would result in some noise impacts, especially for the sensitive marine mammals, shore birds, and other protected species occurring along the coastline and immediately offshore. However, the relatively sparse distribution and the seasonality of many species in the area combine to make the probability of significant adverse cumulative impacts extremely low. Additionally, the increase in launch operations is not expected to alter the number of "takes" per year authorized under Vandenberg AFB's current 5-year NMFS incidental take permit governing marine mammal harassment.

In terms of health and safety, because of the limited scope and duration of added activity, and the proven safeguards in place, no significant cumulative impacts to health and safety are expected at Vandenberg AFB. Established safety procedures and regulations would continue to be followed.

No new hazardous materials and waste would be introduced, and only a small increase in wastes would occur, from the additional flight tests at Vandenberg AFB. The replacement of command and control console equipment also would not exceed current waste handling capacities on base. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

In addition to the rocket launches associated with other programs, other activities are occurring within the Minuteman Launch Area. The Missile Defense Agency (MDA) is in the process of establishing an initial missile defense capability at Vandenberg AFB, which is expected to begin operation in December 2004. Construction and modifications at four other existing MM silos in the area—including launch tube and enclosure modifications, exterior lighting, and security fencing—is near completion. The process of installing Ground-Based Interceptor (GBI) missiles in the silos is ongoing. Previously analyzed in the *Ground-Based Midcourse Defense (GMD) Initial Defensive Operations Capability (IDOC) at Vandenberg Air Force Base Environmental Assessment* (MDA, 2003), this new missile system will provide an initial defense against a limited long-range ballistic missile attack. Though the increased activity of establishing and maintaining the GBI launch facilities, along with the added MM III launch operations analyzed in this EA, will have some cumulative affect in dispersing local wildlife within the Minuteman Launch Area, the overall effects are expected to be minor and mostly short-term.

Over-Ocean Launch Corridor

Potential cumulative impacts could occur from the four additional MM III flight tests, over and above projected FDE and other flight tests identified in Table 4-8. Though sonic booms could lead to hearing loss in marine mammals and sea turtles, the noise levels are of very short duration and the resulting underwater peak pressures caused by MM III launches are expected to be well below TTS levels. There is a slightly higher risk for missile debris to strike marine life along the flight corridor, but again, protected marine species are widely scattered and the probability of debris striking a marine mammal or sea turtle is considered very remote. The resulting shock/sound wave produced by the spent rocket motors when they impact in the water could cause injury or death to animals close to the impact point, and also lead to potential temporary hearing loss in animals farther away. However, the probability for such an occurrence is very low, considering the minimal number of tests conducted annually, the relatively low population distribution of animals in the open ocean, and the small size of the areas affected with each test. Thus, no significant cumulative impacts to biological resources are anticipated.

US Army Kwajalein Atoll

Over years of conducting both MM III and Peacekeeper FDE flight tests, potential cumulative impacts to biological resources at USAKA could result from direct impacts to Illeginni Island, the atoll lagoon, and the ocean waters offshore of Kwajalein Atoll. The additional RV flight tests targeted within the Mid-Atoll Corridor could impact threatened and endangered sea turtles and marine mammals as a result of sonic boom overpressures, chemical release and water contamination, and direct contact and shock/sound wave from the splashdown of missile components. However, the relatively sparse distribution of marine mammals and sea turtles in the area makes the probability of significant adverse cumulative impacts on such species low. For RV tests conducted at Illeginni Island, incidental takes of some migratory birds are possible, in addition to the loss of some protected reef species (e.g., sponges, corals, and mollusks) and fish. Such tests can also damage migratory bird habitat, sea turtle nesting habitat, and coral reef habitat. However, the resilience of native vegetation and migratory bird populations on Illeginni to thrive after years of operations and testing shows that there are minimal long-term adverse affects, if any. The same also applies to the coral reef habitat, which remains diverse and generally in good health, with the exception of one particular area where moderate turbidity in the water column has been noted and the health of the reef adversely affected. The source of degradation is not known. However, the USAF, through USAKA support, has sampled various locations on and around Illeginni Island where RVs have previously impacted. Once complete, the sampling results will be used in determining the need for further consultations with the USFWS, NMFS, and RMIEPA, and if additional mitigation measures are warranted.

Peacekeeper ICBM flight tests will end in 2005 at the completion of system deactivation, which will reduce the number of test RVs targeted in the vicinity of USAKA. As shown in Table 4-9, the total number of test RVs that would impact at or near USAKA would decrease substantially in later years, well below historical test rates. Because the proposed RV tests occur only a few times per year, and since the same areas are normally not impacted with each flight, significant cumulative impacts to biological resources are not expected.

Table 4-9. Reentry Vehicle Flight Test Rate Forecast for US Army Kwajalein Atoll

Launch Program	Fiscal Year							
	2003	2004	2005	2006	2007	2008	2009	2010
Minuteman III RVs	8	6	9	7	6	5	6	4
Peacekeeper RVs	8	8	8	0	0	0	0	0
Total Number of RVs*	**16**	**14**	**17**	**7**	**6**	**5**	**6**	**4**

Notes:
*All test RVs carried on MM III and Peacekeeper missiles would be targeted in the vicinity of USAKA.
Source: Miyamoto, 2004

Procedures used at USAKA for the Proposed Action would be identical to those conducted for ongoing activities, and the proposed flight tests targeted at the atoll would be well within the range's capacity for operation. Also, as prior monitoring efforts have shown, air contaminant (Be and DU) levels at Illeginni Island continue to remain at or near background levels, even after years of RV testing in the area. Though soil concentrations of Be and DU, in the vicinity of RV impacts on the island, can occur above background levels, their concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels. As a result, no significant cumulative impacts to health and safety, or from the management of hazardous materials and waste, are anticipated.

4.7 SUMMARY OF MITIGATION MEASURES, IMPLEMENTATION DETAILS, AND RESPONSIBILITIES

Throughout Chapters 2.0, 3.0, and 4.0 of this EA, various management controls and engineering systems for all locations affected are described. Required by Federal, state, DOD, and Service-specific environmental and safety regulations, and international agreements, these measures are implemented through normal operating procedures.

From earlier discussions, specific mitigation measures and monitoring activities have been identified to minimize the level of impacts that might occur at USAKA as a result of the planned RV flight tests. Grouped by responsible organization, these mitigation measures and monitoring activities are listed below, including the relevant sections of the EA where they apply. DOE/LLNL will provide the leadership for the implementation of the Group 1 mitigation measures. The USAKA Environmental Management Office will provide the leadership for the implementation of the Group 2 mitigation measures. DOE/LLNL and the USAKA Environmental Management Office will coordinate and consult with the ICBM System Program Office, Air Force Space Command (AFSPC), USFWS, NMFS, and the RMIEPA, as necessary, in the implementation of the mitigation measures. Funding for the mitigation measures and the monitoring of their effectiveness will be a joint and shared responsibility of DOE/LLNL, ICBM System Program Office, AFSPC, USASMDC, and the USAKA Environmental Management Office.

Group 1—DOE/LLNL

1) Exclude personnel from the vicinity of Illeginni Island during tests in that area (Section 4.5.3).
2) Protect personnel from exposure during post-test operations near the impact crater (Section 4.5.3).
3) Maintain exclusionary control near a land impact crater and downwind of the crater prior to recovery action (Section 4.5.3).
4) Recover parts and debris as much as reasonably prudent near the impact crater, to include collecting visible debris from the RV that is in the crater and on the island. Excavate the impact crater to recover small particle RV debris after scoring and mapping operations are complete. Use standard USAKA/LLNL procedures [*JTA 300 Series Recovery Plan for US Army Kwajalein Atoll, Illeginni Island* (1992)] involving screening and washing of material removed from the crater. (Section 4.5.4)
5) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down (Section 4.5.3).
6) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards. (Sections 4.5.3 and 4.5.4)
7) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (6) are maintained (Section 4.5.4).
8) Maintain records of Be and DU concentrations in air and soil to document the tests results, and transmit them to the USAKA Environmental Management Office within 6 weeks from the date of sampling (Section 4.5.4).
9) Avoid unnecessary disturbance of migratory bird nests (Section 4.5.1). (See also measure 14.)
10) Refill any land crater in a manner that is least damaging to the environment (Section 4.5.1), with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU (Section 4.5.3).
11) Should an RV impact within one of the littoral forest areas on Illeginni or elsewhere in the vicinity, the least possible amount of vegetation and habitat would be disrupted for equipment access and cleanup operations (Section 4.5.1). (See also measure 14.)

12) Perform opportunistic marine mammal monitoring in the vicinity of the Illeginni Island from the helicopter flights to and from the island during the days and weeks leading up to a scheduled MM III flight test, and report the results to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch (Section 4.5.1).

Group 2—USAKA Environmental Management Office

13) Develop protocols or best management practices, in consultation with the appropriate agencies, to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef, following RV impacts on the reef. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. (Section 4.5.1)
14) Develop protocols or best management practices, in consultation with the appropriate agencies, for the cleanup and backfilling of craters in littoral forests, or in other valuable habitats, by incorporating methods and procedures that would avoid and/or minimize additional impacts to such resources during the cleanup activities. (Section 4.5.1)
15) USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni. Eniwetak was selected on the basis of (a) the presence of active turtle nesting sites, and (b) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. The details of the protected area to be established will be defined through the DEP process. (Section 4.5.1)
16) USAKA will transmit the records of Be and DU concentrations in air and soil to the RMI Government within two weeks from the date of receipt of such records from DOE/LLNL through the established channels approved by the US State Department (Section 4.5.4).
17) Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Island, and along the shorelines and shallow marine environments of the lagoon and ocean side of the island. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted. Based on sample analyses, and other new information as it becomes available, strong consideration will be given to further investigation of associated risks. (Section 4.5.1)

As part of the DEP process described earlier in Section 1.7, the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, USEPA (Region IX), and the RMIEPA to clarify current mitigation measures and determine whether any additional mitigation measures are warranted.

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APPENDIX A

SUMMARY OF THE ENVIRONMENTAL ASSESSMENT FOR DEPARTMENT OF ENERGY REENTRY VEHICLES, FLIGHT TEST PROGRAM, US ARMY KWAJALEIN ATOLL, REPUBLIC OF THE MARSHALL ISLANDS

Summary of the
Environmental Assessment for
Department of Energy Reentry Vehicles, Flight Test Program,
US Army Kwajalein Atoll, Republic of the Marshall Islands

> The following discussion provides an unclassified summary of the *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands,* dated August 4, 1992. The classified environmental assessment (EA) was prepared by Lawrence Livermore National Laboratory for the US Air Force Strategic Air Command, Offutt Air Force Base (AFB), Nebraska. The reentry vehicles (RVs) described in the 1992 EA are similar to the RV designs currently flown as part of the ongoing joint Department of Defense/DOE flight test program.

Department of Defense (DoD) RVs and DOE Joint Test Assembly (JTA) RVs are routinely flown as part of the US Air Force (USAF) developmental and operational Intercontinental Ballistic Missile (ICBM) flight test programs conducted at the Western Test Range (WTR). Peacekeeper and Minuteman III ICBMs launched from Vandenberg AFB, California, are routinely targeted for the US Army Kwajalein Atoll (USAKA) test range (now called Reagan Test Site), in the Republic of the Marshall Islands.

The ICBM flight test program includes several different designs of RVs containing varying quantities of depleted uranium (DU), beryllium (Be), and high explosives. A specific RV design may contain any combination of the above materials, or none. Fissile materials are not included in any flight test RV designs. Reentry vehicles containing high explosives may be detonated at some altitude (airburst) or upon impact at the surface. Following detonation, RV fragments would impact the surface at high velocity. Reentry vehicles without high explosives would impact the surface at high velocity intact and then fragment upon surface impact. Flight tests are planned for deep ocean targets, lagoon targets, and in the vicinity of Illeginni Island within the Mid-Atoll Corridor Impact Area at USAKA. Targeting in the broad ocean area north, east, and west of the Kwajalein Atoll is also planned. All target sites are routinely used in ongoing ICBM flight test programs. High explosive detonation and/or kinetic energy dissipation occurring at impact may distribute low levels of hazardous materials in the ocean, lagoon, or on land (Illeginni) near the impact point and downwind.

In 1992, the USAF prepared an environmental assessment of potential environmental consequences of the kinds of tests included in the ICBM flight test program. Results from the earlier JTA-301 flight test, the first JTA test with materials and quantities identical to those described in the 1992 EA, were used to verify the accuracy of this assessment, and in fact showed that actual levels of hazardous materials were less than those predicted.

The 1992 EA analyzed the potential effects of a water or land impact, or an airburst, of RVs containing DU and Be. An atmospheric dispersion model developed in 1990 for this application, and verified by an ongoing environmental monitoring program, was used. This model was extremely conservative in that it maximized the quantities of the source materials and incorporated a land impact as the worst-case conditions for dispersion.

The testing described in the EA was expected to result in limited, short-term impacts to the natural environment within the immediate area of the RV impact. In addition, if a land impact were to occur, most adverse effects would be mitigated by recovering RV debris and refilling impact craters. If all of the DU and Be in the RVs were to land in the atoll's lagoon or in the open ocean, there would be no impact to the marine environment. The materials are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background. The materials would eventually be distributed in the sediment and be of no consequence to marine species. The same is true for the DU and Be that would be deposited in the ocean or lagoon as a result of an airburst.

The major potential health and environmental concerns discussed in the EA were associated with impact on land and the subsequent effects on workers whose occupations require visits to the island, and the long-term management and restoration of the island. The concentration of Be and DU in air will be elevated only for a brief period of time following the RV impact. Measurements made after the JTA-301 test showed the concentrations of Be and DU in the air to be well below air quality standards for brief exposure to these materials. The long-term concentrations in air from resuspension will be more than a factor of 10,000 lower than the 30-day emission standard for Be and the 1-year standard for uranium (U), a measurement for DU.

The modeled interpretation of the tests and the results from the JTA-301 test and subsequent tests provide enough information to conclude that there will be no potential health effects in the immediate vicinity of the tests and that no air quality criteria will be exceeded anywhere for surface impacts or airburst tests. To make these conclusions, we assume the exclusion of personnel within 2,000 meters (m) downwind of the test area for 15 minutes following each test. Near the impact crater, in the case of land impact, precautions would be taken to recover metal fragments, to protect workers from respiratory exposure, and to secure the area from inadvertent traffic until recovery is complete.

Potential ecological effects on land at Illeginni can be assessed on the basis of deposition and concentration patterns in air observed downwind after testing JTA-301, and several subsequent tests conducted as part of the ongoing flight test program. Debris and ejecta occur close to the point of impact, mostly within a 100 m radius. Deposition of small particles contribute to elevated levels in soil in the immediate vicinity of the impact and extending downwind. The concentration of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 micrograms per gram (μg/g) soluble Be. In view of the fact that the concentration in the area of highest deposition after JTA-301 was only 0.5 μg/g and that Be is extremely insoluble, there will be no impact to plants. The potential effects on animals from breathing respirable dust, or consuming particles deposited on vegetation, would be insignificant. Beyond 50 m from the crater, under probable meteorological conditions, there will be deposition on the water surface. The process of mixing of Be and DU by tide and surf would rapidly dilute the small amounts deposited, and concentrations would be low and non-toxic to fish, considering the low solubility of the Be and DU. Eventually, the Be and DU would be deposited as sediment, where it would slowly weather just as it does in the soil.

For an ocean impact or deposition on water, no cleanup would be required. However, in the case of a lagoon impact, debris would be recovered.

For airburst tests, most of the deposition would be over water and would be of no significant concern, as discussed above. Any deposition of respirable-size material over land would be less than the land impact situation; the deposition on land from an airburst would have to meet the same criteria as listed for land impact.

As part of RV testing, the following mitigation measures would be applied:

1) Exclude personnel during the tests.
2) Protect personnel from exposure during post-test operations near the impact crater.
3) Maintain exclusionary control near a land impact crater and downwind of the crater prior to recovery action.
4) Recover parts and debris as much as reasonably prudent near the impact crater, to include collecting visible debris from the RV that is in the crater and on the island. Excavate the impact crater to recover small particle RV debris after scoring and mapping operations are complete. Use standard USAKA procedures involving screening and washing of material removed from the crater.
5) Set up an array of air samplers and deposition collectors during and after the actual tests to estimate downwind concentrations and deposition patterns for environmental management purposes.
6) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down.
7) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards.
8) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (7) are maintained.
9) Maintain records of Be and U concentration in air and soil to document the tests for the landowners and regulatory agencies.
10) Avoid unnecessary disturbance of seabird nests.
11) Refill any crater that is large enough to warrant the action in a manner that is least damaging to the environment, with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU.

Results from the JTA-301 test showed deposition concentrations of Be and DU in the soil to be slightly greater than natural background concentrations. The concentration of Be and DU in air resulting from the deposition were orders of magnitude below US Federal guidelines. Consequently, for further tests, additional mitigation measures beyond what is identified above are not anticipated.

However, the concentrations of Be and DU in air will be measured after each test to ensure that the cumulative deposition on Illeginni Island does not lead to concentrations that exceed US Federal guidelines. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards.

APPENDIX B

IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

MINUTEMAN III MODIFICATION ENVIRONMENTAL ASSESSMENT

IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

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IMPACTS OF THE PROPOSED MINUTEMAN III REENTRY VEHICLE FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES AT KWAJALEIN ATOLL, THE REPUBLIC OF THE MARSHALL ISLANDS

ABSTRACT

The proposed reentry vehicle (RV) flight test involves launching of a Minuteman III missile that carries one or more RVs, from Vandenberg Air Force Base (AFB), California, and targeting it for either land or deep ocean impact in the vicinity of Illeginni or Kwajalein Missile Impact Scoring System (KMISS) Island, the Republic of the Marshall Islands (RMI). The RV is expected to enter the ocean at a predetermined angle to the ocean surface[4] in the vicinity of Illeginni or KMISS Island, and disintegrate and dissipate most of its kinetic energy at a depth of about 6.9 m from the ocean surface, simulating a single underwater impulse. On the basis of recent investigations[11,16,17] involving the exposure of marine mammals, especially white whale and dolphin, to single underwater impulses, sound pressure levels (SPLs) of 224 and 240 dB re 1 μPa (equivalent to total energy fluxes of 209 and 225 dB re 1 μPa^2-s) have been established as the criteria for the onset of temporary threshold shift (TTS) in their hearing abilities, and for physical injury to their auditory [permanent threshold shift (PTS)], respiratory (lung hemorrhage), and gastrointestinal systems, ultimately resulting in their death. A probabilistic impact model is developed for the purpose of estimating the TTS and physical injury impacts of the proposed Minuteman III RV (MMIIIRV) flight tests on marine mammals and sea turtles (MMST). The concepts of acoustic impact well (AIW) and habitation well (HW) for MMST are defined, and utilized in the development of the probabilistic impact model.

The source strength of an MMIIIRV is 3.06E+06 Pa-m, and the SPL generated by the disintegration of the RV is expected to attenuate to 240 dB re 1 μPa at an acoustic impact radius (AIR) of 3.1 m from the point of RV disintegration. A careful consideration and analysis of the RV impact and disintegration configuration[4] at a recent peer review meeting[34] lead to the following conclusions: (a) The MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration, and (b) the generalized equation (equation 4) utilized to compute the radial distances for acoustic impacts corresponding to the minimum SPLs that may cause TTS and physical injury impacts, may not fully account for the near field nonlinear, nonacoustic effects created by the turbulent heat, mass, and momentum fluxes that accompany the RV impact on the ocean surface, and its disintegration at a depth of about 6.9 m. At a radial distance of 15 m from the point of RV disintegration, the SPL is expected to attenuate to 226 dB re 1 μPa (30 psi) which is only 2 dB higher than the established TTS limit. Nevertheless, in order to err on the side of caution, a radial distance of 15 m rather than the AIR of 3.1m computed for an SPL of 240 dB re 1 μPa using equation 4, has been utilized to compute the volume of the AIW, and the overall probability of physical injury to MMST from acoustic impacts, $P_{OPAI@240}$.

Marine mammals occur in groups, and group is the fundamental unit of choice for the quantification of marine mammal sightings during aerial and shipboard surveys[10]. Hence, the group density of marine mammals rather than their individual species density is utilized in this impact analysis. Sea turtles are solitary animals, and hence, a group size of unity is assumed in

the impact calculations[10]. On the basis of (a) the assumptions made on MMST group sizes, (b) the probabilistic impact model developed, (c) the acoustic impact criteria established, and (d) the rationale developed for the use of a minimum impact radial distance of 15 m, the overall probabilities of the TTS ($P_{OPAI@224}$) and physical injury ($P_{OPAI@240}$) impacts of the proposed MMIIIRV flight tests on MMST have been estimated to be 4.98E-08 and 2.41E-08 respectively. The limited amount of survey data available for sea turtles[6,10,30] in the marine biological literature indicates that the impacts of the proposed MMIIIRV flight tests on sea turtles would be similar to their impacts on marine mammals. From the aerial survey data on MMST[28] collected by the Regional Offices of the United States Fish and Wildlife Services (USFWS), and the National Marine Fisheries Service (NMFS), Honolulu, Hawaii over the test area in the vicinity of Illeginni Island, (i) the number of sea turtles or the number of groups of marine mammals that may experience TTS, N_{TTS} as a result of the proposed MMIIIRV flight tests has been estimated to be 4.98E-07, and (ii) the number of sea turtles or the number of groups of marine mammals that may suffer physical injury (incidental take), N_{IT} as a result of the proposed MMIIIRV flight tests has been estimated to be 2.41E-07. The N_{TTS} and N_{IT} estimates clearly indicate that the impacts of the proposed MMIIIRV flight tests on MMST at Kwajalein Atoll is quite insignificant. In addition, the nearly identical N_{TTS} and N_{IT} estimates obtained from the survey data[13,22-24] collected by the Marine Mammal Research Program (MMRP) of the Acoustic Thermometry of Ocean Climate (ATOC), for the Pacific Missile Range Facility (PMRF) strongly support and validate the assumptions made and the constraints applied in the definition of the AIW and HW, and in the development of the probabilistic impact model, and the analytical approach utilized in the computation of the probabilities for the onset of TTS and physical injury impacts on MMST.

1. INTRODUCTION

National Environmental Policy Act (NEPA)[27] of 1969, Section 102 (A) directs the interpretation and administration of the policies, regulations, and public laws of the United States (US) in accordance with the NEPA policies, and requires all agencies of the Federal Government to utilize a systematic, interdisciplinary approach in order to insure the integrated use of natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment. The purpose of NEPA is to ensure that environmental factors are given the same consideration as any other factors in decision-making by the federal agencies. Since the enactment of NEPA, the environmental law has evolved into a comprehensive system of laws and regulations encompassing Treaties including Compacts, Executive Orders, statutes, regulations, guidelines, and case laws.

Executive Order (EO) 12114[9] provides the exclusive and complete requirement for the consideration of major federal actions that may have a significant impact on the environment outside the territorial waters (twenty-four nautical miles from the nearest shoreline) of the United States, and requires the proponent federal agencies to analyze and document the impact of their proposed actions on the environment outside this territorial limit, consistent with the requirements of national security and foreign policy. The EO furthers the purpose of the NEPA, the Endangered Species Act[7], the Marine Protection, Research and Sanctuaries Act[19], and the Deepwater Port Act[5], and requires the same types of analysis and documentation as required by NEPA. NEPA applies to major federal actions within the territorial waters of the United States whereas EO 12114 applies to major federal actions performed outside this territorial limit. The

Code of Federal Regulations, 32 CFR 187[2] provides the policy and procedures to enable the Department of Defense (DOD) officials to be informed of, and to take into consideration the potential impact of the proposed DOD actions on the environment outside the territorial waters of the United States when authorizing or approving such actions.

1.1. Compact of Free Association Between the Government of the United States of America and the Government of the Republic of the Marshall Islands

Section 161(a)(1) of the Compact of Free Association between the Government of the United States of America and the Government of the Marshall Islands[3] requires the Government of the United States to apply the Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of Marshall Islands (8th Edition)[8] to its activities at USAKA. Section 161(a)(2) of the Compact obligates the Government of the United States to apply NEPA to its activities under the Compact, and its related agreements as if the Marshall Islands were part of the United States of America.

1.2. Environmental Standards and Procedures for United States Army Kwajalein Atoll Activities in the Republic of Marshall Islands

Section 3-4.5 of the USAKA Environmental Standards (UES)[8] which governs the protection of threatened and endangered species at USAKA, requires the establishment of a formal consultation and coordination process with the appropriate agencies that constitute the USAKA project team, to ensure that actions taken at USAKA will not jeopardize the continued existence of the threatened and endangered species or result in the destruction or adverse modification of their habitats.

On October 23, 2003, pursuant to the requirements of the UES, the Intercontinental Ballistic Missiles (ICBM) System Program Office (SPO), the Air Force Space Command (AFSPC), and the Space and Missile Systems Center (SMC) held an informal Consultation and Coordination Meeting[32] in Honolulu, Hawaii with USFWS, NMFS, USAKA Environmental Management Office, and the United States Army Space and Missile Defense Command (USASMDC). At the meeting, USFWS, NMFS and USAKA representatives (a) reported sightings of sperm whales and sea turtles in the vicinity of Illeginni Island at Kwajalein Atoll, (b) stated their concerns regarding the potential impact of the proposed MMIIIRV flight tests on the MMST, and their habitats, and (c) recommended that the Minuteman III Modification Environmental Assessment (EA) list and describe the appropriate and necessary measures to mitigate the impact of the proposed MMIIIRV flight tests on the MMST and their habitats.

On January 7, 2004, at the Consultation and Coordination Meeting[33] in Honolulu, Hawaii, the ICBM SPO and SMC had agreed to determine the potential impact of the proposed MMIIIRV flight tests on the MMST, and their habitats caused by (a) the sonic boom associated with the RV flight over Kwajalein Atoll, and (b) the shock waves generated by the splashdown on the ocean surface, and disintegration underwater of RV and/or RV components. SMC had accepted the responsibility for the sonic boom analysis, and ICBM SPO had accepted the responsibility for the estimation of the shock wave impact on MMST.

2. ESTABLISHMENT OF TEMPORARY THRESHOLD SHIFT AND PHYSICAL INJURY CRITERIA FOR MARINE MAMMALS AND SEA TURTLES

The impacts of the proposed MMIII RV flight tests on MMST, caused by sonic boom and shock waves may be acoustic and/or nonacoustic. Acoustic impacts include temporary behavioral changes characterized by TTS in their hearing abilities, disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding or sheltering (Level B Harassment). Nonacoustic impacts include direct physical injury to their auditory [permanent threshold shift (PTS)], respiratory (lung hemorrhage), and gastrointestinal systems, ultimately resulting in their death, and death or failure of sea turtle eggs or marine mammal embryos to reach their next developmental stage. Nonacoustic impacts on MMST may be caused by collisions with ships, falling objects, and shrapnel from exploding charges, and contacts with, or ingestion of debris and hazardous materials. Fast-moving objects such as meteorites and missiles that enter the ocean, may not only hit the MMST inflicting direct physical injury (nonacoustic impact) to the animals, but they may also generate shock waves that may degenerate into acoustic waves[1] capable of causing acoustic impacts to the MMST. Hence, injury to MMST from shock waves may be acoustic and/or nonacoustic.

Acoustic impacts may be lethal or sublethal. Lethal impacts may cause immediate death or serious physical injury to the impacted animals whereas sublethal impacts may cause a decrease in their hearing sensitivity. Decrease in hearing sensitivity shifts the hearing threshold of the impacted animals to a higher SPL. The shift to a higher threshold may be temporary (recoverable, TTS) or permanent (PTS). Sublethal impacts may cause behavioral reactions in MMST including panic, habitat abandonment, refusal to nurse their infants, and impairment in their ability to forage or detect and escape predators, and hence, may ultimately result in their death.

The inner ears of marine mammals are structurally modified from those of their terrestrial counterparts in such a way as to accommodate rapid pressure transients, and render them acoustically more sensitive[10,16,17]. In addition, marine mammals are naturally protected from self-generated sounds, structurally (anatomically) by the impedance mismatches of the intervening tissues, and functionally (physiologically) by the eardrum and ossicular tensors[17]. Impedance is a concept utilized in electrical, electronic and communication engineering[29] to represent the dynamic resistivity of a system or its components. Impedance mismatch between components in a signal processing pathway will attenuate the signal strength, which is generally an undesirable consequence of equipment obsolescence. Impedance mismatch between structural members of the inner ears of marine mammals attenuates the SPL, and pressure-transduced electrical signals, and protects the marine mammals from direct physical injury to their auditory system.

The self-generated sounds of marine mammals are initiated in coordination with their protective mechanisms, and hence, they are anticipated[17]. On the other hand, external sounds including those generated by the proposed MMIIIRV flight tests are not anticipated, and hence, marine mammals are not adequately protected from their impacts. Very little direct data is currently available for TTS or physical injury impacts on sea turtles[30]. Hence, it is necessary to establish the criteria for TTS and physical injury impacts of the proposed MMIIIRV flight tests to MMST, and to protect them by ensuring that the SPL generated by the underwater disintegration of the RV, does not exceed these established limits at target locations.

2.1. Previously Established TTS, Physical Injury and Mortality Criteria

Table 1 summarizes the general TTS, physical injury and mortality impact criteria established for the WINSTON S. CHURCHILL (DDG 81) Shock Trial in its Final Environmental Impact Statement (EIS) on the basis of blast test experiments involving pulse trains *vice* single pulses [10].

Table 1. General TTS, Physical Injury and Mortality Criteria Established For WINSTON S. CHURCHILL (DDG 81) Shock Trial

Impact Category	Threshold, dB	Threshold, psi	Threshold, Pa-s
TTS	<u>182</u>	0.18	75
Physical Injury	189.39	0.43	<u>175</u>
Mortality	195.75	0.89	<u>364</u>

The Sound pressure level in dB is referenced to 1 μPa. The established threshold criteria are underlined, and their equivalents in the other most commonly used units are listed for convenience.

Darlene Ketten[16,17] of Harvard Medical School, and Woods Hole Oceanographic Institution has recommended the following criteria for TTS and lethal injury impacts caused by single impulses:

(a) TTS for <u>single pulses</u>: 5 – 15 psi peak overpressure (210.75 – 220.29 dB re 1 μPa).

(b) Lethal or compulsory injury zone for fast rise time (short duration pulses, simulating <u>impulses</u>), complex waveforms (not pure sinusoids such as sine and cosine waves): 240 dB re 1 μPa (145 psi).

2.2. Establishment of TTS and Physical Injury Criteria for the Proposed Minuteman III Reentry Vehicle Flight Tests on Marine Mammals and Sea Turtles

Most recent investigations lead by Jim Finneran[11] at Space and Naval Warfare Systems Center, San Diego, utilizing single underwater impulses have suggested the following TTS criteria for white whale and dolphin.

(a) 23 psi peak pressure (224 dB re 1 μPa) for white whale.

(b) 30 psi peak pressure (226 dB re 1 μPa) for dolphin.

The underwater disintegration of the Minuteman III flight test RV simulates a single impulse rather than a pulse train. Hence, the ICBM System Program Office has established the following criteria (Table 2) for the TTS and physical injury impacts on MMST for this special case.

Table 2. TTS and Physical Injury Criteria Established by the ICBM System Program Office for the Impacts of the Proposed Minuteman III RV Flight Tests

Impact Category	Threshold, dB	Threshold, psi	Threshold, Pa-s	Reference
TTS	224	23	9414	Finneran[11]
Physical Injury	240	145	59400	Ketten[16,17]

The Sound pressure level in dB is referenced to 1 μPa. The established threshold criteria are underlined, and their equivalents in the other most commonly used units are listed for convenience.

A careful consideration and analysis of the RV impact and disintegration configuration[4] at a recent peer review meeting[34] has lead to the determination that the MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration. However, no specific criterion is established for the mortality impact of the proposed MMIIIRV flight tests on MMST.

3. DEFINITION OF THE MARINE MAMMAL AND SEA TURTLE HABITATION WELL AND RV ACOUSTIC IMPACT WELL, AND COMPUTATION OF THEIR VOLUMES

3.1. Definition of the Habitation Well: Assumptions and Constraints Utilized

The MMST have been assumed to live in a cylindrical Habitation Well of 24,140 m (15 miles) radius and 250 m depth on the basis of the following considerations:

(a) During ICBM RV flight tests, the essential personnel are warned to stay away at least 10 miles, and nonessential personnel are warned to stay away an additional 5 miles from the expected point of RV impact on land or splashdown on the ocean surface,[12,15].

(b) If a group of MMST is sighted during an aerial survey performed 2 hours immediately prior[12,15] to the scheduled launch of a Minuteman III missile, at a distance of about 24,140 m from the expected point of RV disintegration underwater, and if all the groups of MMST whether they are on or underneath the ocean surface, are assumed to be located at distances of at least 24,140 m from the point of RV disintegration, it is unlikely that any of them will reach the AIW at the exact time of RV splashdown and disintegration if they drifted in a random manner with no preferred direction, and at no preferred speed. Therefore, the HW surface area is computed using a radius of 24,140 m.

(c) The MMST are likely to spend most of their time near the surface of the ocean, down to a depth of about 250 m, due to the availability of food near the surface. Whales have been reported[6] to dive to depths of 1500 - 2000 m. Sea turtles may live much closer to the surface. Therefore, the HW volume is computed using a depth of 250 m.

3.2. Computation of the Volume of the Habitation Well, V_{HW}

The HW volume is computed using the following formula.

$$V_{HW} = \pi R^2 D \quad (1)$$

where V_{HW} refers to the volume of the HW (4.58E+11 m^3),
R refers to HW radius (24,140 m, 15 miles),
D refers to HW depth (250 m).

3.3. Definition of the RV Acoustic Impact Well: Assumptions and Constraints Utilized

The AIR, r is computed from the source strength of an intact RV, and the TTS and physical injury impact criteria established in Section 2.2. Figure 1 illustrates the contour of the AIW in two dimensions.

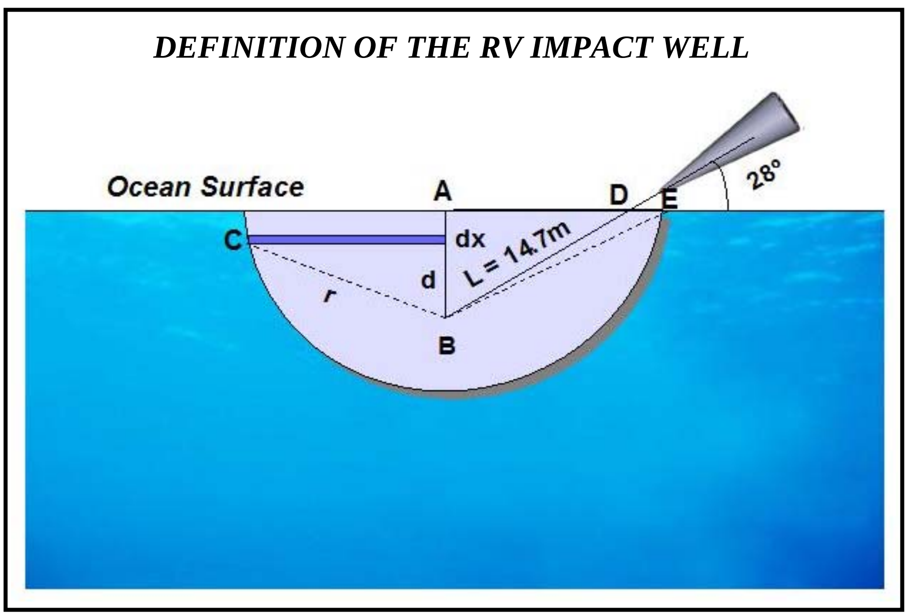

Figure 1

The distance AD is the radius of the surface contour of RV disintegration[4], and it is 13 m. The distance, DB from the point of RV impact (D) on the ocean surface to the point of its disintegration (B) underwater, is computed from AD using a reentry angle (BDA) of 28 degree: DB = 14.7 m. The surface radius (AE), r_s of the AIW is calculated using equation 2:

$$r_s = \sqrt{(r^2 - d^2)} \quad (2)$$

where r_s refers to the surface radius (AE) of the AIW.
r refers to the radius (BE = BC) of the AIW, computed from the RV source strength for a given overpressure at a target location.
d refers to the depth (AB) at which the RV is expected to disintegrate, computed from AD using a reentry angle of 28 degree: 6.9 m.

3.4. Computation of the Volume of the Acoustic Impact Well, V_{AIW}

Volume of the AIW, a sphere of radius, r truncated by the ocean surface is computed using the following formula.

$$V_{AIW} = \pi\left(r^2 d - \frac{d^3}{3} + \frac{2}{3}r^3\right) \qquad (3)$$

in which V_{AIW} refers to the volume of the AIW. Equation 3 is obtained by integration of the truncated sphere.

The AIR, r is a function of the source strength of an intact MMIIIRV, and the overpressure is measured at the target location. It is computed using the following equation[25].

$$r = \left(\frac{S}{P - P_{inf}}\right) \qquad (4)$$

where S is the source strength of the intact RV, 3.06E+6 Pa-m,
$P - P_{inf}$ is the measured overpressure, Pa
P_{inf} is the ambient pressure, Pa.

The TTS and physical injury impact criteria established in Section 2.2 are stated in terms of the SPL measured in dB at target locations. The SPL at a target location is computed from the overpressure measured at the target location using the following equation[25].

$$SPL = 20LOG\left(\frac{P - P_{inf}}{P_{ref}}\right) \qquad (5)$$

in which P_{ref} is the reference pressure which is 1.0E-6 Pa for water. Conversely, the expected overpressure at a target location can be computed using equation 5 for an impact criterion, and utilized for the computation of the AIR using equation 4. Since the reference pressure for water is 1 μPa, equation 5 can be simplified and rewritten as equation 6 by expressing the overpressure and the reference pressure in μPa.

$$SPL = 20LOG(P - P_{inf}) \qquad (6)$$

4. COMPUTATION OF THE PROBABILITIES OF IMPACTS OF THE PROPOSED MINUTEMAN III RV FLIGHT TESTS ON MARINE MAMMALS AND SEA TURTLES

4.1. Definition of the Overall Probability of Acoustic Impact, P_{OPAI}

The following assumptions are made in defining the probability of acoustic impact of the proposed MMIIIRV flight tests on MMST[14,21,37,38].

(a) If there is a sea turtle or a group of marine mammals in the HW, and if it is divided into volume segments equivalent to the volume of the AIW, each volume segment is equally accessible to the sea turtle or the group of marine mammals for habitation at any instant of time.

(b) If the sea turtle, or the group or a member of the group of marine mammals is within the AIW at the time of RV disintegration, it will experience either a TTS or suffer physical injury, depending on its location from the point of RV disintegration.

If there is a sea turtle or a single group of marine mammals in the HW, the probability that it will be within the AIW at the time of RV disintegration, is the same as the probability of it being in any one of the equivalent volume segments. It is just the ratio of the volume of the AIW to the volume of the HW.

$$P_{AIW} = \frac{V_{AIW}}{V_{HW}} \qquad (7)$$

in which P_{AIW} refers to the probability that the sea turtle, or the group or a member of the group of marine mammals is within the AIW.

If a sea turtle, or a group or a member of a group of marine mammals is already within the AIW at the time of RV disintegration, it will be impacted, and the probability of impact is one. This is a conditional probability of acoustic impact, denoted by $P_{IMP/AIW}$. The compound probability of acoustic impact of the proposed MMIIIRV flight tests on MMST is defined as the product of the two probabilities:

$$P_{CPAI} = P_{AIW} P_{IMP/AIW} = \frac{V_{AIW}}{V_{HW}} \qquad (8)$$

where P_{CPAI} is the compound probability of acoustic impact,

$P_{IMP/AIW}$ is the conditional probability of acoustic impact given the fact that a sea turtle, or a group or a member of a group of marine mammals is already within the AIW.

If the Minuteman III missile carries more than one RV during a flight test, the volume of the AIW for a single RV must be multiplied by the number of RVs onboard the missile in order to obtain the total volume of the AIW for all the RVs, assuming that the RVs are independently targeted for splashdown and impact at different locations. This will result in an overall probability of acoustic impact on MMST which is the compound probability of acoustic impact times the number of RVs flight tested onboard a single Minuteman III missile. The overall probability of acoustic impact is computed using equation 8.

$$P_{OPAI} = P_{CPAI} N_{RV} = P_{AIW} P_{IMP/AIW} N_{RV} = \frac{V_{AIW}}{V_{HW}} N_{RV} \qquad (9)$$

where P_{OPAI} is the overall probability of acoustic impact,

N_{RV} is the number of RVs flight tested onboard a single Minuteman III missile.

4.2. Computation of the Overall Probability of Acoustic Impact, P_{OPAI}

The source strength of an MMIIIRV is 3.06E+06 Pa-m (443.63 psi-m), and the SPL generated by the disintegration of the RV is expected to attenuate to 240 dB re 1 μPa at an AIR of 3.1 m from the point of RV disintegration. A careful consideration and analysis of the RV impact and disintegration configuration[4] at a recent peer review meeting[34] lead to the following conclusions: (a) The MMST may be seriously and permanently injured or killed from nonacoustic impacts if at the time of RV disintegration, they are within a distance of 15 m from the point of RV disintegration, and (b) the generalized equation (equation 4) utilized to compute the radial distances for acoustic impacts corresponding to the minimum SPLs that may cause TTS and physical injury impacts, may not fully account for the near field nonlinear, nonacoustic effects created by the turbulent heat, mass, and momentum fluxes that accompany the RV impact on the ocean surface, and its disintegration at a depth of about 6.9 m. At a radial distance of 15 m from the point of RV disintegration, the SPL is expected to attenuate to 226 dB re 1 μPa (30 psi) which is only 2 dB higher than the established TTS limit. Nevertheless, in order to err on the side of caution, a radial distance of 15 m rather than the AIR of 3.1m computed for an SPL of 240 dB re 1 μPa using equation 4, has been utilized to compute the volume of the AIW, and the overall probability of physical injury to MMST from acoustic impacts, $P_{OPAI@240}$.

The overall probabilities of TTS (at 224 dB re 1 μPa, which is equivalent to a total energy flux, E_T of 209 dB re 1 μPa^2-s) and physical injury impact (at 240 dB re 1 μPa equivalent to an E_T of 225 dB re 1 μPa^2-s) were calculated using equation 9. Previously, physical injury impact was estimated using a 12 psi (218 dB re 1 μPa equivalent to an E_T of 193 dB re 1 μPa^2-s) criterion[16,17]. Refer to Table 3.

Table 3. Probabilities of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles for the Intact Minuteman III Flight Test RV

Sound Pressure Level, dB re 1 μPa	Total Energy Flux, E_T dB re 1 μPa^2-s	Overpressure at Target Location, psi	Minimal AIR for Intact MMIIIRV, m	Probability of Impact, P_{OPAI}
218	193	12	39	3.31E-07
224	209	23	19	4.98E-08
240	225	145	15	2.41E-08

4.3. Definition, and Computation of Total Energy Flux, E_T

Total energy flux is frequently utilized along with SPL in the marine biological literature to set acoustic impact criteria for protected marine species, and to compare acoustic impact levels among species. The total energy flux at a certain sound pressure level is defined by equation 10.

$$E_T = 10\mathrm{LOG}\left\{\frac{(P - P_{inf})^2 t_+}{P_{ref}^2 t_{ref}}\right\} = 20\mathrm{LOG}(P - P_{inf}) + 10\mathrm{LOG}(t_+) \qquad (10)$$

Where E_T is the total energy flux, dB re 1 μPa^2-s,

P refers to pressure, μPa,

$P - P_{inf}$ is the measured overpressure, μPa,

P_{ref} is 1 μPa,

t_{ref} is 1 s,

t_+ refers to the duration of the positive phase of a pulse, s.

The first term on the right hand side of equation 10 is the SPL defined by equation 6, and hence, equation 10 can be written compactly as equation 11.

$$E_T = SPL + 10\mathrm{LOG}(t_+) \qquad (11)$$

The average length of the positive phase of a shock wave is 0.03 s for the hypersonic impact of objects on the ocean surface[25]. For $t_+ = 0.03$ s, the contribution of the $10\mathrm{LOG}(t_+)$ term in equation 11 to the total energy flux is -15.23 dB. Hence, for the hypersonic impact of an MMIIIRV on the ocean surface, the total energy flux corresponding to an SPL is obtained by subtracting 15 dB from the SPL.

4.4. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Provided by the National Marine Fisheries Service Regional Office, Honolulu, Hawaii

The number of groups of marine mammals impacted is computed by multiplying the total volume ($V_{AIW} N_{RV}$) of the AIW by marine mammal group density. Also, it can be readily obtained by multiplying the overall probability of acoustic impact (P_{OPAI}) by the estimated number of groups of marine mammals present in the HW as shown in equation 12.

$$V_{AIW} N_{RV} D_{MM} = V_{AIW} N_{RV} \left(\frac{N_{HW}}{V_{HW}} \right) = N_{HW} \left(\frac{V_{AIW}}{V_{HW}} N_{RV} \right) = N_{HW} P_{OPAI} \qquad (12)$$

where D_{MM} is the group density of MMST,
N_{HW} is the number of groups of MMST in the HW.

Aerial or shipboard surveys of MMST are usually performed a number of times over a period of several months to a few years[6,10,13,20,22-24,31]. It is assumed that any one group of MMST is detected only once in any one survey, in estimating the number of groups of MMST that will likely experience TTS, N_{TTS} , and the number of groups of MMST that will likely suffer physical injury (incidental take), N_{IT} , as a result of the proposed MMIIIRV flight tests. The total number of groups in each category of MMST detected in all the surveys are divided by the number of surveys in order to ensure that the same group of MMST are not counted more than once. It is this average number of groups (ANG) of MMST that is used to compute the number of groups of MMST acoustically impacted by the proposed MMIIIRV flight tests.

Aerial or shipboard surveys of MMST will detect only those animals that are on the surface of the ocean at the time of the surveys. At any instant of time, only a small fraction of MMST will be on the surface, and hence, only that fraction of MMST will be available for visual detection. There is a wide variation ranging from 0.1 to 0.5, in the reported fractions of MMST available for visual detection[6,10,20,31]. The fraction of MMST available at any instant of time for visual detection is equivalent to the fraction of time a group of MMST is available for visual detection which is the probability of visual detection, P_{VDET} .

$$P_{VDET} = \frac{t_s}{t_T} \qquad (13)$$

where t_s is the average length of time the group of MMST remains on the surface of the ocean,
t_T is the average total length of time of an MMST submergence/nonsubmergence cycle.

The number of groups of MMST visually detected must be corrected for the availability bias (the submerged fraction of the MMST) in order to estimate the total number of groups that will likely be present in a body (volume) of water. This is accomplished by dividing the number of groups of MMST visually detected by P_{VDET} , which is also known as the submergence correction factor. The TTS and physical injury impacts of the proposed MMIIIRV flight tests on MMST are computed using a P_{VDET} of 0.1 which is the most conservative submergence correction factor reported in the marine biological literature for the estimation of impacts on sea turtles[6,10,20,31].

Aerial surveys for MMST are performed by establishing transects (tracts) of certain width, spaced appropriately, and then flying a survey team over a randomly selected set of transects[6,10,20,31]. The survey will cover only a fraction of the test area. Hence, the data must be corrected for survey effectiveness. A Survey Effectiveness Factor (SEF) for the PMRF survey is not available. On the assumption that the PMRF SEF must be comparable to the SEFs utilized in other impact estimates[6,10,20,31], an SEF of 0.446 that was used in the groundbreaking EIS for the WINSTON S. CHURCHILL (DDG 81) Shock Trial[10], is used to correct the PMRF survey data.

The NMFS reported the sighting of a group of sperm whales[28] over the Kwajalein Atoll test site, assumed to be a circular area of 15 mile radius, in the vicinity of Illeginni Island, during each of its two surveys performed during the years 2000 and 2002. It is very unlikely that an aerial survey of this small test site with low marine mammal densities would have failed to detect all the marine mammals present on the surface. Hence, application of an SEF correction, in addition to the most conservative submergence correction (P_{VDET} = 0.1), to this survey data may overestimate the risk of impact, distort the true picture, and mislead the interested public.

The number of groups of MMST that will likely experience TTS as a result of the proposed MMIIIRV flight tests, N_{TTS} is computed from the NMFS survey data by multiplying the overall probability of TTS ($P_{OPAI@224}$) impact by ANG, and dividing by P_{VDET}.

$$N_{TTS} = P_{OPAI@224} \frac{ANG}{P_{VDET}} \qquad (14)$$

For ANG = 1, and P_{VDET} = 0.1,

$$N_{TTS} = \left[4.98\left(10^{-08}\right)\right]\left(\frac{1}{0.1}\right) = 4.98\text{E-}07$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is computed from the NMFS survey data using equation 15.

$$N_{IT} = P_{OPAI@240} \frac{ANG}{P_{VDET}} \qquad (15)$$

$$N_{IT} = \left[2.41\left(10^{-08}\right)\right]\left(\frac{1}{0.1}\right) = 2.41\text{E-}07$$

in which $P_{OPAI@240}$ is the overall probability of physical injury impact.

4.5. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Opportunistic Sighting Data Provided by the Department of Energy/Lawrence Livermore National Laboratory

The Department of Energy/Lawrence Livermore National Laboratory (DOE/LLNL) reported the opportunistic sighting of a porpoise, and a group of dolphins[18] in the vicinity of Illeginni Island during two of its over 50 helicopter flights, and nearly 20 boat trips between Kwajalein and Illeginni Islands over a period of about 15 years.

The number of groups of MMST that will likely experience TTS, as a result of the proposed MMIIIRV flight tests, N_{TTS} is computed from the DOE/LLNL opportunistic sighting data using equation 14.

$$N_{TTS} = P_{OPAI@224} \frac{ANG}{P_{VDET}} \tag{14}$$

For ANG = 0.029, and P_{VDET} = 0.1,

$$N_{TTS} = \left[4.98\left(10^{-08}\right)\right]\left(\frac{0.029}{0.1}\right) = 1.42\text{E-}08$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is computed from the DOE/LLNL opportunistic sighting data using equation 15.

$$N_{IT} = P_{OPAI@240} \frac{ANG}{P_{VDET}} \tag{15}$$

$$N_{IT} = \left[2.41\left(10^{-08}\right)\right]\left(\frac{0.029}{0.1}\right) = 6.89\text{E-}09$$

4.6. Estimation of TTS and Physical Injury Impacts on Marine Mammals and Sea Turtles from the Survey Data Collected by the Marine Mammal Research Program, ATOC, for the Pacific Missile Range Facility EA, and Provided by the USASMDC

The MMRP of ATOC performed extensive aerial surveys of Hawaiian Waters during the period of 1993 through 1998 for the PMRF EA[22-24]. The USASMDC[13] provided the PMRF survey data to ICBM SPO for analysis, and comparison with the results obtained from NMFS survey data for the proposed MMIIIRV flight tests in the vicinity of Illeginni and KMISS Islands.

Estimates of TTS and physical injury impacts from two or more test sites may be compared to identify sites with the lowest risk, and to validate the assumptions made and the constraints applied in the development of a probabilistic impact model. In order to compare the impacts on marine mammals at the PMRF test site to the impacts at the Kwajalein Atoll test site, the average number of groups of MMST detected at PMRF test site must be multiplied by an area sizing factor (ASF) which is the ratio of the area of Kwajalein Atoll test site to the area of the PMRF test site. The surface area of the Kwajalein Atoll test site is 707 square miles, and the surface area of the PMRF test site is 36,644 square miles[13]. The ASF is 0.02.

The number of groups of MMST that will likely experience TTS as a result of the proposed MMIIIRV flight tests, N_{TTS} is computed from the PMRF aerial survey data by multiplying the overall probability of TTS ($P_{OPAI@224}$) impact by ANG and ASF, and dividing by P_{VDET} and SEF.

$$N_{TTS} = P_{OPAI@224} \frac{(ANG)(ASF)}{(P_{VDET})(SEF)} \qquad (16)$$

For ANG = 21, P_{VDET} = 0.1, ASF = 0.02, and SEF = 0.446

$$N_{TTS} = \left[4.98\left(10^{-08}\right)\right] \frac{(21)(0.02)}{(0.1)(0.446)} = 4.52\text{E-07}$$

The number of groups of MMST that will likely suffer physical injury, N_{IT} is estimated from the PMRF aerial survey data using equation 17.

$$N_{IT} = P_{OPAI@240} \frac{(ANG)(ASF)}{(P_{VDET})(SEF)} \qquad (17)$$

$$N_{IT} = \left[2.41\left(10^{-08}\right)\right] \frac{(21)(0.02)}{(0.1)(0.446)} = 2.19\text{E-07}$$

The PMRF survey data[13], and the results of the acoustic impact analysis are summarized in Table 4.

4.7. Estimation of TTS and Physical Injury Impacts on Sea Turtles from the Survey Data Provided by the Fish and Wildlife Service Regional Office, Honolulu, Hawaii

Sea turtles are solitary animals, and hence, their group size is assumed to be one[10]. The number of groups of sea turtles is the same as the number of individual sea turtles. Sea turtles are submerged almost 90% of the time[10], and the fraction of sea turtles available for visual detection during a survey is 0.1 which is the P_{VDET} used to compute the acoustic impact estimates.

Table 4. Results of the PMRF Survey Data Analysis

Marine Mammals Sighted	No. of Groups Sighted	ANG	Corrected ANG	N_{TTS}	N_{IT}
Whales					
Short-finned pilot whale	22	0.96	0.41	2.06E-08	9.97E-09
False killer whale	5	0.22	0.09	4.68E-09	2.27E-09
Sperm whale	6	0.26	0.11	5.62E-09	2.72E-09
Blainville's beaked whale	2	0.09	0.04	1.87E-09	9.06E-10
Unidentified beaked whale	4	0.17	0.08	3.75E-09	1.81E-09
Culver's beaked whale	1	0.04	0.02	9.36E-10	4.53E-10
Humpback whale	330	14.35	6.21	3.09E-07	1.50E-07
Unidentified whale	20	0.87	0.38	1.87E-08	9.06E-09
Fin Whale	1	0.04	0.02	9.36E-10	4.53E-10
All Whales	391	17.00	7.35	3.66E-07	1.77E-07
Dolphins					
Spotted dolphin	5	0.22	0.09	4.68E-09	2.27E-09
Spinner dolphin	17	0.74	0.32	1.59E-08	7.70E-09
TG	10	0.43	0.19	9.36E-09	4.53E-09
Rough-toothed dolphin	5	0.22	0.09	4.68E-09	2.27E-09
Risso Dolphin	2	0.09	0.04	1.87E-09	9.06E-10
Unidentified dolphin	38	1.65	0.71	3.56E-08	1.72E-08
Unidentified Stenella	7	0.30	0.13	6.56E-09	3.17E-09
Bottlenosed dolphin	8	0.35	0.15	7.49E-09	3.63E-09
All Dolphins	92	4.00	1.73	8.62E-08	4.17E-08
All Mammals	483	21.00	9.08	4.52E-07	2.19E-07

Very little direct data is currently available for TTS and physical injury impacts on sea turtles[30]. The USFWS reported the sighting of a sea turtle[28] in the vicinity of Illeginni Island, during each of its two biannual inventories performed in years 1996 and 2002. On the basis of the assumption that the impacts of the proposed MMIIIRV flight tests on sea turtles would be similar to the impacts on marine mammals, the TTS and physical injury impacts on sea turtles have been estimated from the USFWS survey data, using the same criteria established in Section 2.2 for the TTS and physical injury impacts on marine mammals. The number of sea turtles sighted per survey by USFWS is the same as the number of groups of sperm whales sighted per survey by NMFS, and hence, the estimated TTS and physical injury impacts of the proposed MMIIIRV flight tests on sea turtles are the same as those for the marine mammals: N_{TTS} is 4.98E-07, and N_{IT} is 2.41E-07.

5. CONCLUSION

The criterion for TTS impact to MMST is 224 dB (equivalent to a total energy flux of 209 dB re 1 μPa^2-s). The SPL generated by the disintegration of Minuteman III flight test RV at a depth of 7m from the surface of the ocean, is expected to attenuate to 224 dB at an AIR of 19.3m from the point of RV disintegration. The criterion for physical injury impact to MMST is 240 dB (equivalent to a total energy flux of 225 dB re 1 μPa^2-s), and the SPL is expected to attenuate to 240 dB at an AIR of 3.1m from the point of RV disintegration. The volume of the AIW was calculated using a minimum radial distance of 15m rather than an AIR 3.1m computed using equation 4 for an SPL of 240 dB consistent with the rationale provided in Section 4.2. On the basis of these criteria and the rationale for the use of a minimum radial distance of 15m, the probabilities of TTS and physical injury impacts to MMST have been estimated to be 4.98E-08 and 2.41E-08. The number of sea turtles or the number of groups of marine mammals that may experience TTS, N_{TTS} has been estimated to be 4.98E-07, and the number of sea turtles or the number of groups of marine mammals that may suffer physical injury, N_{IT} has been estimated to be 2.41E-07. Despite the utilization of the same impact criteria for the marine mammals and the sea turtles, the TTS and physical injury impacts of the proposed MMIIIRV flight tests are considered to be less severe on sea turtles than on the marine mammals[6,10,20,31,35].

The N_{TTS} and N_{IT} estimates for the Kwajalein Atoll test site assure the United States Air Force (USAF), DOE/LLNL, USAKA, UASASMDC, FWS and NMFS that the impacts of the proposed MMIIIRV flight tests on MMST is quite insignificant. The assumptions made and the constraints applied in the definition of HW and AIW, and in the development of the probabilistic impact model, and the analytical approach utilized in the computation of the probabilities for the onset of TTS and physical injury impacts have been validated by the remarkably identical N_{TTS} (4.52E-07) and N_{IT} (2.19E-07) estimates obtained from the PMRF survey data. In addition, it is reassuring that the N_{TTS} (1.42E-08) and N_{IT} (6.89E-09) estimates computed from the DOE/LLNL opportunistic sighting data collected over the test site in the vicinity of Illeginni Island are an order of magnitude less than the N_{TTS} and N_{IT} estimates derived from the NMFS and PMRF survey data

The maximum SPL[26] corresponding to the sonic boom associated with the Minuteman III flight test RV is 175.6 dB which is well below the TTS and physical injury impact criteria established in Section 4.2. The MMST may hear and respond (for instance, startling) to the RV disintegartion at even greater radial distances corresponding to an SPL of 120 dB, but it is unlikely that an individual marine mammal or sea turtle would experience any more than a single, momentary disturbance[10,31]. The radius of audibility is much greater than the radius of responsiveness to acoustic disturbances.

The limited amount of data available for sea turtles[6,10,20,31] in the marine biological literature indicate that the impacts of the proposed MMIIIRV flight tests on sea turtles would be similar to the impacts on marine mammals. Hence, the TTS and physical injury impact criteria established for marine mammals are equally applicable to sea turtles.

In Robertson v. Methow Valley Citizens Council[36], The Supreme Court has declared that the sweeping policy goals of NEPA are realized through a set of “action-forcing” procedures that require the federal agencies to take a “hard look” at the environmental consequences of their proposed actions. The ICBM SPO has computed the probabilities of the TTS and physical injury impacts to MMST, and the number of sea turtles and the number of groups of marine mammals that may experience TTS and/or suffer physical injury, and carefully and objectively considered the consequences of the proposed MMIIIRV flight tests on MMST. The USAF and the ICBM SPO have made a serious, objective and good faith effort in estimating the acoustic impacts to MMST, and taken a “hard look” at the expected environmental consequences of the proposed MMIIIRV flight tests, and, on the basis of the analysis of currently available data, concluded that the impact on MMST at Kwajalein Atoll is quite insignificant.

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SYMBOLS

D	Depth of the habitation well (250 m)
D_{MM}	Group density of MMST
d	Depth (AB) at which the RV is expected to disintegrate (6.9 m)
dB	Decibel
E_T	Total energy flux, μPa^2-s
N_{HW}	Number of groups of marine mammals in the habitation well
N_{IT}	Number of groups of marine mammals that will likely suffer physical injury
N_{RV}	Number RVs flight tested onboard a single Minuteman III missile.
N_{TTS}	Number of groups of marine mammals that will likely experience TTS
P	Pressure, Pa (Pascal) or μPa
μPa	Micropascal, 1E-6 Pa
μPa^2-s	Squared micropscal times second
Pa-m	Pascal-meter
Pa-s	Pascal-second
$P - P_{inf}$	Overpressure, Pa or μPa
P_{CPAI}	Compound probability of acoustic impact
P_{OPAI}	Overall probability of acoustic impact
$P_{IMP/AIW}$	Conditional probability of acoustic impact given the fact that a group or a member of a group of marine mammals is already within the impact well.
P_{inf}	Ambient pressure, Pa
P_{ref}	Reference pressure for water, μPa = 1E-06 Pa
P_{AIW}	Probability that a group or a member of a group is within the acoustic impact well
$P_{OPAI@224}$	Overall Probability of TTS impact
$P_{OPAI@240}$	Overall Probability of physical injury impact
P_{VDET}	The probability of visually detecting an MMST
R	Radius of the habitation well (24,140 m, 15 miles)
r	Radius of the acoustic impact well (BC = BE in Figure 1)
r_s	Surface radius (AE in Figure 1) of the impact well
S	Source strength of an intact MMIIIRV, Pa-m
t_{ref}	Reference duration, s
t_s	Length of time a group of MMST remains on the surface of the ocean
t_T	Average total length of time of a submergence/non-submergence cycle
t_+	Duration of the positive phase of a pulse, s
V_{HW}	Volume of the habitation well (4.58E+11 m^3)
V_{AIW}	Volume of the acoustic impact well, m^3

ABREVIATIONS

AFB	Air Force Base
AFSPC	Air Force Space Command
AIR	Acoustic Impact Radius
AIW	Acoustic Impact Well
AME	Aerospace and Mechanical Engineering
ANG	Average Number of Groups (of marine mammals)
ASF	Area Sizing Factor
ATOC	Acoustic Thermometry of Ocean Climate
CFR	Code of Federal Regulations
DOD	Department of Defense
DOE	Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
HW	Habitation Well
ICBM	Intercontinental Ballistic Missiles
IT	Incidental Take
KMISS	Kwajalein Missile Impact Scoring System
LLNL	Lawrence Livermore National Laboratory
MMIIIRV	Minuteman III RV
MMRP	Marine Mammal Research Program
MMST	Marine Mammals and Sea Turtles
NG	Number of Groups (of marine mammals)
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
PMRF	Pacific Missile Range Facility
PTS	Permanent Threshold Shift
RMI	Republic of Marshall Islands
RV	Reentry Vehicle
SEF	Survey Effectiveness Factor
SMC	Space and Missile Systems Center
SMDC	Space and Missile Defense Command
SPL	Sound Pressure Level, measured in dB
SPO	System Program Office
TTS	Temporary Threshold Shift
UES	USAKA Environmental Standards
US	United States
USAF	United States Air Force
USAKA	United States Army Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
USFWS	United States Fish and Wildlife Services
USC	University of Southern California

APPENDIX C

COMMENTS AND RESPONSES ON THE DRAFT ENVIRONMENTAL ASSESSMENT

Comments and Responses on the Draft Environmental Assessment for Minuteman III Modification

A log of public and agency comment documents received on the Draft Environmental Assessment (EA) is provided below, and includes the document date, author, and his/her organization. A photocopy of each document can be found on the page number identified. Within most of the documents, comment numbers have been added along the right margins and are numbered sequentially. A corresponding list of comment responses, or a response letter, is provided immediately following each of the comment documents. Note that in addition to the comment responses, the text of the Final EA has also been revised, as appropriate, to reflect the concerns expressed in the comments.

Comment Documents Received

Date	Author	Organization	Page
September 29, 2004	Doug Norlen	Pacific Environment	C-3
September 30, 2004	Tamra Faris	National Marine Fisheries Service, Pacific Islands Regional Office, Protected Resources Division	C-18
November 5, 2004	Gerald Davis	National Marine Fisheries Service, Pacific Islands Regional Office, Habitat Conservation Division	C-22
November 17, 2004	Gina Shultz	US Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office	C-25

PACIFIC ▪ ENVIRONMENT

Protecting the living environment of the Pacific Rim

September 29, 2004

SMC/AXFV
Attn: Leonard Aragon
2420 Vela Way, Suite 1467, El Segundo, CA 90245-4659
(via email: Leonard.Aragon@losangeles.af.mil)

Mr. Aragon,

Pacific Environment has reviewed the Draft EA and Draft Finding of No Significant Impact (FONSI) for the Minuteman III Modification, and we submit the following comments for consideration.

Pacific Environment is an international Non Governmental Organization (NGO) that supports grassroots and community activism to achieve environmental and social protection and to promote sustainable development.

Pacific Environment respectfully disagrees with the conclusions of the Draft EA and FONSI that there will be no significant environmental and human health impacts of the proposed action on the environment of the Marshall Islands. **1**

The Draft EA acknowledges the environmental importance of the down-range environment in question, including the Mid-Atoll Corridor:

> *The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.*

Source: Naughton, 2004

(Picture of marine biodiversity contained in the Draft EA)

311 California Street, Suite 650 ▪ San Francisco, CA 94104
tel. 415.399.8850 ▪ fax. 415.399.8860 ▪ www.pacificenvironment.org

The Draft EA acknowledges the presence of threatened, endangered and protected species in the area of Kwajalein Atoll, including whales, dolphins, turtles, clams, sponge and coral species, and migratory birds. The Draft EA acknowledges the biological diversity of the over-ocean corridor generally, including micro fauna, threatened and endangered species, protected marine mammals including seals, sea lions, sea otters, porpoises, dolphins, whales, and turtles. The Draft EA
acknowledges the potential for direct impact on Illeginni Island or in the shallow **2**
coral reefs of Kwajalein, including impact on habitat of protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting sites, and coral reef habitat. The Draft EA
also acknowledges the importance of fish to people living in the area, who will be **3**
adversely affected by the proposed action:

> *… 250 species of reef fish are located in the atolls of the Marshall Islands. Because food cultivation on the islands is limited, fish and other sea life are of important dietary value to the Marshallese people (Pacific Island Travel, 2002).*

The Draft EA acknowledges that:

> *[R]esidual amounts of battery electrolytes, hydraulic fluid, propellant, and* **4**
> *other materials in the spent rocket motors could lead to the contamination of seawater…*

And,

> *Following an aerial detonation or impact of an RV in the ocean, the Kwajalein Atoll lagoon, and/or on Illeginni Island, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind.*

However, the Draft EA is dismissive of potential impacts to these ecological and human resources with regards to contaminants to be released by the falling missile
components. For example, it also states: **5**

> *[T]he contaminants released by some RVs are extremely insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels.*

Nowhere in the Draft EA is there data to indicate the rate of dilution and mixing of ocean and lagoon to support the conclusions of the Draft EA that battery electrolytes, hydraulic fluid, and other materials would be "no
different than background levels." In particular, no data is presented to **6**
indicate the rate of dilution and mixing in more shallow ocean, lagoon, and island habitats where debris may land.

Meanwhile, according to the Draft EA, the propellant to be used in the first,
second and third stage motor is Ammonium Perchlorate, which is *absolutely* **7**
not insoluble. There is growing concern about the environmental and human

health impacts of Ammonium Perchlorate because it is highly toxic, soluble
and persistent. Ammonium Perchlorate is a chemical that interferes with
normal thyroid function, and persists indefinitely in the environment.[1]
Ammonium Perchlorate has been documented as a contaminant at rocket
manufacturing, testing, launching and disposal sites across the country, **8**
including Vandenberg.[2] In fact, in a 2001 memo that contained a list of
known users and manufacturers of perchlorate, the EPA noted that at
"essentially every listed facility where an effort has been made to test for
perchlorate, perhclorate has been found in the soil or groundwater."[3] It is very
reasonable to assume that Ammonium Perchlorate contamination will occur in **9**
the marine environment and terrestrial environment at the point of impact,
downwind, and downstream of RV debris.

According to the Draft EA:

> *When the spent rocket motors impact in the ocean, no solid propellant would be remaining in them. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns.*

Elsewhere, the Draft EA contradicts itself on the impacts of propellants:

> *[R]esidual amounts of hydraulic fluid and strontium perchlorate contained in*
> *the 1st- and 3rd-stage motors (respectively), may mix with the seawater,* **10**
> *causing contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.*

Hence, the Draft EA fails to adequately assess the potential impacts of
Ammonium Percholate contamination and its conclusion of no significant
impact is not grounded. The finding of perchlorate contamination at rocket
launching and testing facilities as well as at open burn/open detonation sites **11**
both at military sites and private facilities throughout the US demonstrates
that residual ammonium perchlorate propellant is not only likely to be present
in the spend rocket motors, but that terrestrial and aquatic contamination from
this propellant is likely.[4]

The Draft EA ignores the persistency of some hazardous material by
suggesting potential impacts are short term:

12

> *The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain.*

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[1] See http://www.ewg.org/reports/rocketwater/
[2] See http://geotracker.swrcb.ca.gov/perchlorate/default.asp?cmd=detailedsite
[3] EPA Memorandum, "Perchlorate Contamination Update," from Felicia Marcus, Regional Administrator, 2001.
[4] Ibid #3

However, the words “small” and “minimal” are imprecise and misleading. Ammonium Perchlorate, for example, is hazardous in extremely small amounts. California’s current provisional drinking water standard is 6 parts per billion (ppb). The EPA’s current draft standard is equivalent to 1 ppb.[5] If there is cause for concern with the human health impacts of small amounts of Ammonium Perchlorate, then there is also likely to be corresponding impacts to the marine and terrestrial environment, including protected migratory birds, mollusks, sponges, corals, and other marine life; and damage small areas of migratory bird habitat, sea turtle nesting sites, and coral reef habitat. This is especially true given that perchlorate is known to prevent forelimb emergence and tail resorption as well as altering the sex ratio in frogs at perchlorate levels (~ 150 ppb) similar to or lower than those found at many contaminated sites.[6] **12 (cont’d)**

Meanwhile, the Draft EA describes the impact of a failed or terminated launch:

> *Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure and terminating propellant combustion. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate. Once in the water, it can slowly leach out of the solid propellant resin binding-agent.*

The Draft EA describes such an event as “unlikely,” but elsewhere suggests “aerial detonation” of an RV as a source of dissemination of debris in the the Kwajalein Atoll lagoon, and/or on Illeginni Island. However, the Draft EA does not explain the intended practice of aerial detonation and whether it will occur when motor stages that contain Ammonium Perchlorate or other propellants are still present on the missile. **13**

The Draft EA goes on to state that:

> *The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any pieces of propellant expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.*

Draft EA Figure 2-12 presents a poorly detailed map of where components of the missile will fall, but nevertheless indicates the third motor stage falling in the vicinity of the Utrick Atoll, which includes a number of islets and lagoon areas. If there is any possibility that the third stage could fall near or on the **14**

[5] Ibid #1
[6] Goleman, WL, Urquidi LJ, Anderson, TA, Kendall, RJ, Smith, EE, Carr, JA. 2002. Environ Toxicol Chem. 21: 424-430

Utrick Atoll or any other island or shallow marine area, it is not adequately described or depicted in the Draft EIA. **14 (cont'd)**

Meanwhile, the Draft EIA describes additional components of the missile above the third stage that also contain propellant:

> *Just above the 3rd-stage motor on the MM III is the PSRE. It is a liquid propellant rocket unit consisting of two sealed propellant storage assemblies, a helium gas storage tank for pressurizing the propellant, and several small rocket engines. The propellants used are monomethylhydrazine (CH_6N_2) as the fuel, and nitrogen tetroxide (N_2O_4) as the oxidizer, which form a hypergolic combination.* **15**

And,

> *The nose cap on top of the shroud contains a small rocket motor containing 6.8 lb (3.1 kg) of solid propellant, which is used to eject the shroud from the vehicle while in flight.*

According to the Figure 2-12 and other information in the Draft EA, these components will fall in the vicinity of the Kwajalein Atoll lagoon, and/or on Illeginni Island. Yet, there is <u>no</u> assessment of the impacts of these specific propellants on these environments or on human health.

The Draft Environmental Assessment acknowledges that the heavy metal beryllium (Be) and depleted uranium (DU) could be dispersed into the environment:

> *[D]epending on mission requirements, some of [the RV simulators] may contain varying quantities of hazardous materials, including high explosives, beryllium (Be), depleted uranium (DU)[1], and batteries.*

And,

> *Following an aerial detonation or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind. However, the Be and DU particles or fragments deposited by some RVs are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels.*

Concerning land-based impacts (wildlife and human):

> *In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Though there is the potential for migratory birds on the island to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.*

And,

For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind.

And,

[A]n aerial burst or ocean/lagoon impact by some test RVs would disseminate onboard hazardous and toxic materials—primarily Be and DU—around the impact point and some distance downwind. For a land impact on Illeginni, such debris occurs close to the point of impact, mostly within a 328-ft (100-m) radius. As a result, the major potential health concern of these tests is the subsequent effects on USAKA workers, and other agency and contractor personnel, whose occupations require visits to the island, and the long-term management and restoration of the island.

Concerning marine impacts:

16

Fine particles would eventually be distributed in the sediment and be of no consequence to marine species, while any larger fragments would be recovered from the lagoon or from shallow ocean waters for proper disposal (see Section 4.5.4). (USAF, 1992a)

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Throughout these sections, the Draft Environmental Analysis concludes that there is no significant impact from DU contamination due to factors such as "small amounts" of unrecovered material, dilution, etc. Again, there is no data provided to substantiate dilution rates, particularly in shallow waters or on land.

Meanwhile, Table 4-7 presents an example of the amount of DU recovered in a previous launch, 176 pounds and 97 pounds for land and Atoll lagoon, respectively. However there are no figures indicating what percentage of total original DU this represents, and what amount of unrecovered DU remains. **17** The Draft Environmental Assessment indicates that there could be considerable amounts remaining in small fragments or aerosolized, or simply debris unrecovered from the deep ocean:

> *Because of the hypersonic velocity of RVs at impact, DU components are broken into small fragments and/or aerosolized. All of the Be-containing components are aerosolized because of the composition of the material; thus, no Be has been recovered. No attempts have been made to recover RV debris from deep ocean waters. (Lindman, 2004)*

17 (cont'd)

The size of fragments, which are to be screened and removed manually, is left unclear, but what smaller fragments that remain appear to be buried in the soil, lagoon and ocean reefs by earthmoving equipment:

> *Post-test recovery operations at Illeginni Island require the manual cleanup and removal of any RV debris, including hazardous materials (e.g., DU), followed by filling in larger craters using a backhoe or grader…*

18

And,

> *RV recovery/cleanup operations in the lagoon and ocean reef flats, within 500 to 1,000 ft (152 to 305 m) of the shoreline, are conducted similarly to land operations when tide conditions and water depth permit. A backhoe is used to excavate the crater. Excavated material is screened for debris and the crater is usually back-filled with coral ejected around the rim of the crater.*

Again, the phrase "small amounts" of unrecovered material is imprecise and misleading. It is very likely that "small amounts" of DU can lead to significant harm to the environment and human health. Over the past twenty five years evidence of environmental and human health damage caused by DU has steadily increased, including significant evidence that DU can cause or accelerate cancer, mutate genes, and affect the kidneys, immune system, nervous system, respiratory system, and reproductive system. The United Nations Human Rights Commission considers DU munitions to be "weapons of mass destruction or with indiscriminant effect" incompatible with international humanitarian law.[7] **19**

The Draft EA purports to evaluate the impacts of the proposed action on air quality. Yet, it does so only for the California portions of the proposed action, and even here it omits evaluation of airborne Ammonium Perchlorate. For the Marshall Islands portion of the proposed action, the Draft EA fails to evaluate air quality impact altogether, including from the potential airborne dissemination of battery electrolytes, hydraulic fluid, propellant, and other materials from falling stages or aerial detonation or impact from the falling RV. This includes DU and Be, which the Draft Environmental Assessment indicates will be aerosolized. **20**

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[7] "Depleted" Uranium Munitions, Nuclear Waste as a Weapon, Military Toxics Project Information Sheet, June 2003. See also: http://www.miltoxproj.org/DU/DU_Faqs/Du_Faqs.htm

The Draft EA correctly includes a section on cumulative effects. However, this section is framed as a *discussion* of cumulative effects, without much *assessment* of cumulative effects. For example:

> *The additional RV flight tests targeted within the Mid-Atoll Corridor could impact threatened and endangered sea turtles and marine mammals as a result of sonic boom overpressures, chemical release and water contamination, and direct contact and shock/sound wave from the splashdown of missile components. However, the relatively sparse distribution of marine mammals and sea turtles in the area makes the probability of significant adverse cumulative impacts on such species low.* **21**

Moreover, the cumulative effects section seems to be missing the point that small incremental effects (which the Draft EA acknowledges will occur), when combined with past effects may trigger significant cumulative effects that require an EIS. Instead, the Draft EA simply focus on the small incremental effects, disregarding the range of stressors that may already exist to each of the sensitive resources identified in each of the impact areas.

Thus, much of the cumulative impacts section reaches conclusions based on conjecture rather than assessment.

We are also concerned that the proposed action may be associated with a changed condition relates to the referenced incidental take permit/biological opinion, which triggers a requirement of re-consultation. **22**

Conclusion:

Pacific Environment respectfully challenges the Draft Environmental Assessment finding of no significant impact (FONSI). **23**

Commendably, the Draft Environmental Assessment does a good job to describe the importance of natural and human environment including marine and terrestrial biodiversity, threatened, endangered and protected marine and bird species, and fish resources in the Marshall Islands region. The Draft Environmental Assessment acknowledges contamination of hazardous material including battery electrolytes, hydraulic fluid, propellant, beryllium, and depleted uranium. However, the Draft Environmental Assessment fails to accurately or completely assess the environmental impacts of the proposed action for the following reasons:

- Inadequate description of the proposed action, including "aerial detonation;" **24**
- Poor description of location of falling components; **25**
- Inadequate or no data to base claim that the expected contamination is not significant; **26**

- Internally contradictory statements about potential for impacts from propellants; 27
- Inadequate assessment of potential impact of Perchlorate 28
- No assessment at all of other propellants, including monomethylhydrazine (CH6N2) and nitrogen tetroxide 29
- Inadequate assessment of impacts of Depleted uranium and beryllium 30
- Inadequate assessment of air quality impacts 31
- Inadequate cumulative affects analysis 32
- Change of condition that requires re-consultation related to incidental take permit/biological opinion. 32

As a consequence, we believe that there is inadequate basis for a finding of no significant impact (FONSI), and that a full Environmental Impact Statement is required. 33

RESPONSES TO PACIFIC ENVIRONMENT COMMENTS (9/29/04)

Response to Comment #1
It is acknowledged that Pacific Environment disagrees with the conclusions of the Draft EA and Draft FONSI.

Response to Comment #2
As described in Section 4.5.1 of the EA, the potential for RV impacts on Illeginni Island or in coral reef areas is very low (estimated to be four to five instances over a 20-year period). No significant impacts to biological resources are expected.

Response to Comment #3
The EA does acknowledge the importance of fish to the Marshallese people; however, the comment that people living in the area will be adversely affected by the proposed action is false. There are no people living on or near Illeginni Island, or near any of the lagoon or ocean areas where RVs would impact. Because only a few RV tests would occur each year, and only small areas would be affected with each test, fish populations would not be impacted.

Response to Comment #4
See responses to Comments #6, #9, and #10.

Response to Comment #5
The commentor's quote from the EA "The contaminants released by some RV's are extremely insoluble…" is not entirely correct. The insolubility statement only applies to DU and Be. Chapter 4 of the Draft EA makes that statement in several places that "the DU and Be particles or fragments deposited by some RVs are very insoluble, and the dilution and mixing of the ocean and lagoon are so great that the concentration in water would be no different than natural background levels." Studies cited in Section 4.5.1.1 of the EA support this finding. Analyses of potential impacts from DU and Be particles on the ecological environment and human health are discussed in Sections 4.5.1 and 4.5.3 of the EA, respectively. See also the response to Comment #6.

Response to Comment #6
Though dilution rates for the battery electrolytes, hydraulic fluid, and other materials carried onboard the spent rocket motors and test RVs have not been determined, the relatively small quantities are expected to be well dispersed and diluted once the missile components impact the water. For example, Section 4.5.1.1 points out that the individual RVs impacting at USAKA would contain no more than 2.13 ounces of potassium hydroxide and about 0.2 pounds of lithium compounds. On land or within the shallow waters at USAKA, battery fragments would be recovered as part of post-test cleanup operations. For discussion on the DU and Be materials carried on some RVs, refer to the response to Comment #5.

In regards to the hydraulic fluid, the 1st-stage rocket motor thrust vector control system contains several gallons of the fluid. As described in Section 2.2.3 and shown on Figure 2-10 of the EA, the spent 1st-stage rocket motor would impact in the open ocean approximately 110-160 miles off the California coast. Though the hydraulic fluid could leak into the water, it would not result in significant impacts (see Section 4.4.1 of the EA). As explained in Section 2.1.1, no other Minuteman III missile components (including the test RVs) contain hydraulic fluid.

Response to Comment #7
It is acknowledged that the three rocket motor stages used for the Minuteman III missile contain a solid propellant, which includes ammonium perchlorate as one of the chemical components (see Table 2-1 in

the EA). It is also true that ammonium perchlorate is not insoluble in water. This point is explained in Section 4.3.3.1 of the EA.

Response to Comment #8
As described in Section 3.3 of the EA, prior Installation Restoration Program (IRP) studies at Vandenberg AFB have not shown any concerns for contamination to soils or groundwater from prior launches in the Minuteman Launch Area. However, the Vandenberg AFB IRP did discover perchlorate contamination at the "Site 8 Cluster", which is Space Launch Complex (SLC) 4 on South Base, located approximately 14 miles south of the Minuteman Launch Area. Perchorate levels up to 500 parts per billion (ppb) were detected at this site. This facilitated installation of a perchlorate removal system at SLC-4. The contaminants resulted from prior launch activities at this site.

Except for SLC-4, there are no other known perchlorate contamination sites on base. However, at the request of the California Environmental Protection Agency, Central Coast Regional Water Quality Control Board, a basewide preliminary assessment was recently initiated. This assessment will conduct a historical search and identify any likely sites for perchlorate contamination. The Minuteman launch facilities on North Base are included in this effort. Soil and/or groundwater sampling will be conducted at identified sites as required. This effort will be completed in late FY05.

Response to Comment #9
The statement about perchlorate and RVs is false. As described in Section 2.1.1, the 1st-, 2nd-, and 3rd-stage rocket motors, and the small Reentry System shroud ejection motor, are the only Minuteman III missile components containing solid propellant with ammonium perchlorate. Following launch, each of the three main rocket motors would be expended by the time they impact in the open ocean; therefore, no propellants (or perchlorate) would be expected to enter the water (see Section 4.4.1.1 of the EA). The shroud ejection motor would also be spent early in flight and, should the motor casing survive atmospheric reentry, would not cause any perchlorate contamination in the ocean. Neither the post-boost vehicle, nor any of the test RVs, contains solid propellant or any other forms of perchlorate.

Response to Comment #10
The hydraulic fluid and strontium perchlorate are used in the rocket motor thrust vector control systems. They are not a component of the solid propellant (see Section 2.1.1 of the EA). Though small quantities of these fluids (i.e., up to several gallons of hydraulic fluid and up to several pounds of strontium perchlorate) could leak into the water following motor impact in the open ocean, they would not result in significant impacts (see Section 4.4.1 of the EA).

Response to Comment #11
Though ground "testing facilities as well as at open burn/open detonation sites" may have proven to be sources of perchlorate contamination at some locations (i.e., locations not associated with the proposed Minuteman III Modification), Minuteman III launches have not been identified as a source of such contamination. See also responses to Comments #8 and #9.

Response to Comment #12
The EA does not ignore the persistency of hazardous materials. For example, on Illeginni Island, long-term monitoring of DU and Be from prior RV tests has not shown little or no buildup of contaminants. As described in Sections 4.5.3.1 and 4.5.4.1, prior sampling has shown that levels of contaminants in the air continue to remain at or near background levels. Because no missile components containing solid propellants would impact in the vicinity of the Marshall Islands, there is no means for ammonium perchlorate to be introduced to the islands under the Proposed Action. As noted in the response to Comment #9, the expended rocket motors would not contain any propellant when they impact in the open

ocean. Thus, no sea turtle nesting sites or reef habitat would be affected by ammonium perchlorate. See also responses to Comments #6 and #10.

Response to Comment #13

As described in Sections 4.3.3.1 and 4.4.1.1, a system failure during launch or an early termination of flight would terminate propellant combustion, and potentially disperse solid propellant over a large area. For impacts at Vandenberg AFB, procedures are in place to recover unburned propellant from land and shallow waters (Sections 4.3.3.1 and 4.3.5.1 of the EA), thus, preventing the potential for perchlorate to be released into the soil or groundwater. For impacts in deeper ocean waters, perchlorate leachate concentrations from unburned propellant are not expected to accumulate to a level of concern (see Section 4.4.1.1 of the EA).

As explained in Section 2.2.4 of the EA, RV tests at USAKA do not include rocket motors. As previously noted in responses to Comments #9 and #12, there is no means of introducing ammonium perchlorate to the USAKA environment under the Proposed Action.

Response to Comment #14

USAF and USAKA flight safety requirements specify that missile components and related debris are not to impact on or in the vicinity of inhabited atolls and islands, including Utrick Atoll. Artificial protection boundaries around these land areas are used to ensure the safety of inhabitants of the Marshall Islands. As depicted in Figure 2-12 of the EA, the spent third-stage motor would impact in deep ocean waters far from most land areas.

Response to Comment #15

First, it is important to clarify that neither the PSRE, nor the nose shroud (including the shroud ejection motor), would impact in the vicinity of the Kwajalein Atoll lagoon and/or on Illeginni Island. The nose shroud (with motor) is ejected early in flight and, should it survive atmospheric reentry, would impact in the open ocean approximately 1,000 miles northeast of the Hawaiian Islands (see also response to Comment #9). The PSRE is part of the post-boost vehicle (see Section 2.1.1 of the EA), which impacts in open ocean waters northeast of USAKA (see Figure 2-12 in the EA). As explained in the previous comment response, inhabited atolls and islands are protected from falling missile components and related debris. In the case of USAKA, a missile impact corridor is established across the atoll for each MM III flight test. The safety precautions used in setting up the Mid-Atoll Corridor are explained in Sections 2.2.4 and 3.5.3 of the EA.

In regards to the PSRE and liquid propellants, impact analysis discussions have been added to the EA in Sections 4.3.3 and 4.4.1. Since most of the liquid propellants are consumed during normal flight, this is primarily an issue that would occur during a launch failure or early flight termination. The probability for such an occurrence is extremely low.

As for the shroud ejection motor and solid propellants, refer to the response for Comment #9.

Response to Comment #16

On Illeginni Island, long-term monitoring of DU and Be from prior RV tests have shown little or no buildup of contaminants. As described in Sections 4.5.3.1 and 4.5.4.1 of the EA, prior sampling has shown that levels of contaminants in the air continue to remain at or near background levels. Though soil concentrations of Be and DU, in the vicinity of RV impacts on the island, can occur above background levels, their concentrations in the dissolved form are below background levels. In addition, the rates of dilution for Be and DU are significantly greater than their rates of dissolution in water, ensuring that the concentrations would not exceed background levels. To help confirm this finding, sampling efforts on land and in the shallow waters at Illeginni Island were conducted during the summer of 2004. Once analysis of the samples is complete, the information will be used in determining the need for further consultations with the USFWS, NMFS, USEPA, and RMIEPA (see Section 4.5.1.1).

Response to Comment #17

The amount of materials presented in Table 4-7 of the EA represents totals for all RV impacts in the vicinity of Illeginni Island during the period 1990 to 2003; not totals for a single RV test. Good faith efforts have been made in prior recovery operations, and will continue to be made for future RV tests to ensure unrecovered debris remains at a level of insignificance. The requested information regarding quantities of DU cannot be incorporated into the EA without compromising the security interests of the USAF and the US Government.

Response to Comment #18

During RV recovery operations, various tools are used to locate and collect visible size debris particles that are a few millimeters and larger in diameter. Because of the extreme forces exerted during airburst tests and surface impacts, much of the unrecovered debris is dispersed as an aerosol. See also the responses to Comments #16 and #19.

Response to Comment #19

As previously mentioned, the quantities of DU in question cannot be incorporated into the EA without compromising the security interests of the USAF and the US Government. Though some RV debris materials are not recovered, prior monitoring efforts at Illeginni Island have shown little or no buildup of contaminants (refer to Sections 4.5.1 and 4.5.3 of the EA).

In terms of health risks, DU is not a significant health hazard unless it is taken into the body. External exposure to radiation from DU is generally not a major concern because the alpha particles emitted by its isotopes travel only a few centimeters in air, or can be stopped by a sheet of paper. Also, the uranium-235 that remains in DU emits only a small amount of low-energy gamma radiation. If allowed to enter the body, such as through ingestion or inhalation, DU does have the potential for causing both chemical and radiological toxicity, depending on the level and duration of exposure.[1] However, at Illeginni Island, the observed minute concentrations of residual DU from prior RV tests do not present a significant health risk.

For future RV testing, air and soil monitoring for DU will continue, as specified by the mitigation measures described in Section 4.7 of the EA. The monitoring results will be submitted to the USAKA Environmental Management Office and forwarded to the RMI Government, as required.

Response to Comment #20

During launch of the Minuteman III missile from Vandenberg AFB, combustion of the solid rocket propellant converts the ammonium perchlorate (NH4ClO4) primarily into nitrogen oxides (NOx), hydrogen chloride (HCl), and water (H2O); not "airborne ammonium perchlorate." For further discussions on rocket emissions, refer to Section 4.3.1 of the EA.

As for air quality in the Marshall Islands, the EA does assess the dispersal of DU and Be particles into the air in Section 4.5.3 of the EA. As explained in the response to Comments #6, hydraulic fluid is only used in the Minuteman missile 1st-stage motor, which splashes down in the open ocean off the California coast. No hydraulic fluid is released into the atmosphere during launch. Some residual liquid propellants are likely to remain in the post-boost vehicle when it impacts in the open ocean northeast of USAKA;

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[1] US Department of Energy, Argonne National Laboratory (http://web.ead.anl.gov/uranium/guide/depletedu/health/index.cfm); see also http://www.defenselink.mil/news/Oct2004/n10192004_2004101903.html.

however, these materials would not be dispersed in the air. Regarding battery electrolytes dispersed during RV airbursts or land impacts at USAKA, very small quantities of electrolyte materials (no more than 2.13 ounces of potassium hydroxide and about 0.2 pounds of lithium compounds) might be released into the air, if they survive at all.

Response to Comment #21

Especially for Vandenberg AFB and USAKA, the EA properly assesses the proposed action, in conjunction with other actions having similar impacts, to determine cumulative effects. As described in Section 4.6 of the EA, the addition of two Minuteman III flight tests from Vandenberg AFB in FY 2005 and in FY 2006 would not present a substantial increase in current launch rates. At USAKA, the number of RVs tested would significantly decrease after FY 2005 (see Table 4-9). As Section 4.6 explains, years of RV testing at USAKA have caused minimal long-term affects, if any. In particular, at Illeginni Island, the native vegetation and migratory bird populations continue to thrive, and the coral reef habitat remains diverse and generally in good health.

Response to Comment #22

As explained in Section 4.3.3.1 of the EA, Vandenberg AFB currently has an incidental take permit in place for pinnipeds. No changes to this permit are anticipated.

At USAKA, no incidental take permit is currently in place for RV testing. However, as is explained in the recent USFWS Biological Opinion (see Appendix A of the Final EA), an incidental take statement for green sea turtle nests will apply to future RV tests. Also, as part of the Document of Environmental Protection process explained in Section 1.7 of the EA, the USAF will continue coordination and consultation with USAKA, USFWS, NMFS, and the RMIEPA.

Response to Comment #23

It is acknowledged that Pacific Environment disagrees with the Draft EA finding of no significant impact.

Response to Comment #24

More descriptive information on RV airburst tests has been added to Section 2.2.4 of the Final EA.

Response to Comment #25

More information regarding falling missile components is provided in the responses to Comments #14 and #15.

Response to Comment #26

Sufficient information and data used to analyze potential soil, air, and water contamination is provided in the appropriate sections of Chapter 4 of the EA.

Response to Comment #27

No contradictory statements about potential impacts from propellants have been identified in the EA.

Response to Comment #28

An assessment of potential impacts from perchlorate is provided in Sections 4.3.3 and 4.4.1 of the EA. See also responses to Comments #9, #12, and #20.

Response to Comment #29

See response to Comment #15.

Response to Comment #30

An assessment of potential impacts from DU and Be is provided in Section 4.5 of the EA. See also responses to Comments #5, #12, #16, and #19.

Response to Comment #31

A detailed assessment of potential air quality impacts at Vandenberg AFB is provided in Section 4.3.1 of the EA. A focused assessment of potential air quality impacts at USAKA is included in Section 4.5.3. See also the response to Comment #20.

Response to Comment #32

See the response to Comment #22.

Response to Comment #33

The USAF has determined that a finding of no significant impact is appropriated for the Proposed Action, and that an EIS is not required.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1601 Kapiolani Boulevard, Suite 1110
Honolulu, Hawaii 96814-0047

SEP 30 2004

C/AXFV, Attn: Leonard Aragon
2420 Vela Way, Suite 1467
El Segundo, CA 90245-4659

RE: Comments on Draft Environmental Assessment for Minuteman III Modification (dated August 2004)

Dear Mr. Aragon:

This letter responds to your request, received August 27, 2004, for comments on the Draft Environmental Assessment for Minuteman III Modification (dated August 2004). The National Marine Fisheries Service, Pacific Islands Regional Office, Protected Resources Division is pleased to provide the following comments and information under our statutory authorities under the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.) and the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. §1361 *et seq.*)

General Comments

- The discussion of factors involved in inducing temporary threshold shift (TTS) should more clearly consider the role of exposure duration as well as level. The Finneran et al. (2002) paper referred to in the text does a very nice job of considering the various exposure variables, including peak pressure and energy flux density. It is the interaction of exposure level and duration that is critical in terms of auditory fatigue. The Environmental Assessment (EA) would be improved with a more explicit consideration of this and its bearing on the potential impacts of the sorts of exposures (very brief) generated by sonic booms produced by the reentry vehicle (RV) impacts. A comparison with the Nachtigall et al. (2003) exposure levels and durations will emphasize the point that much higher exposure levels are needed when the duration of exposures is so weak. A translation of the pressure levels given into energy units would be both useful in considering the EA and consistent with the approach increasingly taken regarding exposure to other military sources. Using the longest potential exposure durations (within reason) would be the advisable conservative manner to estimate received energy flux density values. **1**

- The EA fails to consider possible behavioral reactions to either RV overflight during re-entry or sounds produced by impact. It is almost certain that exposed animals will experience behavioral disturbance at levels below those sufficient to induce TTS. While cetaceans seem to be much less impacted by aerial human activities that do breeding pinnipeds, for instance, there is a considerable literature regarding disturbance from airborne activities in cetaceans (see Richardson et al., 1995) that should be considered. It is very likely that behavioral reactions to overflight would be both brief and not biologically significant, but this should be discussed. Similarly, **2** some reasonably conservative means of estimating behavioral disturbance from impacts should be added to this consideration. Potentially affected species include not only cetaceans but also marine turtle and seabird populations. These groups of animals receive much less consideration in terms of hearing impacts (and none in terms of behavioral disturbance as well) than the cetaceans. **2 (cont'd)**

Specific Comments

- The reference to Kastak et al. (1999) on p. 85, fourth paragraph is not the most appropriate reference. For a general statement like this containing many other sources and explicit discussion of the range of behavioral reactions, Richardson et al (1995) would be better. **3**

- Page 85, fifth paragraph, first sentence ("…mild TTS do not cause permanent…and presumably do not do so in marine mammals.") References could be made to the Kastak et al. (1999) study as well as Schlundt (2000); Finneran et al. (2000; 2002); and Nachtigall (2003) and the word "presumably" can be eliminated. There has been sufficient demonstration of TTS in both cetacean and pinniped subjects to know this to be true, at least for the marine mammal species tested. **4**

- Page 85, fifth paragraph, second sentence ("However, very prolonged exposure to sound strong enough to cause a TTS…") overstates current understanding of the relationship between TTS and permanent threshold shift (PTS), even for terrestrial mammals. Asymptotic TTS at low levels (<10 decibels (dB)) even for many days of exposure can be fully recoverable in some species, and in most species tested, over 40 dB of TTS (which would have to be considered well above the TTS onset threshold) is fully recoverable in some conditions. The basic point of the sentence is accurate, but it needs to be more precisely worded (and referenced). Also, the point of the phrase "at least in terrestrial mammals" should be more explicitly made – i.e., that there is no data on PTS in marine mammals. **5**

- While this distinction has no bearing on this EA due to the absence of pinnipeds in the operation area, there should be some indication that cetacean and pinniped TTS onset points appear to be quite different (compare results of all above references – a recent presentation by Finneran at the Marine Mammal Commission meetings (which is available at mmc.gov) lays this out quite clearly.) Were the EA ever to be expanded to include impacts at higher latitudes where pinniped populations occur, the conclusions will need to be revisited. For accuracy, the EA should note that these criteria for cetaceans are based on cetacean data and not necessarily applicable to other groups of marine mammals, including pinnipeds and other cetacean groups for whom there are no hearing data or information regarding noise impacts on hearing (e.g., mysticetes). The wording should be more precise and restrictive to the information currently available. **6**

References not included in the EA

Below are references that should be included in the discussion of impacts in the Draft EA, referenced in the above comments: **7**

Nachtigall, P. E., J. L. Pawloski, and W. W. L. Au. 2003. Temporary threshold shifts and recovery following noise exposure in the Atlantic bottlenosed dolphin (*Tursiops truncatus*). Journal of the Acoustical Society of America 113, 3425-3429.

Richardson, W. J., C. R. Greene, C. I. Malme, and D. H. Thomson (Eds.) 1995. Marine mammals and noise. (Academic Press, New York).

Schlundt, C. E., J. J. Finneran, D. A. Carder, and S. H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins and white whales after exposure to intense tones. Journal of the Acoustical Society of America 107, 3496-3508.

7 (cont'd)

We appreciate the opportunity to provide comments to you on this Draft EA. Please do not hesitate to contact me at (808) 973-2937 to discuss these comments further.

Sincerely,

For

Tamra Faris
Assistant Regional Administrator
Protected Resources Division

RESPONSES TO NATIONAL MARINE FISHERIES SERVICE COMMENTS (9/30/04)

Response to Comment #1
Clarification of the exposure duration and exposure variables, in association with TTS, has been made in Sections 4.4.1.1 and 4.5.1.1 in the form of footnotes and some additional text. This includes a comparison with longer exposure levels as documented by Nachtigall et al. (2003). Based on the longest estimated exposure duration, energy flux density values for shock/sound waves from RV impacts have been calculated and added to Section 4.5.1.1 (Table 4-6) for comparison purposes. Equivalent underwater energy flux density values for sonic booms and spent rocket motor impacts were not included because of the very short durations and minimal potential for biological impacts from those actions.

Response to Comment #2
Behavioral reactions in birds from sonic booms are already addressed in Section 4.5.1.1 of the EA. A brief discussion on reactions in birds from RV impacts has been added to this same section.

Detailed discussions on behavioral reactions in marine mammals (primarily cetaceans) have been added to Sections 4.4.1.1 and 4.5.1.1 of the EA, with reference to both Richardson et al. (1995) and Schlundt et al. (2000). Brief discussions on impacts to sea turtles were included.

Response to Comment #3
The discussion on behavioral reactions has been modified in Section 4.5.1.1 of the EA, per information provided in Richardson et al. (1995).

Response to Comment #4
Citations for Finneran et al. (2002), Kastak et al. (1999), Nachtigall et al. (2003), and Schlundt et al. (2000) have been added to the paragraph, and the word "presumably" has been deleted from the first sentence.

Response to Comment #5
A new paragraph has been added to this discussion (Section 4.5.1.1 in the EA) to help clarify the relationship between TTS and PTS, especially for terrestrial animals. The new discussion includes the point that data on PTS in marine mammals is not available. Appropriate references have been cited.

Response to Comment #6
Applicability of the TTS criterion (224 dB ref to 1 micropascal) has been clarified with some added text and footnotes in both Sections 4.4.1.1 and 4.5.1.1 of the EA. Because comparable data for other cetacean groups [e.g., mysticetes (baleen whales)] and some other marine mammal groups [e.g., sirenians (including dugongs)] are not available, the analysis conducted in the EA assumed that the TTS data collected for small odontocetes is applicable to other whale species and dugongs occurring within the open ocean and/or at USAKA.

Though data cited in Comment #6 (available at http://www.mmc.gov/sound/plenary2/plenary2.html) does show some differences in underwater hearing sensitivities between cetaceans and pinnipeds, specific reference to pinnipeds was not made in either Sections 4.4.1.1 or 4.5.1.1 of the EA because pinnipeds have little or no bearing on the analysis in the open ocean or at USAKA. However, should similar underwater analyses be required in areas where pinnipeds typically occur, it is agreed that different TTS criteria may be needed.

Response to Comment #7
References to Nachtigall et al. (2003), Richardson et al. (1995), and Schlundt et al. (2000) have been added to Section 4.4.1.1 and/or Section 4.5.1.1 of the EA, per earlier comment responses.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1601 Kapiolani Boulevard, Suite 1110
Honolulu, Hawaii 96814-0047

November 5, 2004

SMC/AXFV, Attn: Leonard Aragon
Los Angeles Air Force Base
2420 Vela Way, Suite 1467
El Segundo, CA 90245-4659

Subject: DRAFT ENVIRONMENTAL ASSESSMENT FOR MINUTEMAN III MODIFICATIONS

Dear Mr. Aragon:

The National Marine Fisheries Service (NMFS), Pacific Islands Regional Office, Habitat Conservation Division (HCD) has received the Draft Environmental Assessment (EA) for Minuteman III Modifications prepared by the United States Air Force, dated August 2004. NMFS, HCD has reviewed the Draft EA, as well as the Notice of Proposed Activity (NPA) for the project, and offers the following comments for your consideration.

NMFS has been involved in the review of the proposed modifications to the Minuteman III program for over a year. We submitted comments on the Agency Coordinated Draft EA dated 13 November 2003. Concerns in these comments relating to marine resources and habitats at US Army Kwajalein Atoll (USAKA) were included in the subject Draft EA. In addition, NMFS has met on several occasions with the US Air Force and US Army SMDC to further discuss potential project impacts in the Illeginni Island region of USAKA, as well as mitigation measures to compensate for these potential impacts.

In view of the early coordination process, NMFS believes that the near shore marine resources and habitats in the project area, as well as potential impacts to these resources, are adequately addressed in the Draft EA. NMFS also concurs with the proposed compensatory mitigation measures described in the EA (Sections 4.5.1 and 4.7), which were initiated in consultation with NMFS and USFWS. We believe it is critical that these mitigation measures are further developed in consultation with the resource agencies, and implemented as soon as possible in order to validate the project Finding of No Significant Impact (FONSI). Of particular importance to NMFS are the following mitigation measures: **1**

1. Protocols must be developed in conjunction with the resource agencies to determine which RV impact craters on the reef flats at Illeginni should be filled, and which should be left unfilled in order to avoid further damage to the coral reef ecosystem of Kwajalein Atoll. **2**

2. The marine and terrestrial compensatory mitigation protected area at Eniwetak Island (east side of Kwajalein Lagoon) must be defined and delineated in conjunction with the resource agencies, and established as soon as possible. **3**

The NMFS, Pacific Islands Regional Office, Protected Resources Division (PRD) is also in the process of reviewing the Draft EA and NPA. PRD submitted initial comments date 30 September 2004. Additional comments concerning mitigation for NOAA trust protected resources at USAKA will be submitted shortly.

NMFS, HCD appreciates the opportunity to comment on the subject Draft EA and NPA, as well as the early coordination on the Minuteman III project. Should you have any questions on these comments, please contact John Naughton, Pacific Islands Environmental Coordinator at NMFS in Honolulu (808/973-2935 x 211).

Sincerely,

for Gerald Davis
Assistant Regional Administrator
Habitat Conservation Division

RESPONSES TO NATIONAL MARINE FISHERIES SERVICE COMMENTS (11/5/04)

Response to Comment #1

As described in Section 4.7 of the EA, "the USAF will continue coordination and consultation with USAKA, the USFWS and NMFS Pacific Islands Regional Offices in Hawaii, and the RMIEPA to clarify current mitigation measures and determine whether any additional mitigation measures are warranted." The USAF is committed to working with the appropriate agencies on the implementation of these mitigation measures.

Response to Comment #2

Mitigation measure #13 in Section 4.7 of the EA, regarding the development of protocols for filling in craters, has been modified to include consultation with the appropriate agencies. It is expected that the protocols will initially be developed during consultations for the DEP.

Response to Comment #3

Regarding Eniwetak Island, mitigation measure #15 in Section 4.7 of the EA has been rewritten to better emphasize the USAF commitment to supporting establishment of a protected area for sea turtle nesting and coral reef habitat.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
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TAKE PRIDE IN AMERICA

In Reply Refer To:
PN-04-253

NOV 17 2004

Leonard Aragon
2420 Vela Way
Suite 1467
El Segundo, CA 90245-4659

Re: Draft Environmental Assessment for Minuteman III Modification.

Dear Mr Aragon,

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Environmental Assessment (DEA) for the above referenced action. The DEA was prepared by Acquisition Civil and Environmental Engineering Space and Missile Systems Center, Los Angeles Air Force Base, California. The proposed project is sponsored by the ICBM System Program Office, Ogden Air Logistics Center, Hill Air Force Base, Utah. The following comments pertain only to project-related activities planned for U.S. Army Kwajalein Atoll (USAKA) in the Republic of the Marshall Islands. These comments have been prepared pursuant to the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 853] and other authorities mandating Service concern for environmental values, including the USAKA Environmental Standards (UES). Since the DEA also serves as a Notice of Proposed Activity (NPA) for a USAKA Document of Environmental Protection for the Proposed Action, this letter also transmits the Service's Environmental Comments and Recommendations on the NPA per UES requirements.

The proposed project involves conducting flight tests of Minuteman III missiles, which have been modified with new Mark 21-related hardware and software. Flight tests involve missile launches from Vandenberg Air Force Base (AFB), California, to target locations at USAKA. The missile is comprised of three stages, which will separate from the reentry vehicle (RV) and land in the ocean. RVs are anticipated to land at designated targets at Kwajalein Atoll including deep ocean sites, shallow marine reef flat sites adjacent to Illeginni Islet, and terrestrial sites on Illeginni Islet or be aerially detonated. A total of nineteen tests would be conducted between 2005 and 2010. The DEA evaluates a Proposed Action, which includes the preferred proposed modifications of the Mark 21 RV, and a No-Action Alternative.

GENERAL COMMENTS

We have worked closely with USAKA and the Air Force during scoping and early review of the proposed project, including coordination on the mitigation measures identified in the DEA. Our primary concerns with the proposed action are regarding the analysis of anticipated project-related impacts to significant USAKA species and habitats and with the proposed mitigation measures that are intended to minimize fish and wildlife impacts and compensate for project-related resource losses at Illeginni Islet.

With regard to the impact analysis, the DEA presents little relevant information on which to base a sound analysis for significant protected species at USAKA. For example, the DEA does not provide information on (1) the densities of species protected under the UES in the affected environment, (2) the temporal fluctuations of protected species within identified impact areas, and (3) the historical impact areas. In addition, the DEA does not identify lethal or sublethal levels of project-related contaminants associated with the RVs that pose an exposure risk to protected species at USAKA. This information is germane to an analysis of potential project-related impacts to significant species, especially marine mammals, sea turtles, and migratory birds.

The impact analysis in the DEA is based on population estimates of these organisms from anecdotal observations and on data collected as part of the biennial surveys of USAKA species and habitats of concern conducted by the Service and the National Marine Fisheries Service. It should be made clear that the focus of these biennial surveys is to document, in qualitative terms, the presence or absence of USAKA species of concern and to develop recommendations to conserve both species and habitats at the 11 USAKA-leased islets. The data generated by the surveys should not be interpreted as or used as a basis for an assessment of population sizes of species of concern at USAKA. Therefore, we recommend that the Final Environmental Assessment (FEA) describe these biennial surveys as being qualitative in nature, providing information on the distribution of species of concern at USAKA, but not useful for assessing population sizes of species.

Valid quantitative assessments of the population sizes of significant species that occur in the vicinity of Illeginni Islet (e.g., marine mammals, sea turtles, and migratory birds) are needed to evaluate the potential risk of RV-related impacts and, if necessary, to develop meaningful strategies to avoid or minimize individual and cumulative impacts to these species. We encourage the project sponsors to pursue development of such population assessments and recommend coordination with the National Marine Fisheries Service on future assessments of marine mammals and sea turtles in waters surrounding USAKA. Similarly, we recommend coordination with us on population assessments of nesting sea turtles and migratory birds at USAKA.

Concurrently, we encourage the project sponsors to pursue development of risk analyses on the effects of project-related hazardous materials on protected species. A goal should be to assess possible concentrations of hazardous materials that would be released into the environment from RV impacts and aerial detonations and relate these concentrations to the risk of exposure to protected species (*e.g.*, sea turtles, migratory birds or coral reef organisms), including the identification of possible routes of exposure and uptake.

The problem of attempting to analyze potential project-related impacts based on a very limited amount of information available on critical aspects, such as the lethal and sublethal levels of exposure to various hazardous materials and the population sizes of USAKA species of concern, was discussed early with the project sponsors. In response to this situation, the need for adequate mitigation to reduce the Proposed Action's environmental impacts to less than significant levels was strongly emphasized.

The DEA presents a good summary of the mitigation measures that would be implemented to minimize unavoidable impacts, and we support these measures (Section 4.7). However, the one measure (*i.e.*, Measure 15) intended to provide compensation for anticipated resource losses, such as the loss of sea turtle nesting habitat, falls short of providing this compensation. Although the draft FONSI states that the preservation and protection of sea turtle nesting habitat is identified "for implementation as part of the Proposed Action," the DEA states that "consideration" would be given to protecting sea turtle nesting habitat (*e.g.*, on page 91, 3rd paragraph; page 101, measure 15). We believe the measure itself is justified based on information presented in the DEA, which indicates that the Proposed Action has the potential to damage sea turtle nesting habitat at Illeginni, and on records of previous tests (*e.g.*, as recent as July 2004) that have resulted in impacts to this habitat. We believe a clear commitment to implement this mitigation measure must be included in the FEA in order to justify a FONSI.

We also recommend that the phrase "but highly unlikely" be deleted from Measure 15 in the FEA. Though not anticipated to occur more than four or five times over the next 20 years, a single RV landing on Illeginni can produce a crater approximately 15 feet deep and 25 feet across. The crater would require manual cleanup and removal of any RV debris before being backfilled with a backhoe or grader. Just one such event has the potential to essentially render viable sea turtle nesting habitat permanently unsuitable for successful nesting. Based on information presented in the DEA and on recent records of similar tests, we disagree that it is "highly unlikely" that adverse impacts to potential sea turtle nesting habitat would result from the Proposed Action.

The following comments relate to specific sections in the DEA. We offer these comments to assist in preparation of the FEA.

SPECIFIC COMMENTS

Page 20. Paragraph 1. Sentence 4: The DEA states "Targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats that are protected under the UES." The DEA does not describe the criteria that will be used to "carefully select targets" in order to minimize RV-related impacts to marine mammals, sea turtles, migratory birds, marine life and coral reefs. Even with careful selection of target areas, RV impacts could unintentionally harm or destroy protected species habitat, especially for tests with targets on or near Illeginni and tests with aerial detonation near Illeginni. We recommend that a clear and detailed description of these criteria be provided in the FEA to provide a basis for understanding of how effective the proposed measures are anticipated to be and whether additional measures are needed.

Page 22. Paragraph 2. Sentence 1: The DEA states "RVs that impact in the ocean beyond shallow waters are not recovered." Since RVs contain certain hazardous materials, we recommend the FEA include a discussion of potential adverse impacts to pelagic and deepwater benthic organisms that may occur in the vicinity of unrecovered RVs and a description of any known trophic relationships between these organisms and other species, especially those species that may be consumed by the human population at Kwajalein Atoll.

Page 23. Paragraph 3. Sentence 4: The DEA states "Just as on prior FDE flights, some of the proposed test RVs may contain varying quantities of hazardous materials including high explosives, Be, DU, and batteries." The DEA does not describe the amounts of hazardous materials that may be contained on an RV at the time of impact at or near Illeginni Islet. We recommend that the FEA describe the amount of hazardous materials anticipated to be released and recovered at the impact sites around Illeginni and estimate the amount of unrecovered hazardous materials that may remain in the environment. We further recommend that proposed Mitigation Measure 6 lead to an evaluation of the health risk that estimated concentrations of hazardous materials, such as Be or DU, pose to protected species, such as sea turtle eggs, nesting sea turtle adults, and migratory birds, which are all commonly consumed by the Marshallese population at Kwajalein Atoll.

Page 53 Paragraph 3. Sentence 2. The DEA states "In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA." The focus of these surveys is to document, in qualitative terms, the presence or absence of species of concern and to develop recommendations to conserve both species and habitat at the 11 USAKA leased islets. The data generated by the surveys should not be interpreted as an assessment of populations of species of concern at USAKA. Therefore, we recommend the FEA condition the description of the USAKA biological inventories as being qualitative in nature, providing information on the distribution of species of concern at USAKA, but not useful for assessing population sizes of species.

Page 86. Paragraph 5. Sentence 1. The DEA states "Following an aerial detonation or ocean/lagoon impact by a test RV, the resulting debris would disseminate any on-board hazardous materials around the impact point and some distance downwind." The DEA does not provide a clear description of the extent to which RV-related debris may impact at or near Illeginni Islet following an aerial detonation and does not fully evaluate associated potential impacts to fish and wildlife resources. Also, the DEA does not provide a clear discussion of RV-related hazardous materials that would be released into the environment following an aerial detonation and the possible routes of exposure and uptake of hazardous materials by protected species. Furthermore, the DEA does not clearly evaluate possible concentrations of hazardous materials and relate them to the risk of exposure to protected species (*e.g*, sea turtles, migratory birds or coral reef organisms). Therefore, we recommend the FEA (1) clearly describe the potential area anticipated to be impacted by RV debris after an aerial detonation and (2) evaluate the potential impact that debris from an aerial detonation may have on protected species. We recommend that the project sponsors pursue an evaluation of the health risk that estimated concentrations of hazardous materials, such as Be or DU, pose to protected species as part of proposed Mitigation Measure 6.

Page 87. Paragraph 1. Sentence 5. The DEA states "An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF 1992)." The DEA does not relate concentrations of hazardous materials (*e.g.*, 5 ppm of Be) to the risk of exposure relative to protected species, such as sea turtle eggs or adult female green sea turtles during nest creation (*i.e.*, digging burrows) or migratory birds that occur and nest at Illeginni Islet. Therefore, we again recommend that the project sponsors pursue an evaluation of the health risk that estimated concentrations of hazardous materials, such as BE or DU, pose to protected species as part of proposed Mitigation Measure 6.

Page 88. Paragraph 4. Sentences 4, 5 and 6. The DEA states "As the results of both sets of data show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators, to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the result probabilities for impacts on them would be even less." We believe it is possible that this conclusion may significantly underestimate RV landing-related negative impacts to marine mammals, sea turtles, or migratory birds that occur near or at Illeginni Islet. Population assessments of marine mammals, sea turtles, or migratory birds in the vicinity of Illeginni Islet have not been conducted, and the basis for estimating protected species populations is not clear in the DEA. It appears that these calculations may have been based on artificial population sizes extrapolated from the biennial USAKA biological inventories. If so, the basis for these probability calculations is questionable.

We encourage the project sponsors to pursue development of accurate population assessments of marine mammals, sea turtles and migratory birds within the identified RV impact area in order to more accurately evaluate probabilities of impact so that sound conclusions on the risk of the proposed action on these species is better understood. Furthermore, we recommend that analyses be conducted to evaluate the potential risk of impact that RV landings may present to protected species and that, if necessary, meaningful strategies be developed and implemented to avoid or minimize impacts to protected species.

Page 101. Measure 15. Sentence 1: The DEA states "Consideration would be given to protecting existing nesting habitat for sea turtles on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for the potential, but highly unlikely, adverse impacts to sea turtle nesting sites and coral reef habitats at Illeginni." This statement conflicts with the draft FONSI, which indicates that preservation and protection of sea turtle nesting habitat at Enewetak would be implemented, rather than merely considered. Consideration alone cannot possibly compensate for project-related resource losses, and, as mentioned previously, adequate mitigation is critical to reduce the Proposed Action's environmental impacts to less than significant levels. Therefore, we recommend that a clear commitment to implement all of the proposed mitigation measures be included in the FEA in order to justify a FONSI. In addition, we recommend deletion of the phrase "but highly unlikely" from the above statement because the DEA and FONSI both acknowledge that impacts to Illeginni or the shallow reef adjacent to it could potentially result in the loss and degradation of some protected species habitat.

Page 90. Paragraph 3. Sentence 2. The DEA also states "Should an RV impact either an area occupied by migratory seabirds and shorebirds, any of the patches of littoral forest, or on sea turtle nesting habitat along the shoreline, birds and any other wildlife close to the point of impact could be killed, bird or sea turtle nests might be destroyed, and small areas of nesting habitat lost." In most cases, little or no information has been collected to document project-related impacts to fish and wildlife resources at Illeginni Islet. In addition, an assessment of project-related cumulative impacts to protected species populations has never been evaluated conducted. Therefore, we believe these fish and wildlife resources to be at risk from impacts anticipated to occur as a result of the Proposed Action. We conclude that compensatory mitigation in the form of preservation of fish and wildlife resources at Eniwetak Islet is warranted and we again recommend that a clear commitment to establish a protected area at Enewetak be included in the FEA in order to offset project-related impacts and justify a FONSI for the Proposed Action.

SUMMARY

As currently written, DEA is insufficient to support a FONSI for the Proposed Action. The basis for many conclusions relative to fish and wildlife impacts is not identified, referenced or included. Some conclusions are made based on inappropriate information. A commitment to provide compensatory mitigation in the form of preservation of fish and wildlife resources at Eniwetak Islet is warranted to offset anticipated project-related impacts to significant fish and wildlife resources, especially nesting sea turtles, at Illeginni Islet. We believe establishment of the proposed Eniwetak Conservation Area (Mitigation Measure 15) must be implemented in order reduce the Proposed Action's anticipated environmental impacts to less than significant levels and justify a FONSI.

The Service appreciates the opportunity to comment on the DEA. We look forward to collaborating with the project sponsors in further development of the proposed mitigation measures and the establishment of the Enewetak Conservation Area at the earliest possible time. If you have any questions regarding these comments, please contact Marine Ecologist Kevin Foster by telephone (808-792-9420) or by email (kevin_b_foster@fws.gov).

Sincerely,

for Gina Shultz
Acting Field Supervisor

cc: NMFS-PIRO, Honolulu
USEPA-Region IX, San Francisco
SMDC, Hunstville
RMI-EPA, Majuro
USAKA, Kwajalein Atoll

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFMC)
HILL AIR FORCE BASE, UTAH

17 December 2004

MEMORANDUM FOR USFWS
UNITED STATES FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS FISH AND WILDLIFE OFFICE
300 ALA MOANA BOULEVARD, ROOM 3122
HONOLULU, HAWAII 96850

ATTN: MR. MICHAEL MOLINA

FROM: ICBM SYSTEM PROGRAM OFFICE
OO-ALC/LMV
HILL AFB UT 84056-5826

Subject: Resolution of USFWS Comments on the Draft Environmental Assessment for Minuteman III Modification (USFWS Ref. PN-04-253).

1. In response to the referenced USFWS comments on the Draft Minuteman III Modification Environmental Assessment (EA), the United States Air Force has revised the EA to address your concerns. The most significant concerns involved the potential impacts of the proposed Minuteman III RV flight tests on the sea turtle nesting sites in the vicinity of Illeginni Island at Kwajalein Atoll, the Republic of Marshall Islands which were the subject of telecons between Mr. Randy Gallien, US Army Space and Missile Defense Command, Huntsville, AL, and your office. Revisions were made to pages 20, 53, 87-89, and 101-102 of the EA pursuant to the agreements reached between you and Mr. Gallien. The yellow highlighted sections in the enclosed documents clearly show the revisions agreed upon by USASMDC, ICBM SPO, AFSPC, DOE/LLNL and SMC/AXF. The USAF has already incorporated those revisions in the final EA, which will be provided under separate cover at the same time that it is transmitted to SAF/AQR for FONSI approval.

2. I appreciate your responsiveness in providing the comments on the draft EA in a timely manner, and for your assistance in resolving the comments. It has been my pleasure and privilege to work with you on a number of difficult issues, and reach amicable resolutions on those issues in a very timely and expedient manner. I am especially pleased how we were able to bring together such a diverse group of professionals to the Consultation Meeting with your group, and work on the various truly difficult issues and achieve mutually satisfactory resolutions. I look forward to working with you and your group on issues relevant to the DEP process and activities toward speedy resolutions. Please feel free to contact me at 801-777-2846 (DSN: 777-2846) or via email should you have any questions relevant to the EA and DEP. Thank you very much.

Ram Ramanujam, Ph.D.
Aerospace Engineer

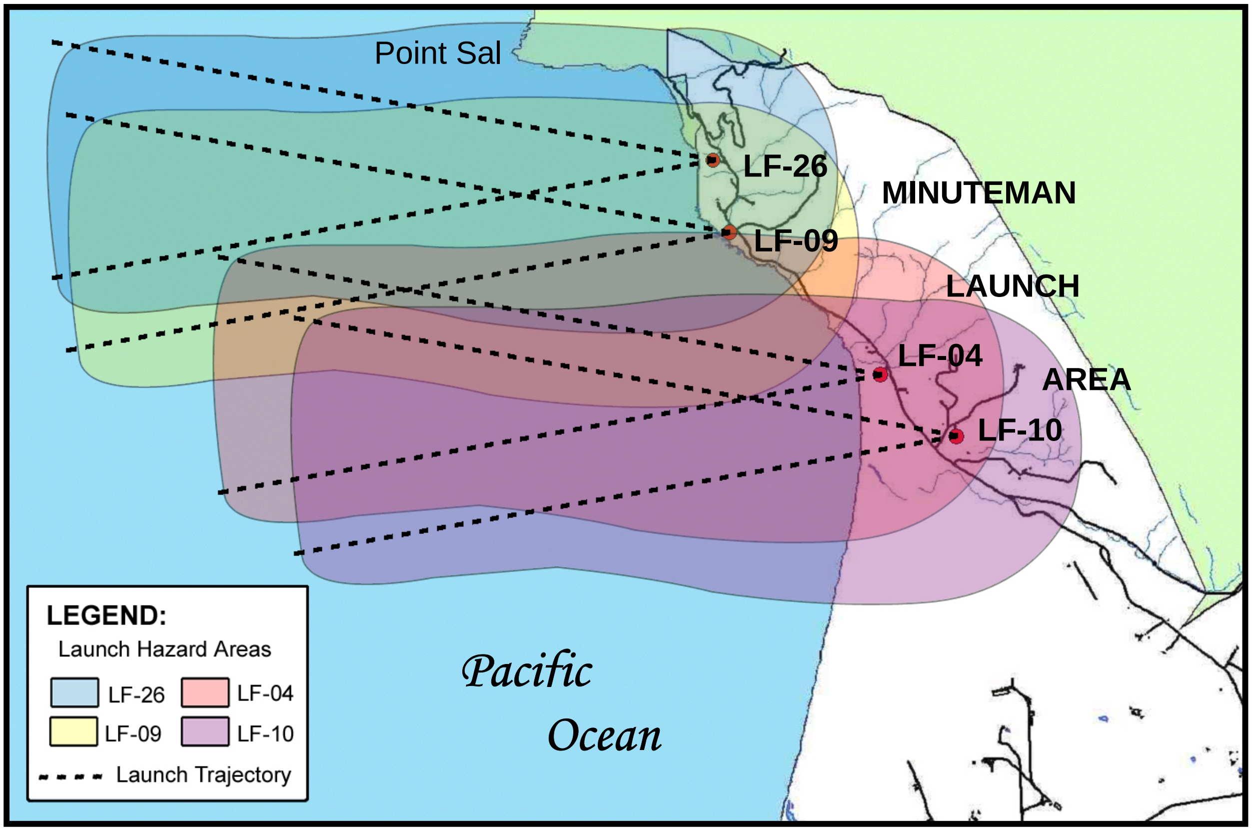

Figure 2-11. Range of Minuteman III Launch Trajectories and Launch Hazard Areas at Vandenberg AFB, California

2.2.4 US Army Kwajalein Atoll

Towards the terminal end of each MM III FDE flight, beyond the 3rd-stage motor drop zone, the post-boost vehicle fragments impact in a predetermined area of the ocean northeast of USAKA in the RMI. The hazard areas for missile impact are shown in Figure 2-12 for a representative MM III flight path. Traveling slightly farther, the one to three RVs (per flight) are targeted towards designated deep ocean areas east of the Kwajalein reef, or in the vicinity of Illeginni Island, depending on mission requirements. Targets are carefully selected to minimize the impact of RV flight tests on threatened and endangered marine mammals, sea turtles, migratory birds, and other marine life; and on the coral reef and island habitats. In particular, areas designated as habitat for species of concern, under the UES, would not be targeted.

To ensure the safe conduct of these types of tests, a Mid-Atoll Corridor Impact Area has been established across USAKA, as is shown in Figure 2-12. When a point of impact is to occur in this area, a number of strict precautions are taken to protect personnel. Such precautions may consist of evacuating nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor. Just as at Vandenberg AFB, NOTAMs and NOTMARs are published and circulated in accordance with established procedures to provide warning to personnel, including natives of the Marshall Islands, concerning any potential hazard areas that should be avoided. Radar and visual sweeps of hazard areas are accomplished

The Mid-Atoll Corridor straddles Kwajalein Atoll, which is a crescent-shaped coral reef dotted with a string of approximately 100 islands that enclose the world's largest lagoon [1,100 square mi (2,849 square km)]. Lagoon depths are typically 120 to 180 ft (37 to 55 m), although numerous coral heads approach or break the surface. Ocean depths outside the lagoon descend rapidly, to depths as much as 13,000 ft (3,952 m) within 5 mi (8 km) of the atoll. The top of the Kwajalein Atoll reef (or reef flat) is intertidal. Natural passages through the reef flat allow passage of marine mammals, sea turtles, and other marine life to and from the lagoon.

Both the reef rock from which the atoll is built, and the sands and sediments of its beaches and lagoon bottom, are formed entirely from the remains of calcium-secreting marine organisms such as coral, coralline algae, calcareous algae, mollusks, and foraminiferans. The tops of the reefs are a thin veneer of actively growing organisms that accrete over the remains of prior generations of reef organisms and add to the reef structure. The reef-building organisms are sensitive to sedimentation, burial, and changes in circulation caused by human activities.

The descriptions of biological resources provided in the paragraphs that follow are based largely on past surveys conducted by the USFWS and NMFS. In accordance with requirements specified in the UES, USAKA must conduct a natural resource baseline survey every 2 years to identify and inventory protected or significant fish, wildlife, and habitat resources at USAKA (USASMDC, 2003a). In providing support to USAKA, USFWS and NMFS personnel normally conduct the biennial biological resource inventories at all islets leased from the RMI, which includes those areas on and adjacent to Illeginni Island. These surveys were initiated in 1996 and continue to be conducted on a regular basis every 2 years. The next survey is scheduled to occur in 2004. It is important to note that the USAKA survey data is qualitative in nature, so data gathered at other geographical locations [i.e., Pacific Missile Range Facility (PMRF), Hawaii], with known species densities, were used to determine risks to marine mammals in Chapter 4. Although the population sizes of marine mammals in the vicinity of Illeginni are not known, the surrogate data used in the analysis is considered to be conservative since marine mammal densities at Kwajalein are not expected to exceed densities in areas of Hawaii where marine mammals have been documented for many years. For sea turtles, however, no comparable data existed so we evaluated the probability for habitat destruction since habitat details are known.

Vegetation

Illeginni is a 31-acre (12.5-hectare) island consisting of managed vegetation (primarily grassy lawns) surrounding buildings and other facilities, and four relatively large patches of native vegetation (see Figure 3-3). The native vegetation present on the island consists of one patch of herbaceous strand and several patches of littoral (near shore) forest. The forest areas are made up primarily of *Pisonia*, *Intsia*, *Tournefortia*, and *Guettarda* trees. Some littoral shrubland can also be found mostly on the western end of the island. (USFWS/NMFS, 2002)

Threatened, Endangered, and Other Protected Species

Within the area of Kwajalein Atoll, the UES provides protection for all of the following:

- Any threatened or endangered species that may be present
- Any species proposed for designation, candidates for designation, or petitioned for designation to the endangered species list that could be affected by USAKA activities

Potential ecological effects on Illeginni Island can be assessed on the basis of deposition and concentration patterns observed from prior RV tests on land. Debris and ejecta occur close to the point of impact, mostly within a 328-ft (100-m) radius. It is expected that very little of the RV battery materials would survive impact. For the DU and Be, the deposition of small particles can contribute to elevated levels in soil in the immediate vicinity of the impact point and extend downwind. An earlier RV test at Illeginni resulted in soil concentrations of only 5 ppm of Be in the area of highest deposition (USAF, 1992a). For comparison purposes, this concentration falls in the low end of the range of naturally occurring Be found in soils in the United States, which ranges from 0.1 to 40 ppm (ANL/DOE, 2002). The Be remains bound to the soil within the environmental pH range of 4 to 8 and does not dissolve in water, thus preventing release to ground water (USEPA, 1998). Furthermore, Be is not likely to be found in natural water (within normal pH ranges) in greater than trace amounts, because of the extreme insolubility of the material (NAS-NRC, 1977).

For the DU particles deposited on the ground, studies have shown that low levels of soluble U will travel very slowly through soil and are subject to adsorption as they pass through the soil (DOD, undated; Stegnar and Benedik, 2001). The transport of U with rainwater runoff is limited because of its low solubility and high density (DOD, undated). Even under extreme hydraulic conditions within a laboratory, the probability for significant surface water transport of DU from soil appears to be low (WRRC, 1995). Possible DU contamination of ground water from vertical migration has also been shown to be highly unlikely (DOD, undated).

The concentrations of soluble Be in soil will be orders of magnitude below the observed phytotoxicity concentration of 2 ppm soluble Be (USAF, 1992a). Plants also do not readily absorb U from soil (Stegnar and Benedik, 2001). In view of the very low solubility and limited transport of Be and DU in soil and water, it is not likely that these materials would have any serious adverse effects on plants at Illeginni, or on the animals that might feed on those plants. Though there is the potential for migratory birds on the island to breath respirable dust particles of Be and DU, or consume particles deposited on vegetation, exposures (through breathing or feeding) to significant levels of these materials are not expected because of the small amount of unrecovered material that may persist in the environment.

Beyond 164 ft (50 m) from the impact crater, under probable meteorological conditions, there is deposition on the water surface. The process of mixing Be and DU particles by tide and surf would rapidly dilute the small amounts deposited, and considering the low solubility of the Be and DU, resulting concentrations would be low and non-toxic to fish, sea turtles, coral, and other marine invertebrates along the reef. Eventually, the Be and DU are deposited as sediment, where they would slowly weather just as they do in the soil (USAF, 1992a). Thus, the overall health of the coral reef should not be affected.

Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Islet, and along the shorelines and shallow marine environments of the lagoon and ocean side of the islet. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted.

Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

test RV contains a high explosives package makes little difference. The resulting underwater waveform in either case would last only about 10 to 30 milliseconds. (Moody, 2004a; Tooley, et al., 2004)

As described earlier, the onset of TTS in marine mammals has been determined to occur at peak pressure levels of about 218 to 224 dB (referenced to 1 micropascal and equal to 12 to 23 psi, respectively), depending on the species and only for occasional, short-term exposures. Based on the underwater acoustic impulse produced by an RV impact, distances for when the onset of TTS might occur in marine mammals are presented in Table 4-5. As the table shows, this distance ranges from 62 to 128 ft (19 to 39 m), depending on which sound pressure level is used. For this analysis, it is presumed that sea turtles would also fall within this range for TTS occurrence.

Table 4-5. Reentry Vehicle Impact Distances for the Onset of Temporary Threshold Shift (TTS) in Marine Mammals

Sound Pressure Level (dB ref to 1 micropascal)	Equivalent Underwater Peak Pressure (psi)	Radial Distance from the Point of RV Impact [1] [ft (m)]	Reference for Pressure Level
218	12	128 (39)	69 FR 2333-2336 69 FR 29693-29696 Ketten (1995)
224	23	62 (19)	Finneran, et al. (2002)

Notes:
[1] Radial distances were calculated in accordance with methods described in Moody (2004a).

At distances less than 62 ft (19 m) from the RV impact point, it can be expected that marine mammals and sea turtles might suffer PTS and/or other injuries. An underwater pressure level of approximately 240 dB (referenced to 1 micropascal and equal to 145 psi) is considered the baseline criterion for defining physical injury or death for marine mammals (Ketten, 1998). Such pressure levels would only occur within several feet of the RV impact point. With increasing distance from the RV impact point, pressure levels would decrease, as would the risk for injury to animals. The range of impact distances for the onset of TTS, and for determining physical injury/death, are illustrated in Figure 4-2. Because the 218-dB (referenced to 1 micropascal) level represents the lowest pressure level for when TTS might occur, it can be considered the outermost limit for potential harm to marine mammals, as well as for sea turtles.

Because the USAKA survey data described in Section 3.5.1 is qualitative in nature, probabilities for determining potential underwater shock/sound wave impacts on protected marine mammals were based on surrogate data from the sea range at PMRF, Hawaii, which has higher species densities than the Illeginni Island vicinity. Using the sound pressure levels identified earlier in Table 4-5, probabilities for the number of groups (pods or schools) of marine mammals that could potentially be impacted by a single RV are presented in Table 4-6 for the onset of TTS, and for physical injury/death. As the results show, the probability for animals to be struck or exposed to the harmful affects of the underwater shock/sound waves is estimated to be no higher than 3 in one million, or 0.000003. For two or three RV simulators to be used in a single test event, the probabilities would be 0.000006 or 0.000009, respectively. Because sea turtles generally have been shown to occur in smaller numbers, when compared to marine mammals, the resulting probabilities for impacts on them would be even less.

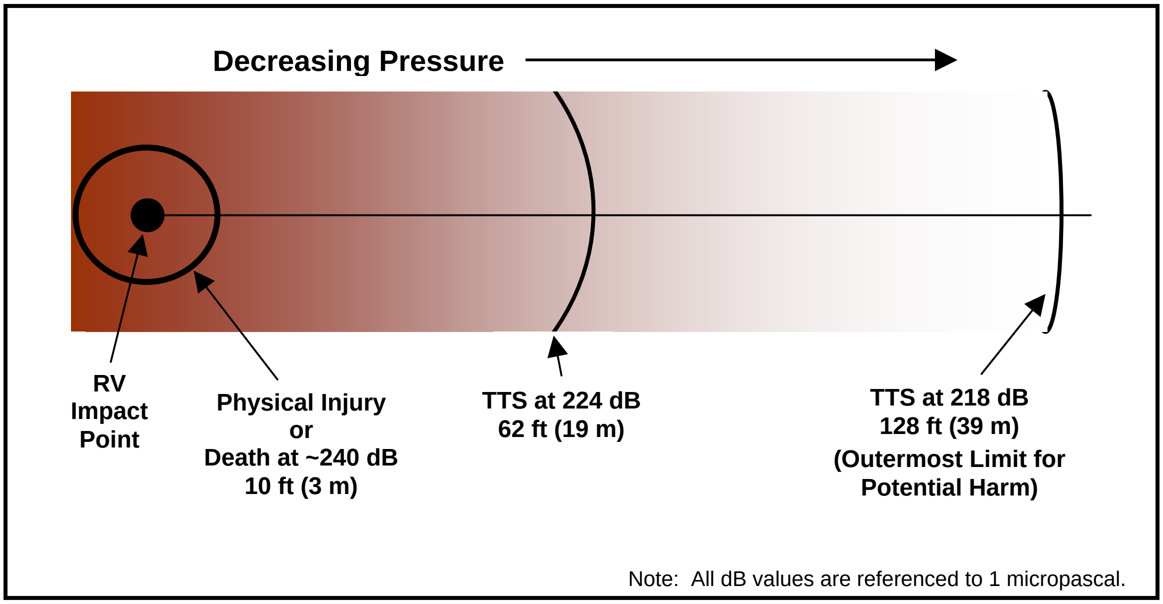

Figure 4-2. Illustration of Predicted Ranges for Underwater Shock/Sound Wave Impacts on Marine Mammals

Table 4-6. Number of Groups[1] of Marine Mammals that May Experience Temporary Threshold Shift (TTS), or Suffer Physical Injury or Death, from a Reentry Vehicle Impact

Sound Pressure Level (SPL) (dB ref to 1 micropascal)	Radial Distance from the Point of RV Disintegration [ft (m)]	Potential Effect	Number of Groups of Marine Mammals Exposed[2]	
218	128 (39)	TTS [original limit by Ketten (1995)]		3.01E-06
224	62 (19)	TTS [new limit by Finneran, et al. (2002)]		4.52E-07
240	10 (3)	Physical Injury or Death		2.19E-07

Notes:

[1] Marine mammals occur in groups (pods or schools), and aerial and shipboard sightings of marine mammals are reported in units of groups rather than of individuals. Hence, group density rather than the density of individuals is the appropriate basis for estimating the risk of RV impacts to marine mammals. For analysis purposes, a single group is assumed to contain 10 to 12 animals.

[2] Estimations of TTS, physical injury, and death impacts are fully described in Ramanujam (2004).

5) Minimize helicopter and vehicular traffic in the vicinity of a land impact crater until the soil deposition is stabilized by wetting, and the helipad has been washed or swept down (Section 4.5.3).
6) Conduct sampling of the air and soil to ensure that the concentration in air of Be and of DU does not exceed established standards. Removal of the top 0 to 2 inches (0 to 5 cm) of soil would be required if concentrations exceeded established standards. (Sections 4.5.3 and 4.5.4)
7) Maintain necessary surveillance of the cumulative effect from repetitive tests to ensure that the criteria listed in item (6) are maintained (Section 4.5.4).
8) Maintain records of Be and DU concentrations in air and soil to document the tests results, and transmit them to the USAKA Environmental Management Office within 6 weeks from the date of sampling (Section 4.5.4).
9) Avoid unnecessary disturbance of migratory bird nests (Section 4.5.1). (See also measure 14.)
10) Refill any land crater in a manner that is least damaging to the environment (Section 4.5.1), with precautions taken to avoid exposure of personnel to any hazardous levels of Be and DU (Section 4.5.3).
11) Should an RV impact within one of the littoral forest areas on Illeginni or elsewhere in the vicinity, the least possible amount of vegetation and habitat would be disrupted for equipment access and cleanup operations (Section 4.5.1). (See also measure 14.)
12) Perform opportunistic marine mammal monitoring in the vicinity of the Illeginni Island from the helicopter flights to and from the island during the days and weeks leading up to a scheduled MM III flight test, and report the results to the USAKA Environmental Management Office, RTS Test Group, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list, and for consideration in approving the launch. (Section 4.5.1).

Group 2—USAKA Environmental Management Office

13) Develop protocols or best management practices in consultation with the appropriate agencies to determine which craters should be filled and which should be left unfilled to avoid further impacts or disturbances to the reef, following RV impacts on the reef. Any such movement of equipment would occur along predetermined routes to minimize environmental effects. (Section 4.5.1)
14) Develop protocols or best management practices in consultation with the appropriate agencies for the cleanup and backfilling of craters in littoral forests, or in other valuable habitats, by incorporating methods and procedures that would avoid and/or minimize additional impacts to such resources during the cleanup activities. (Section 4.5.1)
15) USAKA, in cooperation with the RMIEPA, will establish a protected area for existing sea turtle nesting habitat on Eniwetak Island (located on the eastern side of USAKA), and the reef areas immediately surrounding the island, in order to compensate for potential impacts to sea turtle nesting and coral reef habitats at Illeginni. Eniwetak was selected on the basis of (a) the presence of active turtle nesting sites, and (b) the availability of viable enforcement options to protect the sea turtles and their nesting sites from poachers. (Section 4.5.1) The details of the protected area to be established will be defined through the DEP process.
16) USAKA will transmit the records of Be and DU concentrations in air and soil to the RMI Government within two weeks from the date of receipt of such records from DOE/LLNL through the established channels approved by the US State Department. (Section 4.5.4)
17) Based on existing data, definitive conclusions on risks to animal species and human health cannot be reached. For this reason, soil, sediment, and tissue samples have been taken at Illeginni Islet, and along the shorelines and shallow marine environments of the lagoon and ocean side of the islet. Though the sampling effort at Illeginni has already been completed, the analytical results for the samples collected are not expected until late 2004. Once the sampling results are known, the information will be utilized in determining the need for further investigation in consultation with the USFWS, NMFS, USEPA, and RMIEPA, and if additional mitigation measures are warranted. Based

on sample analyses, and other new information as it becomes available, strong consideration will be given to further investigation of associated risks.

APPENDIX D

BIOLOGICAL OPINION ON THE EFFECTS OF THE MINUTEMAN III MODIFICATION ON NESTING HABITAT FOR THE GREEN TURTLE (CHELONIA MYDAS)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
PN-04-246

JAN 1 1 2005

Colonel Jeffrey C. Smith
U.S. Army, Deputy Chief of Staff, Engineer
U.S. Army Space and Missile Defense Command
P.O. Box 1500
Huntsville, Alabama 35807-3801

Dear Colonel Smith:

Subject: Biological Opinion on the Effects of the Minuteman III Modification on Nesting Habitat for the Green turtle (*Chelonia mydas*).

Dear Colonel Smith:

This responds to your September 15, 2004, request for consultation under section 3-4.5.3 (Procedures for Consultation on Endangered Resources) of the U.S. Army at Kwajalein Atoll (USAKA) Environmental Standards (UES) (8th edition) for the proposed Draft Environmental Assessment (DEA) Minuteman III Modifications (MMII), August 24, 2004. The U.S. Air Force (USAF) is the action agency for this project and is proposing to modify MMIII flight tests in which the re-entry vehicle (RV) portion of the MMIII missile terminates in either the Pacific Ocean (Kwajalein Bight), the shallow marine environment near Illeginni Islet, or on Illeginni Islet, a USAKA-controlled area at Kwajalein Atoll, Republic of the Marshall Islands (RMI). The proposed project is to increase the number of flight tests from 3 or 4 per year by two additional flight tests in fiscal years 2005 and 2006; and beginning in 2006, Mark 12 RVs would be replaced with Mark 21 RVs. This document represents the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the proposed project on the green turtle (*Chelonia mydas*), a federally listed threatened species under the U.S. Endangered Species Act (Act), and USAKA Species of Concern for which consultation is triggered under the UES (section 3-4.5.3).

This BO is based on the following information: 1) the USAF August 24, 2004 DEA; 2) biological literature (see Literature Cited section at the end of the document); and 3) other information sources. Our log number for this consultation is PN-04-246. Copies of pertinent materials and documentation are maintained in an administrative record in our Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii.

Consultation History

August 24, 2004: The USAF released the DEA to the public on August 24, 2004. The DEA serves as the Notice of Proposed Action (NPA) for a Document of Environmental Protection (DEP) and the Biological Assessment (BA) for species consultation under the UES.

September 15, 2004: The Space and Missile Defense Command initiates consultation under the UES based on its determination that the proposed MMIII project may adversely affect green turtle (*Chelonia mydas*) nesting habitat at Illeginni Islet, Kwajalein Atoll, Republic of the Marshall Islands.

BIOLOGICAL OPINION

Description of the Proposed Action

This project description summarizes information taken from the August 2004 DEA. The proposed action is a modification of an existing program in which MMIII missiles launched from Vandenberg Air Force Base, California, cross the central North Pacific, and impact within the Mid-Atoll Corridor Impact Area, USAKA, Republic of the Marshall Islands. This area includes a broad area of the mid-section of Kwajalein Atoll. The intent of the flight test is to target either Illeginni Islet, the vicinity of Illeginni Islet or the deep ocean locations, east and west of Kwajalein Atoll. Most RVs targeted for the vicinity of Illeginni will impact in the deep ocean area south of Illeginni. A small number of RV flights are anticipated to impact at Illeginni Islet and or on the reef flats within its vicinity over the life of the program. The action proposes to modify the existing MMIII program with: new hardware for the Mark 21 RV; new electronic signal generators; changes to software programs and data collection systems; modifications to system test and evaluation hardware/software; personnel training; and an evaluation of the modified MMIII missile flight test.

Under normal circumstances, approximately three or four MMIII test flights are conducted each year. Four additional flight tests may be conducted in 2005 and 2006, with two tests scheduled between June and August, 2005, and two tests scheduled between February and September, 2006. RVs may contain quantities of hazardous materials that include high explosives, Beryllium (Be), Depleted Uranium (DU), and batteries. Only one RV per year is planned to contain high explosives, and would be targeted for the vicinity of Illeginni Island. A small number of RV flights are anticipated to impact at Illeginni Islet or on the reef flats of Illeginni Islet over the life of the program. RVs that impact on Illeginni Islet, or in the shallow nearshore marine environment near Illeginni, will form a crater. Sediments are displaced by the RV and ejected, along with RV debris, up to 100 meters (m) from the crater. In addition, RVs may be aerially detonated between several hundred and several thousand feet above Illeginni Islet, resulting in the dispersion of particles and fragments at the impact site, and within its vicinity over an undescribed area.

Debris is recovered when RVs impact on Illeginni Islet, or in the shallow marine environment, within approximately 152 to 305 m from the shoreline, or when RVs impact in the ocean at depths less than 30 m. RVs that impact in the ocean at depths greater than 30 m are not recovered.

Debris is excavated from impact sites with the use of a backhoe. Excavated material is screened and RV debris is recovered. RV impact holes are back-filled with displaced coralline algae, mollusc sediments, rubble and rocks. The DEA indicates that some RV debris (small fragments millimeters in size) will never be recovered from the environment.

Conservation Measures

The following list of activities represent actions that USAKA and the USAF will undertake to avoid or minimize impacts to green turtle nesting habitat at Illeginni Islet. These activities will be undertaken as part of the process to develop a Document of Environmental Protection (DEP) for the MMIII project. The Service believes implementation of these actions will result in significant steps towards offsetting sea turtle nesting habitat losses at Illeginni Islet.

1.a. USAKA, in coordination with the USAF, RMI and USFWS, will support establishment of a sea turtle nesting preserve at Eniwetak Islet as part of the DEP process for the MMIII project in accordance with the associated timelines identified in the most recent edition of the UES.

1.b. USAKA will initiate consultation with the RMI to establish protocols to ensure that unauthorized personnel will not have access to Eniwetak. The protocols will address such issues as periodic inspections, removal of trespassers, sanctions for violation of access restrictions and public awareness activities. Public awareness activities may include public meetings, advertisements (newspaper and radio), or other media and signage at Eniwetak.

1.c. USAKA will monitor beaches at Eniwetak Islet for sea turtle nesting success. Inspections for sea turtle nests, egg incubation and hatchling success will be made on a monthly basis during peak nesting periods (May – November).

1.d. USAKA will maintain nesting beaches at Eniwetak Islet by removing marine debris or other hazards that may impede female haul-out, nesting, egg incubation, and hatchling migration to the ocean.

1.e. USAKA, USAF and Department of Energy/Lawrence Livermore National Laboratories (DOE/LLNL) will inspect beach areas for active nests at Illeginni, beginning 70 days prior to each RV impact. If eggs are discovered, they will be moved to Eniwetak Islet, in coordination with the USFWS and USAKA Environmental Office. Protocols for relocating eggs from nests at Illeginni to nests at Eniwetak will be provided by the USFWS to USAKA upon request.

Status of the Species/Critical Habitat

Information in this section is taken from the *Recovery Plan for U.S. Pacific Populations of the Green Turtle* (NMFS and USFWS, 1998), unless otherwise noted.

Species Description

The green turtle (*Chelonia mydas*) is the largest member of the marine turtle family CHELONIIDAE and is found throughout the Pacific, Indian, and Atlantic oceans and the Mediterranean Sea. Green turtles are distinguished from other sea turtles by their smooth carapace with four pairs of lateral scutes, a single pair of prefrontal scutes, and a lower jaw-edge that is coarsely serrated. Adult green turtles may weigh more than 100 kilograms (kg) and exceed one meter in carapace length. The common name of this species refers to the green color of its subdermal fat. The carapace color of adult turtles ranges from light to dark brown, sometimes with an olive cast, radiating or wavy lines, and/or dark blotches. The plastron typically is yellowish to orange, and in the east Pacific often has a grayish cast.

The major taxonomic split within this species is between populations in the Atlantic/Mediterranean and populations in the Pacific/Indian oceans. Although the populations of green turtle in the East Pacific have traditionally been referred to as a distinct subspecies (*C. mydas agassizii*), this distinction as yet has no documented genetic basis. Nevertheless, mitochondrial DNA studies have revealed fixed or near-fixed genotypic differences among nesting populations. This genetic substructure underlies the natal-beach homing behavior of reproductive female turtles. For management and conservation purposes, each nesting population must be treated as an independent demographic unit.

The green turtle was listed in 1978 as threatened under the Endangered Species Act (Act) throughout its Pacific range because of overexploitation, habitat loss, lack of regulation and adequate enforcement, and evidence of declining numbers. Populations nesting in Florida and on the Pacific coast of Mexico are classified as endangered under the Act. The green turtle is also classified as endangered worldwide by the International Union for the Conservation of Nature and Natural Resources, and it is listed in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Because of its status as a federally and internationally protected species, green turtles were included among other sensitive animals afforded special protection at USAKA under the UES in 1995. In 1998, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service completed a recovery plan for the U.S. Pacific populations of the species.

Life history

Throughout their range, adult green turtles typically are resident in foraging areas (*e.g.* seagrass or macro-algae habitats). Periodically, turtles migrate long distances to breeding areas where copulation and nesting take place. Mating usually terminates when nesting has commenced. Based on growth rates observed in wild green turtles, females are thought to reach sexual maturity at 25 years of age or later (Eckert, 1993). Reproductive females generally nest every year, but may skip years. Adult males may migrate and breed every year. Females emerge from the sea to nest 25-35 days after copulation. Green turtles may lay up to six clutches in one season, and each clutch may contain about 100 eggs. After the female has laid the eggs and covered them, the eggs incubate in the soil for up to two months (mean = 64.5 days Balazs 1980). Hatchlings are photopositive and may be disoriented from their search for the sea by artificial light.

Green turtles prefer areas where surface water temperatures are no lower than about 20°centigrade (C) in the coldest month; for example, during warm spells (*e.g.*, El Niño), green turtles may be found considerably north of their normal distribution. Based on the behavior of

post-hatchlings and juveniles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS, 1998). The maximum recorded dive depth for an adult green turtle was 110 meters (NMFS and USFWS, 1998), while subadults routinely dive 20 meters for 9-23 minutes, with a maximum recorded dive of 66 minutes (NMFS and USFWS, 1998). Additionally, it is presumed that drift lines or surface current convergences are preferential zones due to increased densities of likely food items. In the western Atlantic, drift lines commonly contain floating *Sargassum* capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS, 1998).

Sea turtle gender is primarily determined by nest temperature (Mrosovsky and Yntema 1980; Yntema and Mrovosky 1980; and Morreale et al., 1982). Clutches produced between 27°C and 31°C are usually mixed gender. Eggs incubated when average temperatures fall below 27°C during the middle trimester produce males, while females are usually produced when temperatures exceed 31°C (Alvarado and Figueroa, 1987).

Most green turtles appear to have a nearly exclusive herbivorous diet, consisting primarily of sea grass and algae (Wetherall *et al.*, 1993). In some areas, such as along the eastern Pacific coast, green turtles display carnivory, feeding on molluscs and polychaetes, fish, fish eggs, and jellyfish. In the Hawaiian Islands, green turtles are site specific, feeding consistently in the same areas on preferred substrates, which vary by location and between islands (NMFS and USFWS, 1998).

Population Dynamics

The absolute number of green turtles in any population is difficult to assess. The size of a population typically can only be measured as the relative abundance of nesting females. Because an individual female may only nest once every two or more years, even these measures are very rough estimates.

Historical and recent accelerated rates of exploitation of green turtles have lead to significant declines in their distribution and resulted in fewer and smaller remaining breeding sites. In the western Pacific, the only major (greater than 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall *et al.*, 1993) and at French Frigate Shoals (FFS) and scattered locations in the Hawaiian Archipelago (Balazs, 1995). In the Marshall Islands, Bikar Atoll may support between 100 and 500 nesting females (Puleloa and Kilma, 1992), and between 25 and 100 nests may occur at Erikub, Jemo and possibly Ailinginae Atolls (Puleloa and Kilma, 1992). Other atolls may support low level nesting (less than 25 nests) activities, but little information is available concerning current breeding success in these areas.

Although attempts have been made to model the population dynamics of green turtles, few data are available that describe key life history traits, such as growth rates, recruitment, and mortality that influence the population variability and stability of this species (Chaloupka and Musick 1997).

Status and Distribution

Green turtles are declining throughout the Pacific Ocean as a direct consequence of overexploitation and habitat loss (Eckert, 1993). Recovery efforts are hampered by the lack of information about the numbers, distribution, and migration patterns of turtles in most U.S. Pacific populations. Although quantitative assessment of declines also is limited, the continuing decline in this species is the result primarily of harvesting of eggs and adults by humans and nesting habitat due to human development-related activities. Furthermore, nesting sites will not be replenished by the recruitment of turtles from other nesting sites because of the species high fidelity to natal beaches. In the green turtle recovery plan, this directed take is identified as a "major problem" throughout U.S. Pacific territories and the Freely Associated States (FAS: *i.e.*, Republic of the Marshall Islands, Federated States of Micronesia and the Republic of Palau). Severe exploitation of turtles and their eggs in recent decades throughout their range reflects important socio-cultural and economic changes in the Pacific (and throughout the green turtle's range). Specifically, these changes include: 1) erosion of traditional restrictions limiting the number of turtles taken by increased use of island residents; 2) modernized hunting gear; 3) easier boat access to remote islands; 4) extensive commercial exploitation for turtle products in both domestic markets and international trade; and 5) loss of the spiritual/cultural significance of turtles.

Continued poaching, incidental take by sport and commercial fishing gear, and the incidence and severity of tumors caused by a fibropapilloma disease in Hawaii, all act to compromise the green turtle's recovery. Fibropapilloma is often fatal and its etiology is unknown.

Environmental Baseline

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area contemporaneous with the consultation in process. In this case, the baseline includes RMI, local, and private actions that affect the species at the time the consultation begins. Unrelated Federal actions that have already undergone consultation are also a part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

<u>Status of species within the action area</u>

In the Marshall Islands, sea turtle nesting generally occurs between May and November, with some exceptions of nesting observed in December. At Illeginni Islet, the western shoreline (inter-islet reef flat) and northwestern shoreline (lagoon facing) are suitable nesting locations for green turtles (USFWS and NMFS, 2000). Three nest pits were observed at the western shoreline by Service and NMFS biologists in 1996 (USFWS and NMFS, 1996).

Factors affecting species environment within the action area

Few data are available with which to assess population dynamics for this or any sea turtle species. The Marshall Islands population of green turtles is at risk from human harvest of adults, juveniles and eggs; incidental take by fishing gear; marine debris; egg and hatchling predation by rats; and loss of nesting habitat due to human encroachment and construction in areas previously

used by sea turtles (McCoy, 2004). The vast majority of green turtles nesting in the Marshall Islands may be highly sensitive to any perturbations that take place at existing nesting sites.

Existing activities that affect green turtles at Illeginni Islet include: 1) RV's have been documented to impact and contaminate sea turtle nesting habitat at Illeginni Islet; 2) general USAKA operations (*e.g.*, maintenance of existing infrastructure, refurbishment activities and heli-pad) which may interrupt attempts by female green turtles to haul-out and nest on the islet; 3) release of hazardous materials during the detonation of unexploded ordnance at the designated ordnance burn site (western end of islet) which may disturb egg incubation, sea turtle haul-out, or hatchling migration to the ocean; 4) the harvest of green turtle eggs, juveniles and adults by humans for subsistence purposes; and 5) egg and hatchling predation by rats (*Rattus* sp).

Effects of the Action

Turtle nesting habitat may be destroyed when an RV impacts at Illeginni or during post-impact cleanup-related activities (USAF, 2004). In the event an RV impacts on or heavy equipment traverses across turtle nesting habitat, it is possible that turtle eggs may be severely damaged or destroyed, and that the suitability of the habitat for future successful nesting may be eliminated by associated physical changes to that habitat.

The overall effect of the action would not benefit green turtles and other wildlife on Illeginni Islet. RV impacts and recovery activities are expected to result in degradation to shoreline areas that support such habitat, affecting the ability of sea turtle nesting activities to stabilize. Without the action, it is feasible that sea turtle nesting may stabilize, particularly if other negative influences could be eliminated or controlled in concert.

Prior to each launch that could potentially impact at or near Illeginni Islet, USAKA will inspect sea turtle nesting habitat to ensure that no sea turtles are hauled out or active nests exist that could be affected by the RV. The USAF has projected that approximately four or five RVs will impact at Illeginni over the next twenty years. It is also feasible that RV- generated sediment plumes that impact near Illeginni may negatively affect sea turtle nesting habitat as well. However, the window of time that an adult green turtle would be exposed on Illeginni to risk of harm from the RV impact is considered quite small and the risk to be negligible.

The proposed action may, however, result in take in the form of harm or harassment of green turtles by precluding females from haul-out and nesting, preventing normal embryonic development, disturbing or destroying turtle nests, and compromising hatchling growth and success. In addition, a single RV landing on Illeginni can produce a crater approximately 15 feet deep and 25 feet across and eject sediments (*e.g*, primarily coral rubble) up to 100 m from the crater across the islet. Just one such event has the potential to essentially render viable sea turtle nesting habitat permanently unsuitable for successful nesting, and injure or kill hatchlings at Illeginni Islet.

Three sea turtle nests at Illeginni Islet were observed by the Service during the USAKA biennial survey in 1996. Though the nests were not disturbed, we anticipate that each clutch may contain about 100 eggs (Balazs 1980), or about 300 eggs total at the nesting site. Potential project-related impacts to eggs include direct impacts from RV's, post-impact refurbishment activities (e.g., earth moving equipment), or from exposure to project-related contaminants.

Certain components of the RV are comprised of Depleted Uranium (DU), a heavy metal, and Beryllium (Be). When an RV impacts on Illeginni Islet or the shallow nearshore marine environment, it breaks up. As heavy metals mix into the Illeginni environment, they may present an exposure risk, primarily to animals. Exposure to toxic levels of heavy metals has been documented in test animals to result in growth anomalies, tumors, pneumonitis, hypersensitivity, cancer and death (T.C. Pellmar *et.al.*, 1999; Hoffman *et al.*, 2003; Klaassen *et al.*, 1986; and Lewis 1998).

Soil sampling for Be was conducted at an RV impact site in 1992 that resulted in the identification of Be concentrations of about 5 parts per million, very near background levels. Though Be and DU are known to be highly insoluble (USAF, 2004), sea turtles have not been evaluated for toxic exposure to DU or BE, and it is feasible that the health of nesting females, embryos, and hatchlings at Illeginni may be degraded, resulting in reduced ability of the animal to resist diseases, successfully evade predators, forage or reproduce.

The USFWS and NMFS have recently collected tissue samples of organisms in the vicinity of Illeginni Islet. The samples are being currently analyzed at the Lawrence Livermore National Laboratories (LLNL). Evaluation of these samples is the beginning of a process to determine the potential for toxic exposure of DU and BE to sea turtles.

Establishing Eniwetak Islet as a conservation area would protect the existing sea turtle nesting habitat from disturbance. Two nests have been observed at Eniwetak during previous USAKA biennial surveys. The nests were left undisturbed and no attempt was made to estimate clutch size. However, we anticipate that about 100 eggs may have resided in each nest. Therefore, we estimate the productivity of this nesting area to be about 200 eggs per nesting season. Estimates of replacement vary considerably (*e.g*, 5,000 to 12,000 eggs = 1 adult) (P. Jokiel, pers. communication; and Limpus and Balazs 1991), but suggest that relative contributions of the conservation area, though similar to potential losses at Illeginni, would be modest, but would likely offset losses that may occur due to implementation of the proposed action.

Cumulative Effects of Non-Federal Activities

Cumulative effects include the effects of future RMI, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 3-4.5.3 of the UES.

Though Illeginni Islet is a USAKA-leased islet and closed to public access, it is possible that humans may gain access to the islet and harvest eggs or adult green sea turtles.

Conclusion

After reviewing the current status of the green turtle, the environmental baseline for the action area, the effects of the proposed shoreline stabilization, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of this species. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 3-4.8.1 of the UES prohibits the take of endangered and threatened species, respectively. Incidental take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

The measures described below are non-discretionary, and must be undertaken so that they become binding conditions. Because USAKA has command over all United States Government activities at USAKA-controlled islands, the Mid-Atoll Corridor, and USAKA-controlled activities within the RMI, these measures will be implemented by USAKA. However, the USAF must support implementation of these measures in coordination with USAKA. Furthermore, the USAF has a continuing duty to regulate the activity, in coordination with USAKA, covered by this incidental take statement. If the USAF (1) fails to support implementation of the terms and conditions or (2) fails to adhere to the terms and conditions of the incidental take statement, USAKA and the RMI may seek to enforce the terms. In order to monitor the impact of incidental take, the USAF must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

Amount or Extent of Incidental Take

The Service anticipates incidental take to occur in the form of harm or harassment to the breeding success or loss of up to three green turtle nests or injury or loss of up to 300 eggs or hatchlings per year as a result of project-related RV impacts at Illeginni Islet or during the process to transport eggs from Illeginni to the sea turtle conservation area at Eniwetak Islet.

Effect of the Take

The Service does not believe that this level of incidental take is likely to result in jeopardy to the species or destruction or adverse modification of critical habitat, as critical habitat is not designated in the project area. The level of take is not likely to result in jeopardy because the overall effect of the action will likely affect no more than three green turtle nests or approximately 300 hatchlings per year at Illeginni Islet. Furthermore, these losses are expected to be offset by the implementation of conservation measures to protect green sea turtle nesting habitat at Eniwetak Islet. It is expected that about three sea turtle nests with an anticipated production of up to at least 300 green sea turtle hatchlings per year will be protected in perpetuity at Eniwetak Islet.

Reasonable and Prudent Measures

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the actions, the level of incidental take is

exceeded, the action agency is required to reinitiate consultation and review the reasonable and prudent measures provided in this biological opinion. In addition, the Army must cease the activities that caused the taking; must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the reasonable and prudent measures.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts on green turtles.

(1) Minimize the number of nests destroyed.
(2) Monitor and report any incidental take that occurs.

Terms and Conditions

In order to be exempt from the prohibitions of section 3-4.8.1 of the UES, the USAF must comply with the following terms and conditions, which implement reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

In order to implement reasonable and prudent measure 1 above, the following term and condition applies:

1. The USAF will target the RVs away from the known sea turtle nesting areas within the Mid-Atoll Corridor Impact Area.

In order to implement reasonable and prudent measure 2 above, the following terms and conditions apply:

2.a. The USAF will work with the USAKA Environmental Management Office to inspect the RV impact zones to assess sea turtle mortality after each mission.

2.b. The USAF will submit an annual report by December 31 of each year to USAKA for the MMIIIRV test flights, if any, that would have impacted in the vicinity of Illeginni Island. The USAKA Environmental Management Office will forward the report to the PIFWO Field Supervisor at the above address documenting take of green turtle and suggesting ways to further minimize incidental take at Illeginni Islet.

The PIFWO believes no more than 3 nests per year will be precluded from reaching complete incubation (*i.e.*, hatching). The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of this BO and review of the reasonable and prudent measures provided. The USAF must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Federal agencies may carry out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information. When recommendations are provided, they relate only to the proposed action and do not necessarily represent complete fulfillment of an agency's responsibilities for the species.

1.a. The USAF may support eradication of all species of rats from Eniwetak and maintain this islet as a rodent free environment to encourage incubation and hatchling success.

1.b. The USAF may conduct a risk analysis of sea turtle exposure to DU and Beat Illeginni. Rats (*Rattus* sp) that occur within the vicinity of sea turtle nesting sites may be used as surrogates to supplement this analysis. The analysis should evaluate concentrations of DU or Be in the kidney, liver, bone and lung tissue.

This concludes consultation on the action described in the August 24, 2004 Draft EA for the Minuteman III Modification. Reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions concerning this BO, please contact Marine Ecologist Kevin Foster (phone: 808/792-9420; fax: 808/792-9581).

Sincerely,

for Gina Shultz
Acting Field Supervisor

cc: NMFS- PIRO
EPA-San Francisco
USAF
USAKA
RMI-EPA

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