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ENVIRONMENTAL ASSESSMENT

BRILLIANT PEBBLES EXPERIMENT PROGRAM (U)

MAY 1990

DEPARTMENT OF DEFENSE
STRATEGIC DEFENSE INITIATIVE ORGANIZATION
WASHINGTON, D.C. 20301-7100

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FOR THE
BRILLIANT PEBBLES
EXPERIMENT PROGRAM

PREPARED BY
DEPARTMENT OF DEFENSE
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Cover Sheet

Responsible Agency:	Strategic Defense Initiative Organization
Proposed Action:	Implement the Space-Based Architecture Study (SBAS) relating to the Demonstration/Validation Testing program for space-based elements of the Candidate Phase I Architecture
Responsible Individual:	Capt V.G. Brown Environmental Coordinator SDIO/ENEC Washington, D.C. 20301-7100
Designation:	Environmental Assessment
Abstract:	The Strategic Defense Initiative Organization (SDIO) plans to conduct concept feasibility and technology validation tests on the Brilliant Pebbles (BP) Experiment Program, an innovative interceptor technology and competitor for the planned Space-Based Interceptor (SBI). BP tests will include component/subassembly ground tests and preflight and flight tests to ensure all technical issues are addressed to a sufficient level to reduce risk at the full-scale development (FSD) decision point, and to demonstrate and validate the BP components' capability and vehicle's survivability in a space environment. Proposed locations for testing include: Lawrence Livermore National Laboratory, Sandia National Laboratories, National Test Facility, Arnold Engineering Development Center, Nevada Test Site, Edwards Air Force Base, Wallops Flight Facility, Pacific Missile Range Facility, U.S. Army Kwajalein Atoll, Wake Island, and Vandenberg Air Force Base.
Availability:	Secret Classification, available April 1990.

FINDING OF NO SIGNIFICANT IMPACT

BRILLIANT PEBBLES EXPERIMENT PROGRAM

STRATEGIC DEFENSE INITIATIVE ORGANIZATION

U.S. DEPARTMENT OF DEFENSE

AGENCY: Department of Defense
Strategic Defense Initiative Organization (SDIO)

ACTION: Implement the Space-Based Architecture Study (SBAS) as it relates to the testing program for the space-based elements of the Candidate Phase 1 Strategic Defense System (SDS) Architecture.

BACKGROUND: Pursuant to Council on Environmental Quality Regulations (40 CFR 1500-1508) for implementing the procedural provisions of the National Environmental Policy Act (42 U.S.C. 4321 et. seq.), and Department of Defense (DoD) Directives on environmental effects of DoD actions, SDIO has conducted an assessment of the potential environmental consequences of the implementation of the Space-Based Architecture Study.

SDIO is evaluating the feasibility of developing a defense against ballistic missiles. The candidate Phase 1 SDS architecture consists of a mix of land and space-based elements. The SBAS review of the space-based elements focused on an innovative, singlet interceptor technology, Brilliant Pebbles (BP), as a substitute for the multiple interceptor carrier concept of the Space Based Interceptor (SBI).

SUMMARY: The substitution of BP for SBI in the Candidate Phase 1 SDS will result in an increase in BP testing and an attendant decrease in SBI demonstration/validation activities. Basically, all SBI flight tests and associated target flights will be deleted from the SBI testing program. Ground testing of components and analysis and simulations of SBI will continue, however.

The BP Experiment Program is being conducted in two phases, concept feasibility and technology validation. Each phase will consist of three types of activities: 1) component/subassembly ground tests; 2) preflight activities and tests; and, 3) flight tests. In addition to these activities, all test sites will engage in data collection, analysis, and simulation.

The locations of test activities for BP are:

INSTALLATION	TEST TYPE
Lawrence Livermore National Laboratory, CA	Ground Tests
Sandia National Laboratory, NM	Ground Tests
Arnold Engineering Development Center, TN	Ground Tests
National Test Facility, CO	Analysis, Simulations
Nevada Test Site, NV	Ground Tests
Edwards AFB, CA	Preflight Tests
Wallops Flight Facility, VA	Preflight, Flight Tests
U.S. Army Kwajalein Atoll, Republic of the Marshall Islands	Preflight, Flight Tests
Wake Island	Preflight, Flight Tests
Pacific Missile Range Facility, Kauai, Hawaii	Preflight, Flight Tests
Vandenberg AFB, CA	Preflight, Flight Tests

Details of the technology validation phase of the BP Experiment Program are not as defined as the concept feasibility phase; therefore programmatic analysis has been applied as a planning guide for program definition. As the technology validation phase matures, or if the concept feasibility phase activities are modified, the newly proposed activities will be evaluated, and, if necessary, supplemental environmental documentation will be prepared.

Plans for the use of the test ranges may change as operational considerations arise. These operational considerations will be coordinated with the host agency to accommodate technical, scheduling or other operational parameters. At the time these changes arise, SDIO will reevaluate the environmental consequences of the changes, and, if necessary, supplemental environmental documentation will be prepared.

FINDINGS: No significant impacts would result from the proposed BP analysis and simulation activities. All potentially significant impacts from the BP ground, preflight, and flight test activities will be mitigated to insignificant levels by implementing standard, planned safeguards. These mitigations have been incorporated into the BP Program as an integral part of its operation.

Potential land use, water resources, flora and fauna, utilities, and safety issues concern the release of liquid propellant, in various forms of hydrazine. The BP program adopts as mitigation procedures to implement spill control, containment, handling and disposal practices which will reduce the risk of releasing liquid propellant into the environment. Appropriate personnel protection devices will be used during fueling/defueling and purging operations.

Potential air quality impacts will be mitigated by not conducting BP experiments during heavy rains in order to minimize creation of hydrochloric acid in the atmosphere. Moreover, tests will not be conducted when an inversion layer would trap the liquid fuel oxidizer (nitrogen tetroxide) close to the ground, not allowing proper dispersion of the gas.

Potential noise impacts from BP launches and ground activities will be mitigated by ensuring personnel wear hearing protection equipment which will reduce noise levels to the proper safety and health minimums. Moreover, personnel will be protected from blast noise during launches by evacuating to noise insulated bunkers or by moving beyond the calculated safety distance. Times of flight near populated areas will be limited in order to minimize noise exposure.

Safety parameters will be implemented to prevent risk of harm to people and inhabited structures during BP experiments. Electromagnetic radiation from BP activities will be monitored to ensure exposure limits are not exceeded. Further, controlling access to hazard areas and shielding will prevent injury. Impacts from open air testing of lasers will be mitigated by establishing minimum eye safe distances, training, filtration devices, and other control procedures. Areas will be monitored to ensure access to the hazard area is controlled and to prevent firing of the laser when aircraft are in the test airspace.

Accidental explosion of a rocket booster on the launch pad or shortly after launch could pose a hazard to

personnel in the vicinity of the launch area. The range safety officer will mitigate the potential for such a hazard by calculating the explosive quantity safety distance for each rocket launch and monitoring the hazard area to prevent unauthorized entry. BP launch control activities will take place in facilities which are either outside the hazard area or are designed to withstand the force of an explosion based on the largest booster net explosive weight, without causing injury.

The range safety officer will also monitor the test range to ensure it is clear of ship and plane traffic prior to launch. Notices to airmen (NOTAMS) and local notices to mariners (LONOTES) will be issued to warn traffic of the pending launch. In order to mitigate potential harm to populated or other sensitive areas, the safety officer will also continuously monitor the flight of the launch vehicle to ensure it does not exceed its flight dispersion pattern or launch hazard area. If the vehicle approaches the limits of its flight operations, then the safety officer will terminate the flight over the test range.

Modifications to the SDI testing program would involve curtailing activities assessed previously and found to have no significant impact on the environment. These activities would largely be replaced by BP tests and comparable insignificant impacts are expected.

The no action alternative would result in insignificant environmental consequences that have already been assessed in previous documents. The no action alternative would continue these activities unchanged.

Overall, no significant impact would result from implementing the SBAS, specifically conducting the BP Experiment Program and modifying the SBI test program. Therefore, no environmental impact statement will be prepared for the proposed action.

POINT OF CONTACT: Capt V.G. Brown
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Washington, DC 20301-7100

DATED 7 May 90

GEORGE L. MONAHAN, JR.
Lieutenant General, USAF
Director, SDIO

EXECUTIVE SUMMARY

PROPOSED ACTION AND ALTERNATIVES (U)

(U) The baseline architecture of the Strategic Defense System (SDS) is referred to as the Candidate Phase I Architecture and consists of a combination of ground-based and space-based elements. SDIO commissioned a review, the Space-Based Architecture Study (SBAS), of the space-based elements of the Candidate Phase I Architecture. The SBAS focused on an innovative interceptor technology, Brilliant Pebbles (BP), as a competitor for the then primary interceptor technology, the Space-Based Interceptor (SBI). BP offers the advantages of "off-the-shelf" technology, proliferation, greater survivability, and lower cost than SBI.

(U) The proposed action is to implement the SBAS as it relates to the Demonstration/Validation (Dem/Val) testing program for the space-based elements of the Candidate Phase I Architecture, including (1) execution of the BP testing program, and (2) modification of the current SBI testing program. If the BP concept is feasible, it will be substituted for the SBI and its attendant functions.

The BP Experiment Program (U)

(U) The BP system design concept consists of ground- and space-based segments where a large number of autonomous, capable platforms, each of which contains a single kinetic kill vehicle (KKV) (interceptor), will be deployed in low-earth orbit (LEO). The primary mission is defense against ballistic missile targets in the boost and post-boost phases of their trajectories. The BP systems will have onboard surveillance and tracking capabilities.

(U) SDIO is conducting the BP Experiment Program in two phases: (1) concept feasibility, and (2) technology validation. The phases will consist of two types of activities--component/subassembly ground tests and preflight and flight tests--that will determine whether the components, subsystems, and systems satisfy the mission requirements. Analyses, simulations, data gathering, and evaluations will be accomplished during each activity to determine if component/subsystem prototypes satisfy their functional performance requirements.

(U) The concept feasibility phase is being executed in cooperation with the Lawrence Livermore National Laboratory (LLNL) and will focus on the proof of the concept prior to transitioning the effort to industry. The technology validation phase will provide for industry involvement, is not as clearly defined as the concept

feasibility phase of the BP Experiment Program. However, it is expected that the technology validation testing will be similar in nature and scope.

(U) The testing program will, to the maximum extent practicable, be conducted using existing facilities and personnel currently working at those facilities. The component/subassembly ground tests and simulations are a series of tests that seek to verify the ability of the component or subsystem to satisfy mission requirements. This testing includes all bench, thermovac, Hardware-in-the-Loop (HWIL), Software-in-the-Loop (SWIL), and survivability testing of all BP components and subsystems. Ground tests also include integrated sensor tests and integrated subsystem tests that demonstrate various integration concerns, such as subsystem interoperability, hardware and software interface, etc. Also included in this category are the data analysis and phenomenology studies associated with target and background characteristics.

(U) The preflight ground tests are designed to demonstrate that the flight vehicle (including all subsystems) configured for a given flight test is capable of performing its intended operational functions. The testing activities will include mission-specific software test and evaluation (T&E), integrated subsystem and system bench testing, integrated vehicle air-bearing test, and integrated environmental testing of the payload (i.e., the flight vehicle or "probe") and payload delivery vehicle. The objective of these tests is to ensure that the test vehicle is properly integrated and operates according to specified parameters prior to actual flight tests.

(U) (S) There are several proposed flight tests, which will be conducted over a period of 3 years. The purpose of these tests is to evaluate the key technologies necessary for development and deployment of a BP system element. These flights will demonstrate, through increasingly complex testing, the performance characteristics of the components/subsystems on different flight vehicles that represent an incremental advancement of intercept capabilities. The objectives of the flight tests are to demonstrate the ability of the interceptor to successfully engage boost and post-boost targets in increasingly complex scenarios,

[redacted]

Modifications to the SBI Testing Program (U)

(U) The SBI is an orbiting weapon system whose mission is to intercept targets on a kinetic energy (KE) "hit-to-kill" basis during the target's boost, post-boost, and midcourse phases of

flight. The SBI constellation would consist of several carrier vehicles (CVs), each carrying multiple interceptor vehicles (IVs) in near-Earth orbits. Modifications to the SBI testing program would involve curtailing the activities described in the 1987 SBI Dem/Val Environmental Assessment (EA) with respect to the flight tests.

Alternative to the Proposed Action (U)

(U) The no action alternative is to continue with the current Dem/Val testing program as outlined in the 1987 EAs and the 1989 U.S. Army Kwajalein Atoll (USAKA) Environmental Impact Statement (EIS) without conducting the proposed BP testing activities. Although this alternative would provide the necessary information on the baseline Phase I Architecture, it would not provide sufficient information for future decisions regarding the BP element in the SDS.

Environmental Consequences (U)

(U) The proposed action and alternatives were assessed against the following environmental media: land use, water resources, air quality, noise, flora and fauna, archaeology and history, socioeconomics, utilities, and safety. The analysis was accomplished in two phases: (1) technology impacts and (2) specific test facility impacts.

(U) The BP technology, including the series of experiments, was evaluated to determine whether BP or its testing program cause any significant environmental effects on land use, water resources, air quality, noise, flora and fauna, archaeological and historical resources, socioeconomics, utilities, and safety. Impacts resulting from BP activities will be avoided or minimized through implementation of appropriate mitigation measures or modification of the technology design testing procedures. Therefore, no significant impacts are expected.

(U) For the site-specific analysis, impacts resulting from BP activities will be avoided or minimized by modification of testing procedures or protection of the potentially affected resources.

(U) For the preflight and flight test activities, no significant impacts are expected. The proposed BP Experiment Program activities at WFF will use existing launch and tracking facilities associated with sounding rocket activities. In combination with other launches at WFF, the BP Experiment Program would increase the number of launches by 5 percent or less, depending on the launch frequency of other vehicles at the facility. SDI will implement all mitigation measures, such as closed-loop fueling/defueling,

spill containment procedures, etc., to ensure that there are no impacts on personnel or other resources at WFF.

(U) At USAKA, the proposed BP Experiment Program would serve as a substitute for the SBI as a system element in the Candidate Phase I Architecture. SBI activities were addressed in a 1989 EIS, which covered current and proposed SDI activities at USAKA. Substitution of BP for SBI flight tests results in no net increase in the total launches at the range. Therefore, the BP Experiment would not represent an incremental increase over proposed SDI activities and would not result in potentially significant impacts. The mitigations that apply to the proposed SDI activities will also apply to the BP Experiment Program, and no additional mitigations specific to BP are necessary.

(U) Flight activities planned for Wake Island will be conducted at existing launch facilities. These facilities have been positioned and mitigations taken as listed in the Project Starbird EA. Operational activities for BP are anticipated to be similar to those required for Project Starbird. Additional mitigations for liquid propellant fueling, such as launch pad spill containment; closed-loop fueling/defueling/purging; and cleaning, handling, and treatment procedures, will be implemented. Implementation of these measures will ensure that there are no significant impacts on the environment.

(U) Proposed BP flight activities at PMRF are planned to use the Strategic Target System (STARS) launch facilities and boosters. STARS activities are currently being assessed in a draft EA, which will be finalized before any STARS flights associated with BP are scheduled to occur. Mitigation measures adopted in association with STARS will be implemented for any STARS flights associated with BP.

(U) Proposed flight activities at VAFB will be conducted at existing facilities. Operational activities at VAFB for the BP Experiment Program are anticipated to be similar to ongoing activities at VAFB, and mitigation measures adopted in previous environmental documentation at VAFB will be adopted for the BP Experiment Program. Therefore, the proposed BP Experiment Program activities are not expected to cause significant adverse impacts on the environment.

Modifications to the Space-Based Interceptor (SBI) Testing Program (U)

(U) Modifications to the SBI testing program would include curtailing testing programs as outlined in the Dem/Val EA for SBI. The potential impacts and mitigations for these activities are addressed in the 1989 EIS on proposed actions at USAKA.

Alternatives to Proposed Action (U)

(U) The environmental consequences of the SBI, Space-Based Surveillance and Tracking (SSTS), and Ground-Based Surveillance and Tracking (GSTS) activities have been analyzed in several EAs and an EIS.

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ACRONYMS

ACS	Attitude Control System
AEDC	Arnold Engineering Development Center
AFAL	U.S. Air Force Astronautics Laboratory
AFB	Air Force Base
AGT	Above Ground Test
BBX	Black Brandt X
BBV	Black Brandt V
BM/C^3	Battle Management/Command, Control, and Communications
BMD	Ballistic Missile Defense
BOA	Broad ocean area
BP	Brilliant Pebbles
BSTS	Boost Surveillance and Tracking System
CCE/SOIF	Command Center Element/System Operation Integration Functions
CSOC	Consolidated Space Operating Center
CV	Carrier Vehicle
Dem/Val	Demonstration/Validation
DNA	Defense Nuclear Agency
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
EA	Environmental Assessment
EAFB	Edwards Air Force Base
EIS	Environmental Impact Statement
EMP	Electromagnetic pulse
EMR	Electromagnetic radiation
EQSD	Explosive Quantity Safety Distance
ERIS	Exoatmospheric Reentry Vehicle System
FAA	Federal Aviation Administration
FOC	Full operational capacity
FONSI	Finding of no significant impact
FSD	Full-Scale Development
GBI	Ground-Based Interceptor

GBR	Ground-Based Radar
GSTS	Ground-Based Surveillance and Tracking System
HCL	Hydrochloric Acid
HEDI	High Endoatmospheric Defense Interceptor
HLOS	Horizontal line-of-site
HVG	Hypervelocity gun
HWIL	Hardware-in-the-Loop
HWSI	Hybrid water-scale-integration
ICBM	Intercontinental ballistic missile
IR	Infrared
IV	Interceptor vehicle
KE	Kinetic Energy
KFIT	Kinetic Flight Integration Test
KHIT	Kinetic Kill Vehicle Hover Integration Test Bed
KKV	Kinetic kill vehicle
KTF	Kauai Test Facility
LEO	Low-earth orbit
LIDAR	Light detection and ranging
Ldn	Day-night average sound level
LLNL	Lawrence Livermore National Laboratory
LONOTE	Local Notice to Mariners
MAB	Missile Assembly Building
MCV	Mission-capable vehicle
MMH	Monomethyl hydrazine
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
Nd:YAG	Neodinium:Yttrium Aluminum Garnet
NEW	Net explosive weight
NIOSH	National Institute of Occupational Safety and Health
NOAH	National Oceanic and Atmospheric Administration
nm	nautical mile
NOTAM	Notice to Airmen
NTF	National Test Facility
NTS	Nevada Test Site
OSHA	Occupational Health and Safety Administration

PAB	Payload Assembly Building
PIP	Predicted Intercept Point
PMRF	Pacific Missile Range Facility
ppm	parts per million
psi	pounds per square inch
RCRA	Resource Conservation and Recovery Act
RSO	Range Safety Officer
RV	Reentry vehicle
RWQCB	Regional Water Quality Control Board
SBAS	Space-Based Architecture Study
SBI	Spaced-Based Interceptor
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDS	Strategic Defense System
SNL	Sandia National Laboratories
SRM	Solid rocket motor
SSTS	Space-Based Surveillance and Tracking System
STARS	Strategic Target System
SWIL	Software-in-the-Loop
SW/MWIR	Short-wave/medium-wave infrared
T&E	Test and Evaluation
THC	Toxic Hazard Corridor
UDMH	Unsymmetrical dimethylhydrazine
UGT	Underground Nuclear Test
USAKA	U.S. Army Kwajalein Atoll
USASDC	U.S. Army Strategic Defense Command
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
UV	Ultraviolet
VAFB	Vandenberg Air Force Base
VOC	Volatile organic carbon
WFF	Wallops Flight Facility
WWII	World War II

1.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (U)

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION (U)

(U) The President's announcement on March 23, 1983, initiated an extensive research program to determine the feasibility of developing an effective Ballistic Missile Defense (BMD) system (known as a Strategic Defense System) to protect the United States and its allies from an enemy ballistic missile attack. The Strategic Defense Initiative Organization (SDIO) was established to plan, organize, coordinate, direct, and enhance the research and testing of technologies applicable to a Strategic Defense System (SDS). The research activities are collectively known as the Strategic Defense Initiative (SDI). Future implementation of an SDS would be based on information gained through implementation of the Strategic Defense Initiative Program.

(U) The SDS that would culminate from the SDI program is referred to as a "system of systems." The organization and function of the elements that would make up the SDS are called an architecture.

(U) The baseline architecture of the SDS is referred to as the Phase I Architecture, and consists of a combination of ground-based and space-based elements. The elements of this architecture, shown notionally in Figure 1-1, included Boost Surveillance and Tracking System (BSTS), Ground Surveillance and Tracking System (GSTS), Exoatmospheric Reentry Interceptor System (ERIS) [now known as Ground-Based Interceptor (GBI)], Space-Based Interceptor (SBI), and Battle Management/Command, Control, and Communications (BM/C^3) [now known as Command Center Element/System Operation Integration Functions (CCE/SOIF)].

(U) SDIO is accomplishing environmental planning simultaneously with the program planning activities. In 1987, SDIO evaluated the environmental impacts of the Demonstration/Validation (Dem/Val) testing program of the Candidate Phase I Architecture in a combination of seven Environmental Assessments (EAs), one for each technology and a Summary EA. The U.S. Army Strategic Defense Command (USASDC) [parent organization to U.S. Army Kwajalein Atoll (USAKA)] and the SDIO prepared an Environmental Impact Statement (EIS) to assess the cumulative environmental effects of the ongoing USAKA activities and the proposed SDI testing at USAKA. This EIS was finalized in December 1989. USASDC completed an EA for the Ground Base Radar (GBR) Dem/Val testing program in March 1989, which resulted in a finding of no significant impact (FONSI).

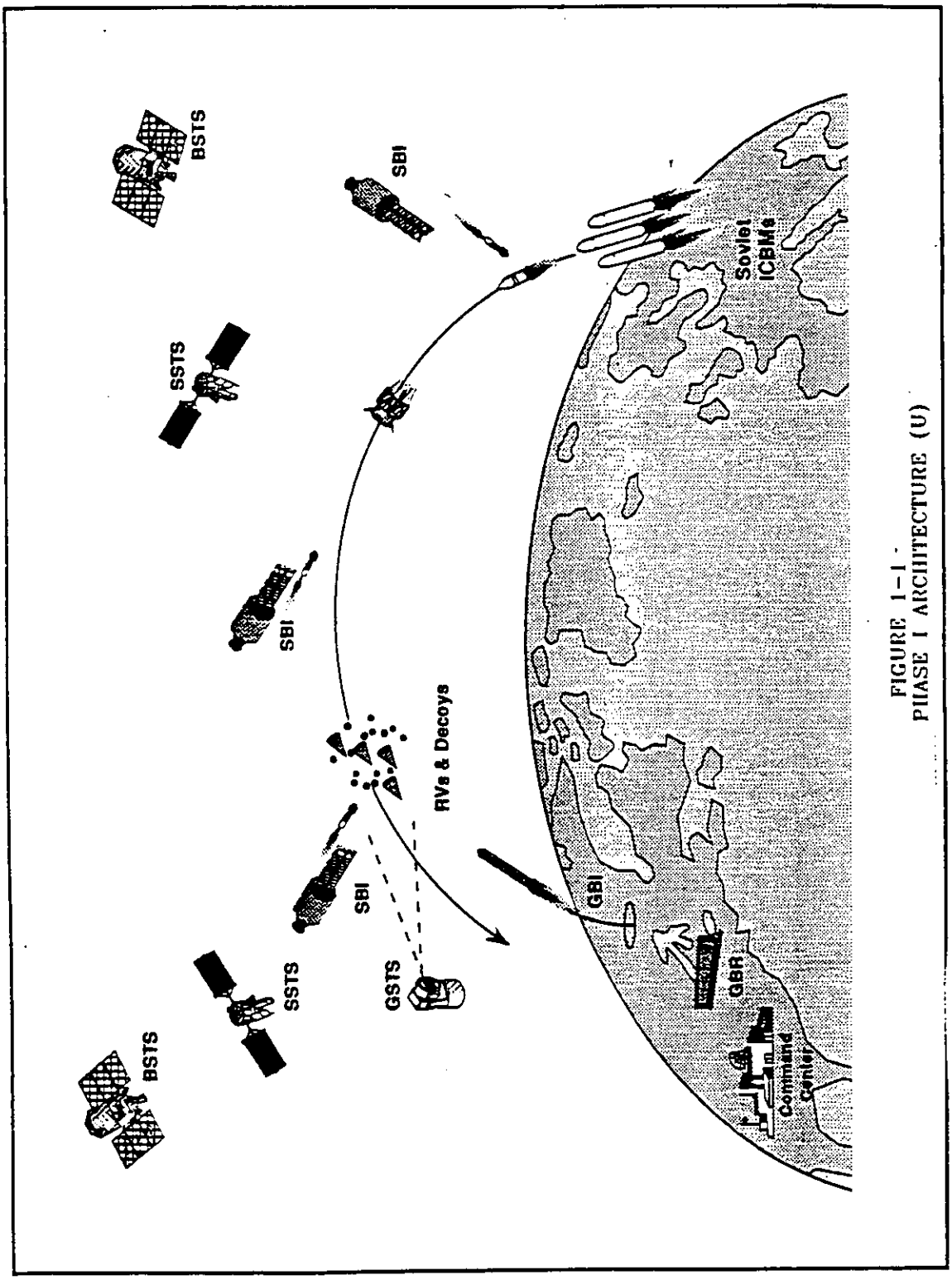


FIGURE 1-1 -
PHASE I ARCHITECTURE (U)

(U) In the summer of 1989, SDIO commissioned a review, the Space-Based Architecture Study (SBAS), of the space-based elements of the Candidate Phase I Architecture. This review focused on an innovative interceptor technology, Brilliant Pebbles (BP), as a competitor for the SBI. Brilliant Pebbles offers advantages of "off-the-shelf" technology, proliferation, greater survivability, and lower cost than the SBI.

(U) The proposed action would incorporate the recommendations of the SBAS into the Candidate Phase I Architecture by substituting BP for SBI as a system element. The modification would result in a decrease in technology development test activities for SBI and an attendant increase in testing activities for BP. Thus, the purpose of the proposed action is to fulfill the recommendations of the SBAS by altering the current Dem/Val testing program to replace SBI with BP, and validate the concept of BP as a system element in the Candidate Phase I Architecture (Figure 1-2).

(U) Conduct of the test activities to fulfill the SBAS does not preclude the possibility of testing or advancing other technologies in the acquisition process, nor does it constitute a decision that indicates the BP or any system element of the Candidate Phase I SDS Architecture will be deployed. Further advancement and testing of the Candidate Phase I Architecture or its elements will be supported by additional environmental analysis and documentation, as required.

1.2 PROPOSED ACTION (U)

1.2.1 Background and Concept (U)

(U) The proposed action is to implement the Space-Based Architecture Study (SBAS) as it relates to the Dem/Val testing program for the space-based elements of the Phase I Architecture. The proposed action is divided into two discrete activities: (1) execution of the BP testing program, and (2) modification to the SBI testing program. As stated earlier, the Phase I Architecture consists of BSTS, SSTS, GSTS, GBI, SBI, GBR, and CCE/SOIF. If the concept is feasible, BP would be substituted for the SBI and its attendant functions.

(U) The BP system design concept consists of ground- and space-based segments where a large number of autonomous-capable platforms (life jackets), each of which contains a single interceptor, would be deployed in a low-Earth orbit (LEO). The primary mission is defense against ballistic missile targets in the boost and post-boost phases of their trajectories. BP derives its name from

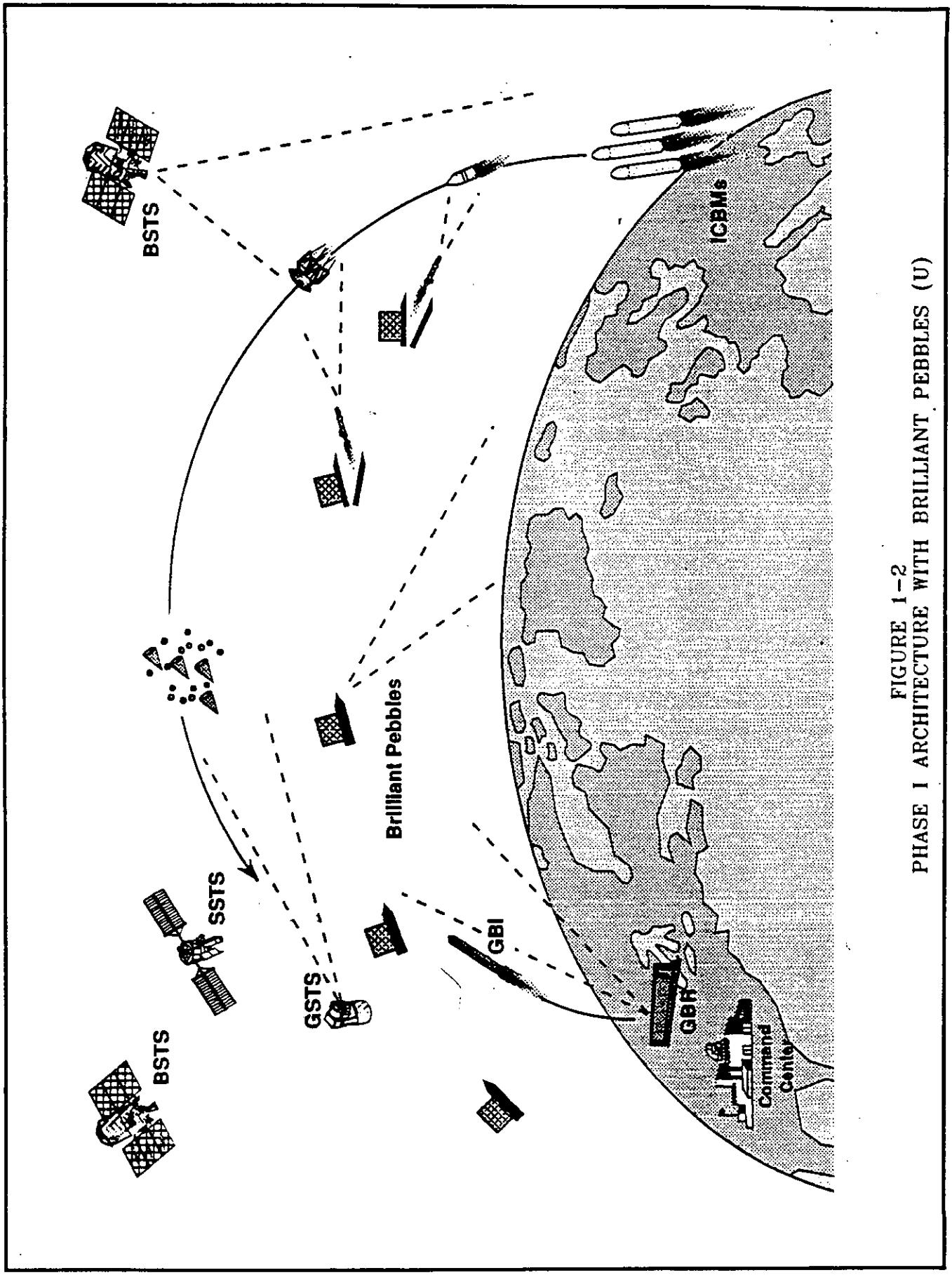


FIGURE 1-2
PHASE I ARCHITECTURE WITH BRILLIANT PEBBLES (U)

its characteristics as a small, single, integrated sensor and interceptor deployed in space. It is distinguished by its small size, low cost, high capability/flexibility, and survivability.

(U) Figure 1-3 depicts the BP system design. The interceptor consists of a single Kinetic Kill Vehicle (KKV), providing sensors, guidance, control, and battle management, and a dropaway propulsion stage. The KKV propellant consists of 24 percent hydrazinium nitrate-doped hydrazine. The propulsion system will carry no pressurized gas; instead, decomposed hydrazine is used as the pressurant for the fuel pump and attitude-control thrusters, and the end-caps of the hydrazine fuel tanks are pre-filled with an inert pressurization agent (isopropyl/butane), which maintains the tankage piston.

(U) The Star Tracker (currently placed on the interceptor, but will eventually be on the life jacket) is used for orientation and monitors stars for attitude and position determination. Also on-board the interceptor is the Ultraviolet (UV)/Visible Camera and a Short-Wave/Medium-Wave Infrared (SW/MWIR) Camera. The Light Detection and Ranging (LIDAR) Transmitter/Receiver contains a diode pumped Neodinium:Yttrium Aluminum Garnet (Nd:YAG) laser with 5 millijoules of pulse energy. The computer system contains a 32-bit CMOS RISC microprocessor system, packaged using hybrid wafer-scale-integration (HWSI) techniques.

(U) The dropaway tank will contain mixed propellant: one-half of the tank contains neat hydrazine, and the other half contains 24 percent hydrazinium nitrate-doped hydrazine. The dropaway tank will also contain pumps, valves, thrusters, and plumbing. Thrusters provide the axial propulsion and divert thrust.

(U)

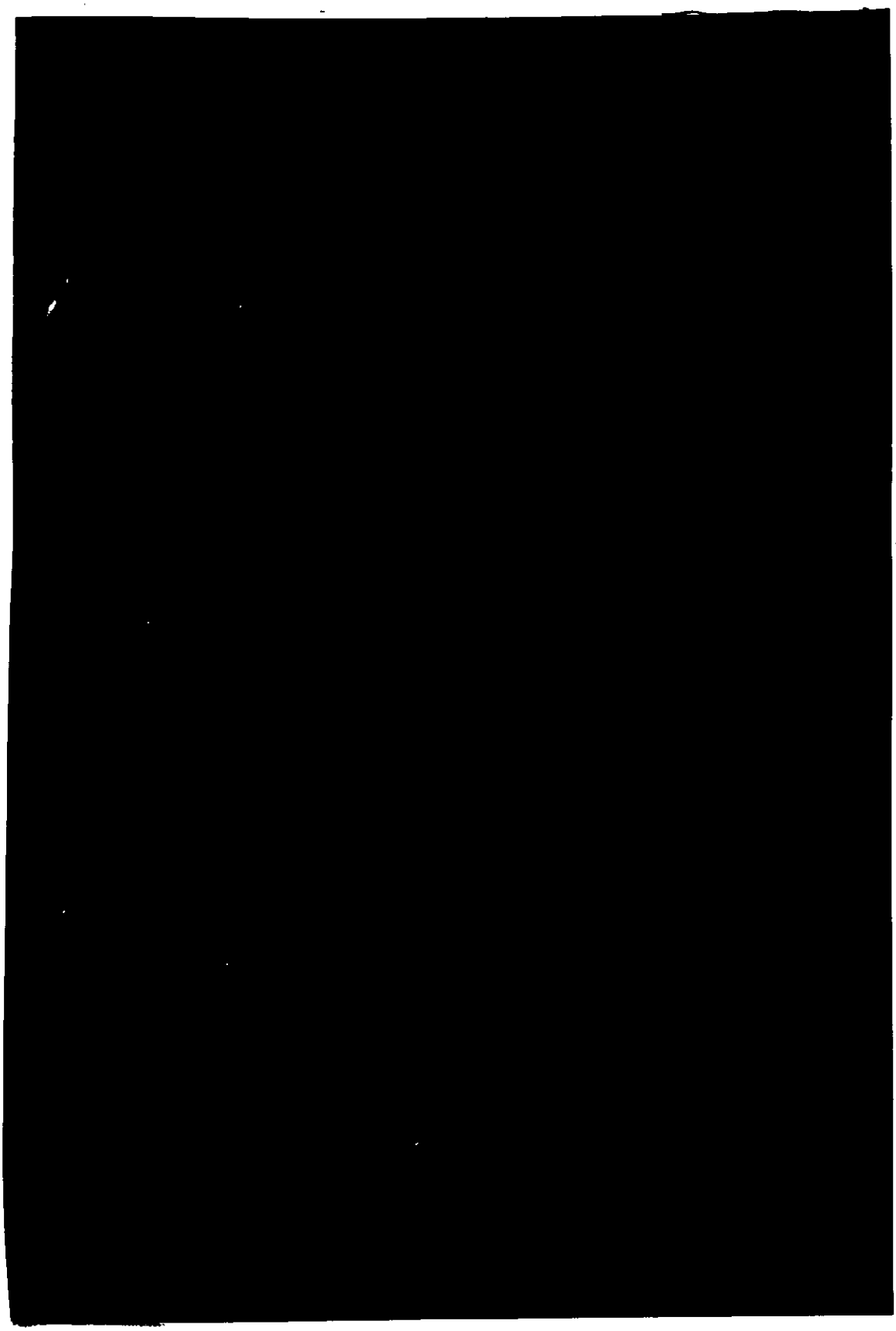


FIGURE 1-3
BP SYSTEM DESIGN

1.2.2 Brilliant Pebbles Experiment Program (U)

(U) SDIO is conducting the BP Experiment Program in two-phases: (1) concept feasibility, and (2) technology validation. These two phases will consist of two types of activities: component/subassembly ground tests, and preflight (i.e., those tests that directly support flight tests), and flight tests to demonstrate the ability of the components, subsystems, and systems to satisfy the mission requirements. Analyses, simulations, data gathering, and evaluations will be accomplished during each activity to ascertain whether the component/subsystem prototypes satisfy their functional performance requirements.

(U) The concept feasibility phase is being executed in cooperation with the Lawrence Livermore National Laboratory (LLNL) and will focus on the proof of the concept prior to transitioning the effort to industry. The technology validation phase will provide for industry involvement to assist SDIO to better evaluate and identify additional BP challenges, refine the technology, and resolve critical technical issues. The results of experiments from the concept feasibility phase will be used to create the BP as a system element.

(U) The objectives of the BP Experiment Program are to ensure that all technical issues are addressed to a sufficient level to reduce risk at the full-scale development (FSD) decision point, and to demonstrate and validate the BP components' capability and vehicle's survivability in a space environment. The testing program will, to the maximum extent practicable, be conducted using existing facilities and personnel currently working at those facilities.

(U) Details of the technology phase are not as clearly defined as the concept feasibility phase of the BP Experiment Program; therefore, programmatic discussions and analysis will be accomplished as an aid to the planning for the BP Experiment Program. When the technology validation testing program plans mature and more specific information becomes available, the proposed activities will be reevaluated and, if necessary, supplemental environmental documentation will be prepared.

1.3 COMPONENT/SUBASSEMBLY GROUND TESTS AND SIMULATIONS (U)

(U) The component/subassembly ground tests and simulations are designed to verify the ability of the component or subsystem to satisfy mission requirements. This testing includes bench, thermovac, Hardware-in-the-Loop (HWIL), Software-in-the-Loop (SWIL), and survivability testing of all BP components and

subsystems. Ground tests also include integrated sensor tests and integrated subsystems tests that demonstrate various integration concerns, such as subsystem interoperability, hardware and software interface, etc. Also included in this category are the data analysis and phenomenology studies associated with target and background characteristics.

(U) Many of the particulars of the technology validation efforts are unknown at this time; however, it is anticipated that activities will be similar in scope to the concept feasibility efforts.

(U) The following sections present a description of stationkeeping/communication tests, laser communication tests, target acquisition/discrimination tests, survivability tests, and power supply tests. These tests are required to validate the subsystem components and will be conducted, to the maximum extent practicable, using existing facilities and personnel already in place at those facilities. Only minor construction or addition/reassignment of personnel will be required to support these tests.

1.3.1 Stationkeeping/Communication Testing (U)

(U) BP requires certain stationkeeping and communication equipment onboard its life jacket to maintain its position in space, monitor onboard functions, and communicate with the command and control element. The purpose of these tests is to validate and demonstrate the interfaces between the interceptor and the life jacket, the operation of the life jacket in the simulated space environment, and the ability of the life jacket to maneuver using its ACS, which controls the position of the BP.

(U) [redacted]

1.3.2 Laser Communication Testing (U)

(U) Laser communication tests are required to validate and demonstrate the laser communication system for command and control of the BP. During concept feasibility testing, these tests will

take place in the open air at LLNL. Eye hazard and area warning protection per Occupational Health and Safety Administration (OSHA) and U.S. Department of Energy (DOE) safety regulations will be required.

1.3.3 Target Acquisition/Discrimination Testing (U)

(U) (S) The BP will acquire, track, and discriminate intercontinental ballistic missiles (ICBMs) during the boost and post-boost phases of flight using three separate sensor components: UV, IR, and LIDAR. [redacted] The components will be tested against simulated space environments, Earth backgrounds, and boost and post-boost heat generation to validate the sensor's capability.

(U) (S) During testing, the UV light and IR heat sources will be artificially created in the lab (LLNL) to test these sensor components. During UV testing, a light source will move against simulated space and earth backgrounds to test the UV hardware and software performance. During IR testing, a heat chamber will be used to provide the IR source while simultaneously cooling the sensor with a cryocooler. The IR and UV sensor components will also undergo vacuum chamber tests.

(U) (S) Bench and vacuum chamber tests of the LIDAR will take place at LLNL. Open air testing of the LIDAR will be accomplished by LLNL and the contractor to verify the system's operational parameters [redacted] Clearance procedures contained in DOE safety regulations and OSHA safety regulations will be required for eye protection. At LLNL, no unauthorized personnel will be permitted at Site 300. The nearest inhabited structure or population center is 18 miles away.

1.3.4 Survivability Testing (U)

(U) (S) Radiation exposure testing [redacted] will be conducted on BP components at the Sandia National Laboratories (SNL) PROTO II test facility and a LLNL Costa Mesa, California, facility. [redacted] testing will occur at the Defense Nuclear Agency's (DNA) underground test facility in Nevada, known as the Nevada Test Site (NTS). [redacted]

[redacted] The [redacted] testbed is designed to provide a simulated nuclear threat environment for testing to verify nuclear hardness of technologies and validate that systems meet nuclear hardening requirements. The SDIO Service agents will utilize this testbed to evaluate and demonstrate nuclear hardening technologies. The UGT must be used in order to obtain high fidelity environments necessary to validate nuclear survivability. Above ground test (AGT) and UGT data are used in conjunction to assure cost effectiveness; however, the UGT remains the only resource which can adequately simulate the threat environment. The UGT data helps to balance the hardness of a design and reduces risk in the selection of a given technology path. All UGTs and activity at the NTS are covered in a blanket document - Final Environment Impact Statement National Test Site Nye County, Nevada; ERDA-1551 UC-2,11; Dated: September 1977.

(U)(S) Electromagnetic pulse (EMP) tests will be performed at SNL and LLNL on computer and electronic components. These tests will simulate the electromagnetic energy from nuclear weapon detonations. [redacted] The facilities used for radiation and EMP testing are specifically designed for this function and have been used extensively in the past for similar tests. All emanations from these tests will remain inside the test facilities. Safety procedures and worker protection are in place per DOE and DNA regulations.

(U)(S) Directed and kinetic energy impact tests will be conducted on BP at LLNL during the concept feasibility phase. [redacted]

1.3.5 Power Supply Testing (U)

(U)(S) Power supply components [redacted] will be bench tested at LLNL during concept feasibility testing. [redacted] The power supply components will be tested in a vacuum chamber and subjected to heat stress to simulate the harsh space environment.

1.4 PREFLIGHT AND FLIGHT TEST ACTIVITIES (U)

(U) The preflight ground tests are designed to demonstrate that the flight vehicle (including all subsystems) configured for a given flight test is capable of performing its intended operational functions. The testing activities will include mission-specific software test and evaluation (T&E), integrated subsystem and system bench testing, integrated vehicle air-bearing test, and integrated environmental testing of the payload (i.e., the flight vehicle or "probe") and payload delivery vehicle. The objective of these tests is to ensure that the test vehicle is properly integrated and operates according to specified parameters prior to actual flight tests. Although many of the particulars of the technology validation efforts are unknown at this time, it is anticipated that activities will be similar in scope to the concept feasibility efforts.

(U) The concept feasibility flight test program consists of several tests and will be conducted over a period of 3 years. The purpose is to evaluate the key technologies necessary for development and deployment of a BP system element. These flights will demonstrate, through increasingly complex testing, the performance characteristics of the components/subsystems on different flight vehicles that represent an incremental advancement of intercept capabilities. The flight vehicles are generally referred to as the "probe" and are differentiated by their component content, the size and mass of the components, the size and mass of the structure, the form of divert and attitude control, the level of component/subsystem technology employed, and the mission profiles.

(U) The objectives of the flight tests are to demonstrate the ability of the interceptor to successfully engage boost and post-boost targets in increasingly complex scenarios, and to demonstrate the integrated BP/life jacket's ability to perform stationkeeping functions, communications, and detection and discriminations of launches over an extended period.

(U) The following sections present a more detailed description of integration and hover tests, the launch and target vehicles required, the five generic flight profiles to be used to resolve the BP critical issues previously described, and the flight safety requirements to be used in execution of the flight test program. These activities will be conducted, to the maximum extent practicable, using existing facilities and personnel already in place at those facilities. No major construction or addition/reassignment of personnel will be required.

1.4.1 Integration and Hover Tests (U)

(U) (~~S~~) Integration and hover tests will be accomplished to demonstrate the BP test vehicle's ability to maneuver and track while mated to the payload booster and hovering. These tests will occur at the Kinetic Kill Vehicle Hover Integration Test Bed (KHIT) facility at Edwards Air Force Base (EAFB), California. During these tests, the BP test vehicle will be tethered in the first series of tests and then allowed to hover free of external surfaces. [redacted] Similar tests were previously assessed in the SBI Dem/Val EA, and no significant impacts were identified to occur as a result of these types of testing activities.

(U) (~~S~~) In addition, the various stages of the booster sets will be integrated at the contractor's facility for checkout prior to shipment to the flight test facility. These integration tests will confirm the computer and power supply performance, the control of flight surfaces, and the activation of flight safety mechanisms such as beacons and flight termination systems. The boosters themselves will not be test fired, but their ability to receive commands and respond to the preprogrammed ignition sequence will be confirmed. These propulsion integration tests will be conducted for all of the BP payload launch vehicles.

(U) Target vehicles will undergo similar integration checkout tests at the contractors' facilities. Small amounts of solvents (less than 100 milliliters) will be used to refurbish the boosters. Handling of the solid propellant boosters will follow U.S. Department of Defense (DoD) Standard 6055.9 Ammunition and Explosive Safety Standards, 31 July 84 for protection of explosives (Walt Doerle, May 1990). Appropriate safety distances (dependent on booster set configuration) will be calculated and applied for storage and handling of the booster sets.

1.4.2 BP Launch and Target Vehicles (U)

(U) The BP Experiment Program requires several boosters to demonstrate the capability of the BP system components; therefore, a detailed description is provided here. The purpose of this section is to provide an understanding of the types of boosters proposed for the BP Experiment program and to facilitate an understanding of the flight profile discussion in Section 1.4.4 for use in the profile discussions. Table 1-1 describes the various boosters that could potentially be used for the flight test program.

TABLE 1-1
Booster Data Summary

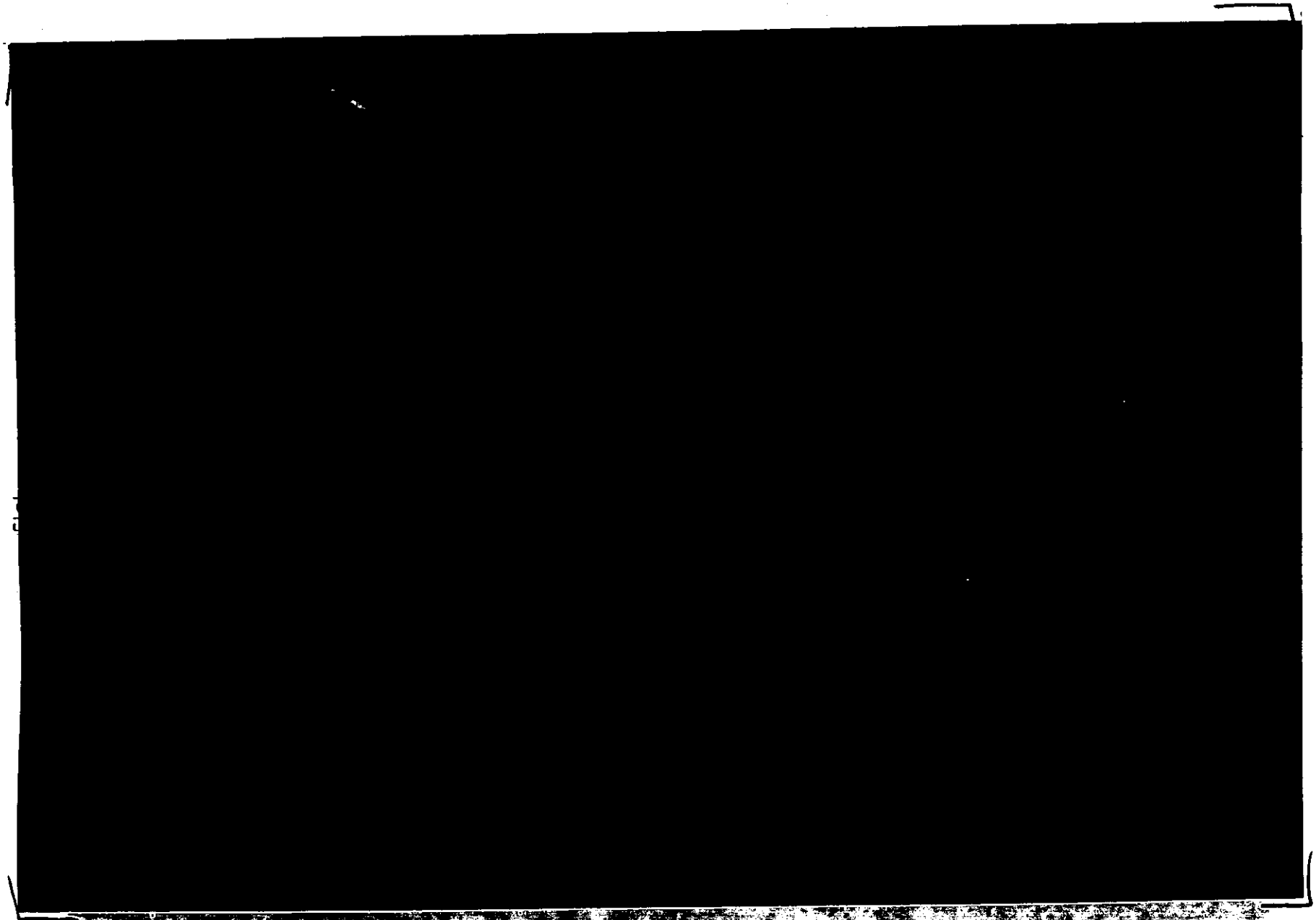


TABLE 1-1 (cont.)

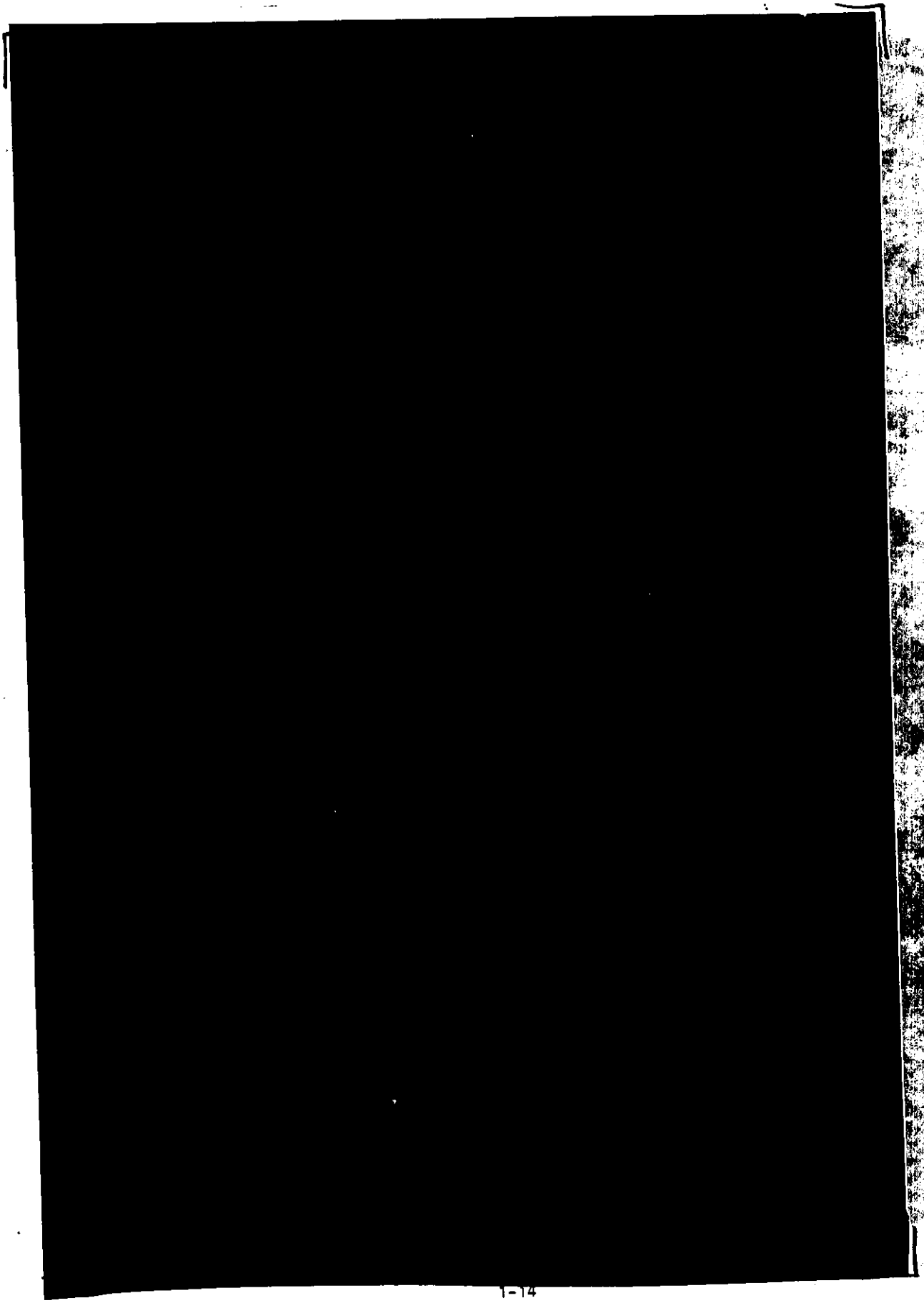
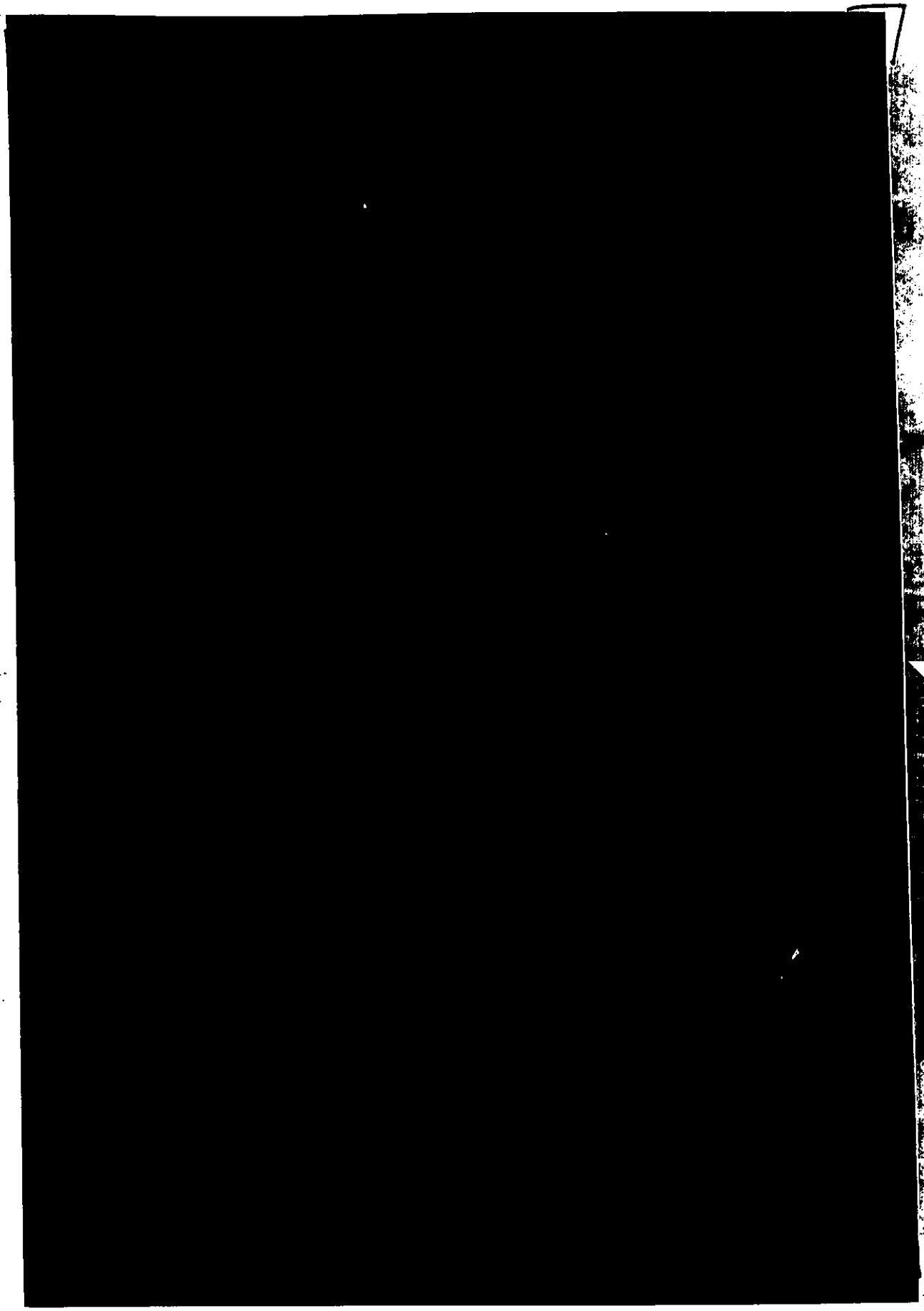


TABLE 1-1 (cont.)

[redacted]

TABLE 1-1 (cont.)



[redacted]

TABLE 1-1 (cont.)

(U) (C) Several booster set configurations are planned for the concept feasibility stage of the BP Experiment Program. [redacted]

(U) (C) Initial flights will use [redacted]

(U) (S) Later flights will use lighter, next generation hardware, and intercepts will occur. These flights would use the BP probe launch vehicle launched from Kwajalein Atoll. [redacted]

(U) (S) The target vehicles for the intercept flights from Kwajalein will be flown from four possible launch sites: [redacted]

(C) [redacted]

(U) (C) Another target vehicle that will be used in the tests will be [redacted]

(U)(S) [redacted]

The life jacket will not contain a mission-capable BP during these tests.

1.4.3 Preflight Ground Activities (U)

(U) Preflight ground activities associated with BP consist of transportation, assembly, fuel upload, checkout, and positioning of the test vehicles on the launch pad. A description of the boosters required to support the flight test program are described in detail in Section 1.4.2.

1.4.3.1 Disassembly and Transportation. (U) As stated in Section 1.4.1, the boosters and payloads will undergo integration tests at the contractors' facilities. Once the boosters and payloads pass the integration tests at the contractors' facilities, they will be disassembled, packed, and shipped to the flight test center. Transportation will be by truck to Wallops Island and by air to Hill Air Force Base (AFB); VAFB; Barking Sands, Hawaii; Wake Island; and Kwajalein Atoll. Packing, shipping, and placarding requirements will conform to U.S. Department of Transportation (USDOT) requirements for the appropriate explosive hazard class. Offload of the boosters will occur at designated hot spots with proper safety distances maintained. Liquid fuel will be shipped separately using USDOT procedures for hazardous material shipments. The boosters and payloads will be moved by truck, and in the case of Kwajalein by barge, to Meck and Roi-Namur Islands and by truck to the assembly buildings.

1.4.3.2 Assembly and Checkout. (U) The BP payload booster, launch vehicle, and the target boosters will be remated inside the assembly building at the designated flight test facility. Integrated flight control system checks will be reperformed. The integrity of the solid boosters and the liquid propellant tanks will be verified. Proper safety distances around the assembly buildings will be established while the boosters are inside.

1.4.3.3 Launch Pad Activities. (U) Launch pads will be refurbished where necessary to accommodate the BP launch and target vehicles. Refurbishment may consist of cleaning old launch residues, inspecting and painting launch rails and gantries, and replacing wornout equipment.

(U) The BP launch vehicles and targets will be transported by truck to the launch facility and mounted on the rail or positioned at the gantry or silo. The launch control team will checkout all hardware, software, and controls for the vehicles prior to flight. Following checkout, liquid propellants will be uploaded in the booster. The launch pads will have a spill containment system for boosters and payloads with liquid propellants. Appropriate safety distances from the launch pad will be established and maintained in accordance with DoD Directives and the appropriate agency or service explosive safety regulations.

1.4.4 Flight Profiles (U)

(U) The concept feasibility phase of the testing program currently consists of several flights and will follow an evolutionary process, beginning with proof of the hardware in a concept design vehicle during the early stages of testing through the engineering and testing of a mission-capable vehicle (MCV) during the latter stages. However, the description of the flights to be accomplished by the technology validation contractor is unknown. Therefore, the flight test segment will be described as five generic profiles. Each profile will identify the potential range locations where those activities could take place, identify the potential booster sets that could be used at that range, and provide data on the type of boosters that will meet the performance requirements of the particular flight profile. These profiles are applicable to both phases of the BP Experiment Program.

1.4.4.1 Flight Test Profile 1. (U) The purpose of this profile is to demonstrate the basic flight worthiness of the booster and validate the early design of the target and payload vehicles. The objectives of this profile are to demonstrate that the booster properly separates from the rail, gantry, or silo; demonstrate that the planned trajectory is followed; demonstrate the booster flight stability; demonstrate that the booster stages separate in the proper sequence and at the proper time; demonstrate that the flight termination system operates properly; and demonstrate the payload performance capability. Normally, the payload will have reduced capabilities. There are no Profile 1 flights scheduled for concept feasibility testing; however, SDIO envisions several proof-of-hardware flights during technology validation testing..

(U) These tests can take place at a variety of places as long as the downrange distance does not exceed the range capability. Specifically, these tests can be accommodated at Wallops Island, USAKA, Barking Sands, Wake Island, and VAFB using a Black Brant X rocket. This profile is shown in Figure 1-4. Typically, these

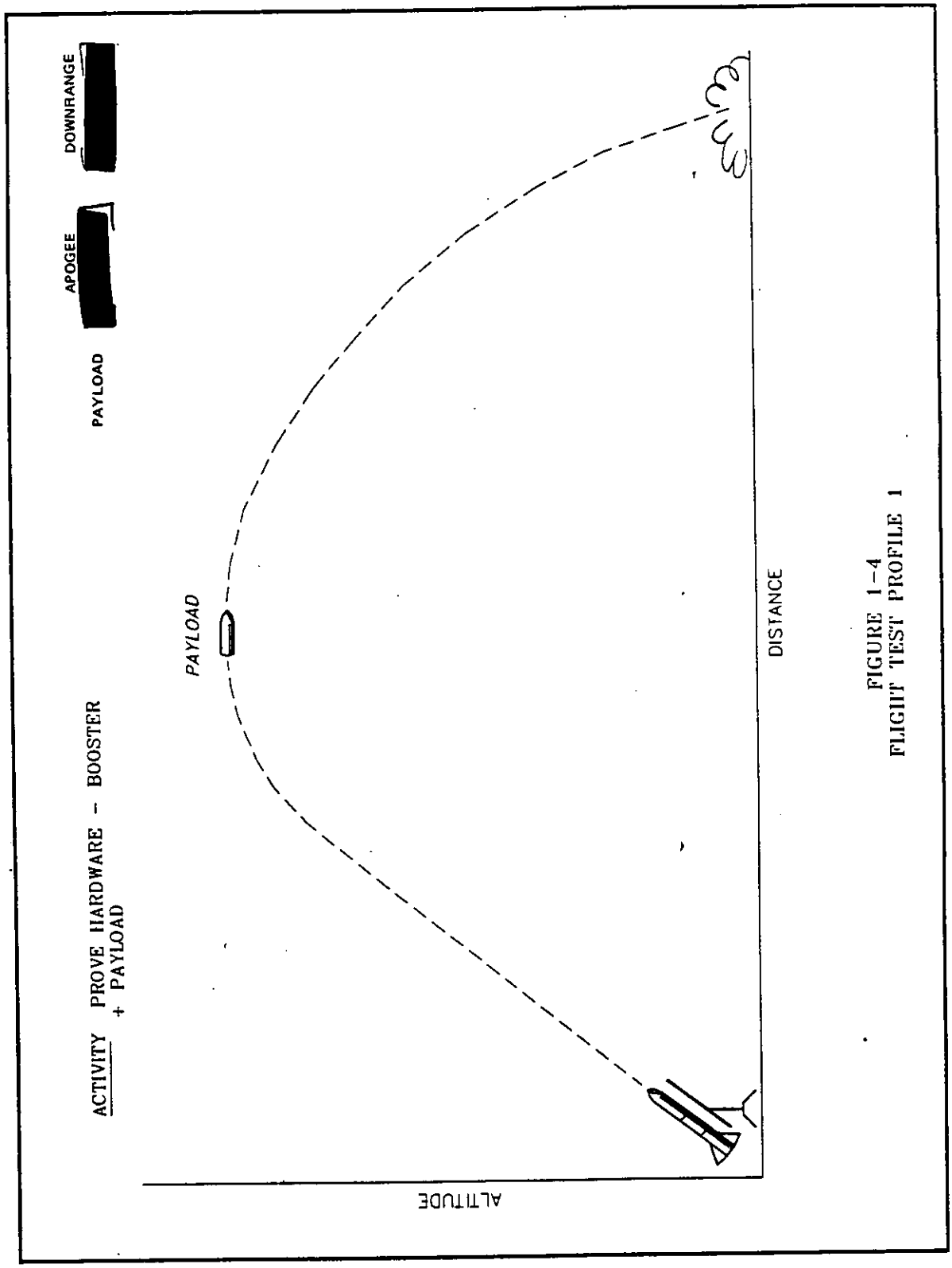


FIGURE 1-4
FLIGHT TEST PROFILE 1

tests are of short duration, with the primary ground activities consisting of flight safety monitoring and performance data collection and analysis using the information gathered from onboard sensors and ground tracking and recording sensors.

1.4.4.2 Flight Test Profile 2. (U)(S) The purpose of Profile 2 is to confirm performance of the sensor and the ACS using a single launch of the BP payload. There are two scenarios under Profile 2, shown in Figures 1-5 and 1-6. [redacted]

(U)(S) In both scenarios the BP payload will orient itself using the Star Tracker and maneuver using the ACS. [redacted]

(U)(S) In the first scenario the BP payload will perform additional tests of the ACS. [redacted] Any debris from the intercept will fall into the ocean.

(U)(S) Ranges that can accommodate Profile 2 are Wallops Island, USAKA, VAFB, Wake Island, and Barking Sands. Profile 2 tests are of short duration, with ground activities including flight safety monitoring and data collection. Information will be gathered from onboard sensors as well as ground tracking and recording sensors. This information will be analyzed to confirm the performance parameters of the flight vehicles.

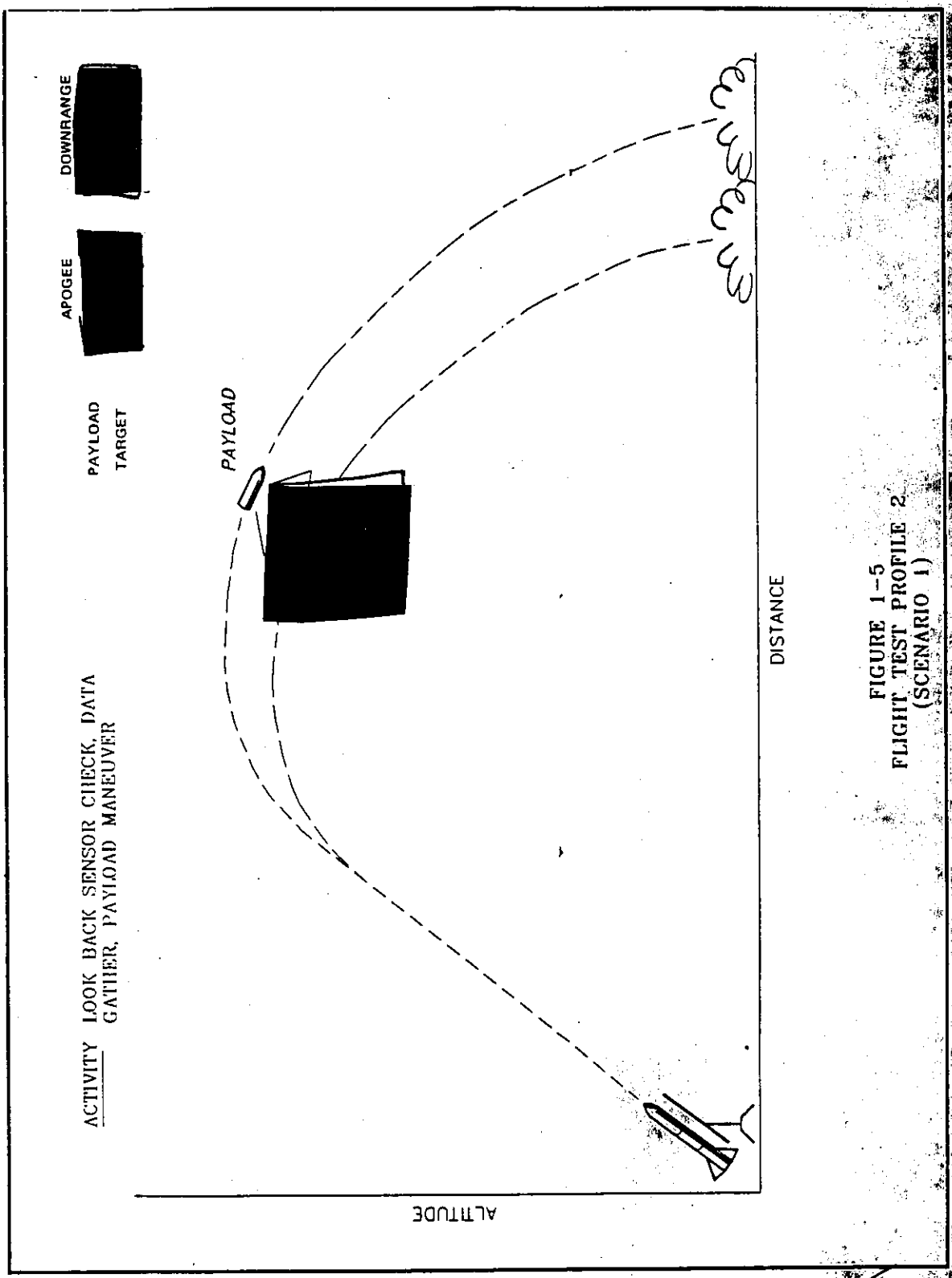


FIGURE 1-5
FLIGHT TEST PROFILE 2
(SCENARIO 1)

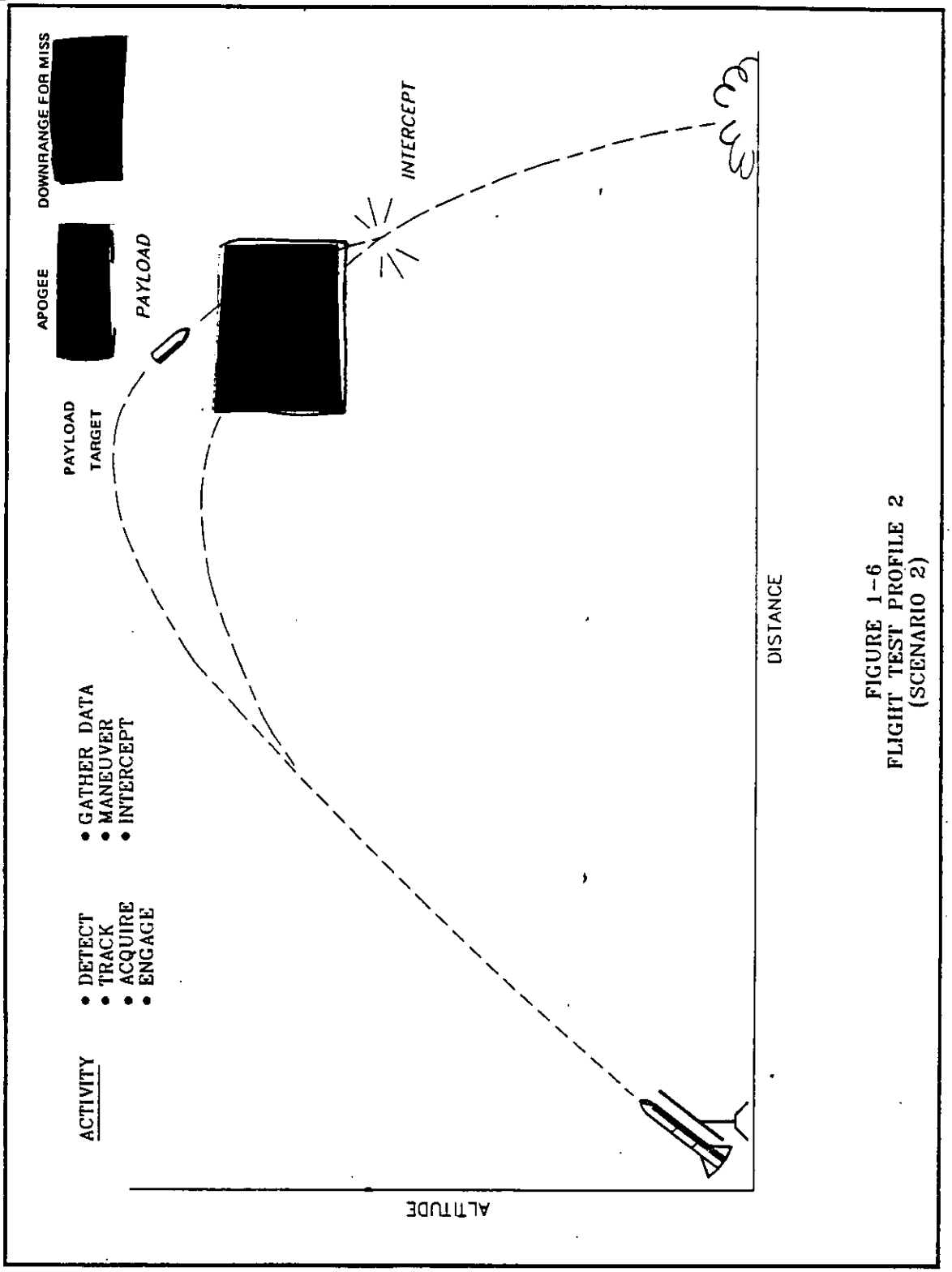


FIGURE 1-6
FLIGHT TEST PROFILE 2
(SCENARIO 2)

1.4.4.3 Flight Test Profile 3. (U) (S) The purpose of Profile 3 is to loft the probe to an altitude where it can look down and observe a target vehicle that has been launched from another test range. There are two scenarios under this profile, as shown in Figures 1-7 and 1-8. The first scenario involves the launch of a booster, such as the ARIES II, as the test vehicle. After the first and second stages have separated, the Star Tracker on the BP test vehicle will orient the vehicle and the other sensors will begin scanning for the target vehicles. Once the BP test vehicle is in position, the target vehicle will be launched. Using the IR sensors, the BP test vehicle will detect then track the target booster. The UV/visible sensors will assist in tracking and engaging the target until the LIDAR can take over for final engagement. No intercept would occur in the first scenario.

(U) (S) In the second scenario the test vehicle will maneuver using its onboard sensors to engage and then intercept the target vehicle. The intercept will occur over the broad ocean area (BOA), so any remaining debris would fall into the ocean.

(U) (S) There are three Profile 3 tests scheduled for the concept feasibility phase of the BP Experiment Program. All three flights are planned as intercepts. Because of the amount of maneuvering room required to support the engagement, the BP test vehicle will be launched from Meck Island at USAKA. [redacted] It is envisioned that the follow-on contractors will propose to conduct similar tests using USAKA, Barking Sands, and Wake Island. It is also envisioned that these tests will propose to intercept a Minuteman I or II ICBM launched from VAFB with a BP test vehicle launched atop an ARIES II booster from Meck Island. Approximately 50 additional personnel will be required at USAKA to support the BP launches, and 30 to 50 personnel will be required to support target launches at Wake Island and Barking Sands. No additional personnel will be required at VAFB.

(U) Profile 3 tests are of longer duration than Profiles 1 and 2, lasting 10 to 25 minutes. Ground activities will include the flight safety monitoring of both the BP test vehicles and the target vehicles. Data will be gathered from onboard sensors as well as ground tracking stations, optical sensors, and radars to confirm the performance parameters of the flight vehicles.

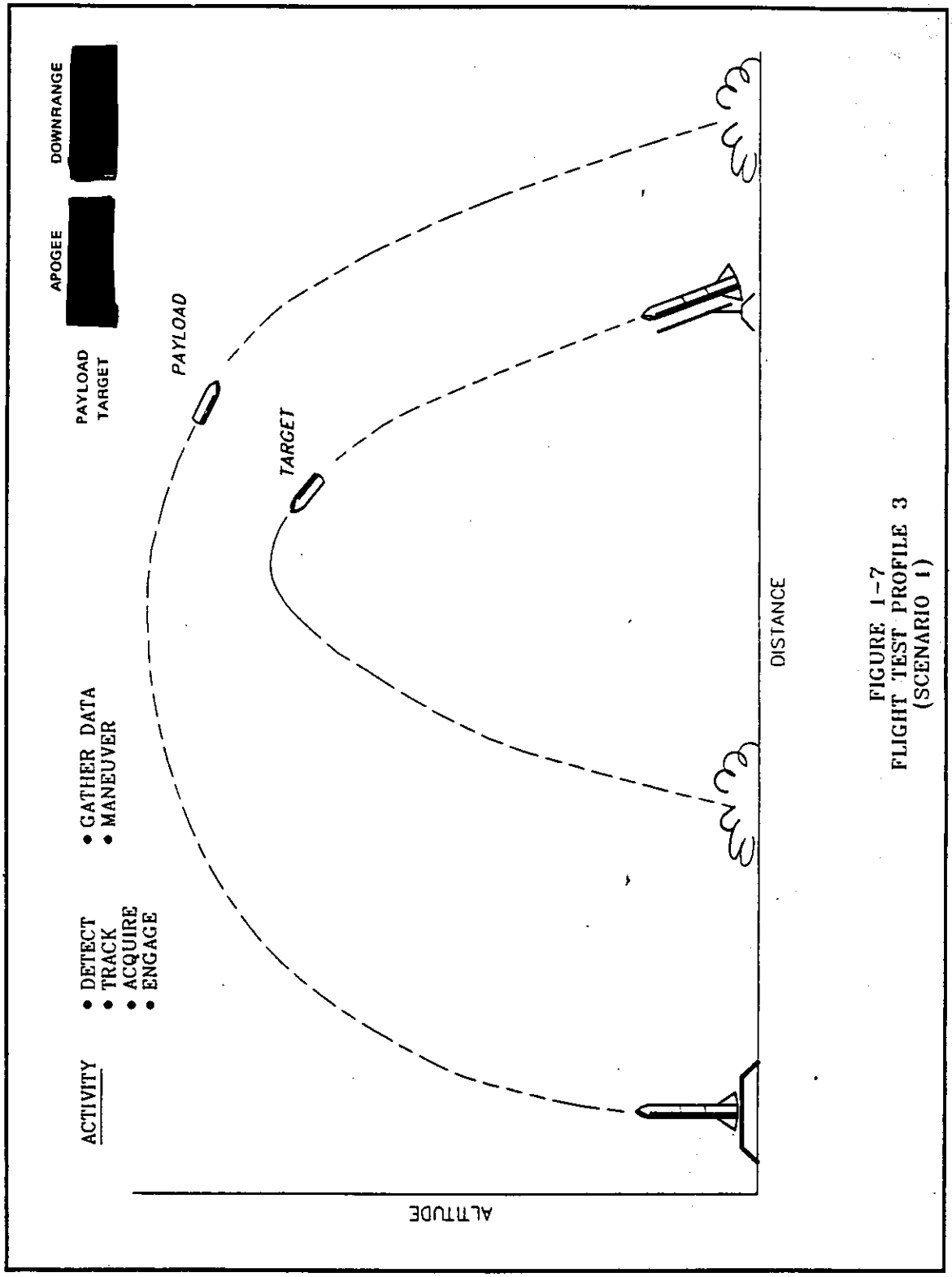


FIGURE 1-7
FLIGHT TEST PROFILE 3
(SCENARIO 1)

FIGURE 1-8
FLIGHT TEST PROFILE 3
(SCENARIO 2)

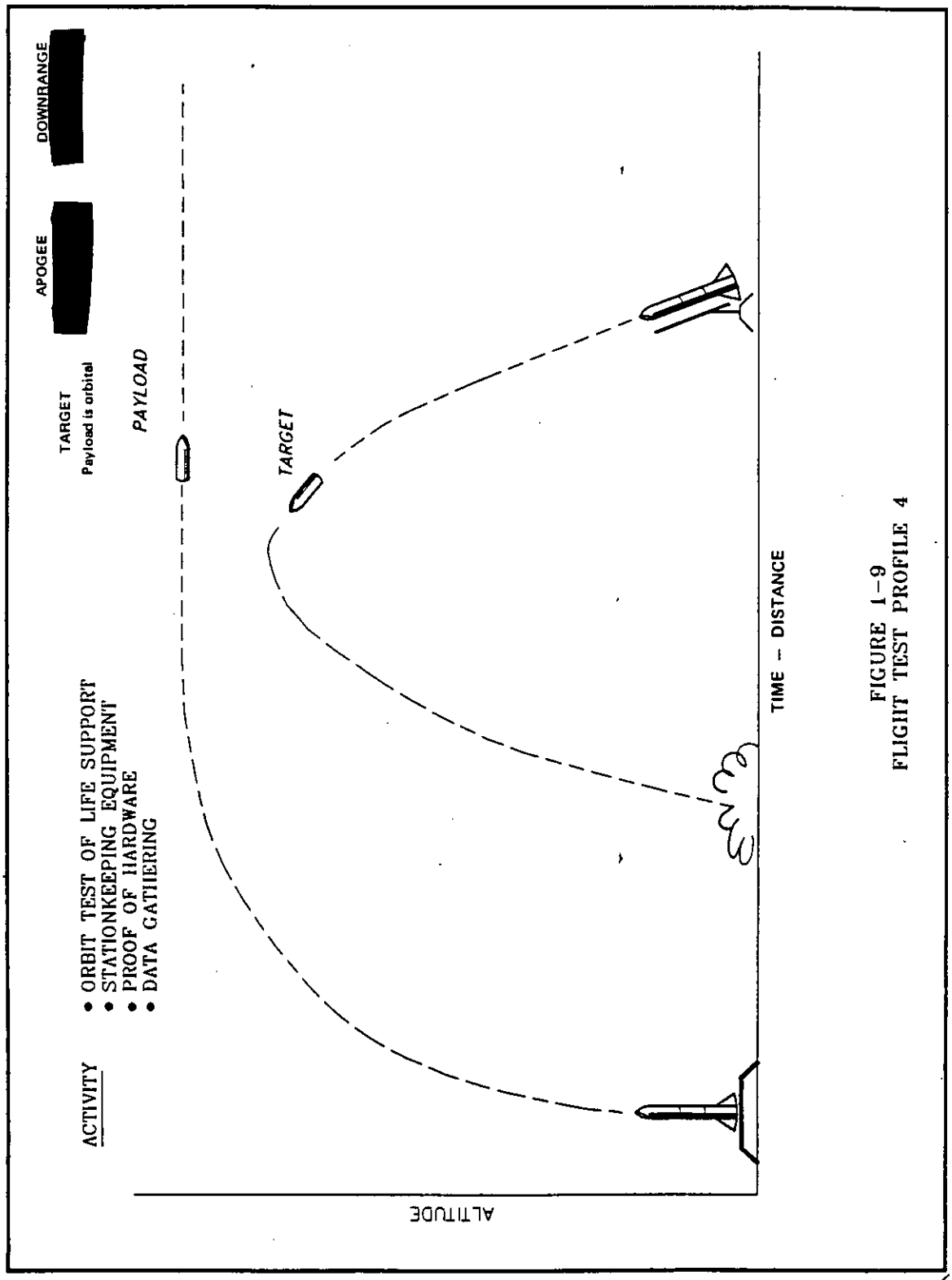


FIGURE 1-9
FLIGHT TEST PROFILE 4

(U)

1.4.4.4 Flight Test Profile 4. (S) The purpose of Profile 4 (Figure 1-9) is to confirm the performance of the life jacket for BP in LEO. [redacted]

(U) (S) Once the hardware performance has been confirmed, additional tests of a more sophisticated life jacket will occur. During these tests, [redacted]

(U) (S) SDIO envisions four to five orbital tests of the BP system during the technology validation effort. The life jackets and the mother satellite will be launched from VAFB aboard a Scout rocket. No additional personnel are needed at VAFB to support these launches. [redacted] Approximately 30 to 50 additional personnel will be required at each of these sites to launch the target vehicles.

(U) (S) Ground activities associated with Profile 4 include flight safety monitoring and ground station, optical sensor, and radar tracking. Data collection and communication with the life jackets and mother satellite will occur throughout the test periods. Once the tests are complete, the orbits of the life jackets, MCVs, and mother satellite will deteriorate, resulting in burnup of the vehicles as they reenter the Earth's atmosphere. Debris from the vehicles will be minor. If any debris survives the reentry, it is anticipated that it will fall into the BOA or unpopulated areas. Reentry analysis will be performed at each site prior to any launch activities. In addition, as described in Section 3.0, the Range

Safety Officer will monitor the flight path of the booster to ensure that it does not fly outside of the flight hazard area, which will have been precleared to ensure that no personnel, ships, or aircraft are in the vicinity.

1.4.4.5 Flight Test Profile 5. (U) The purpose of Profile 5 (Figure 1-10) is to demonstrate the capability of certain BP sensors or components to perform in a space environment. Rather than launching the BP as a single integrated test vehicle, the Profile 5 tests will launch individual components of the BP system onboard an orbiting satellite or space platform. In most instances, the satellite or platform will not be solely dedicated to the BP mission, but the BP will ride as an adjunct experiment. The sensor components launched on a Profile 5 flight will view dedicated targets and targets of opportunity. Other components, such as communications, shielding, and microprocessors, will be tested for performance in the harsh space environment. Additional personnel will be needed to support the flight tests to monitor the transmissions from the sensors or components. Ground activities will consist primarily of monitoring the onboard performance of the BP components.

1.4.5 Flight Safety (U)

(U) This section provides a brief description of the flight safety activities typically used for any flight test program similar to the BP Experiment Program. The safety of range and flight operations is an important component of all the flight activities described in the proposed action. Although specific parameters for each flight operation are undefined at this time, many flight safety procedures have been developed and will be applied to each test operation. This section discusses the application of safety procedures to the storage, assembly, positioning on the launch pad, prelaunch, and launch activities. The discussion covers the application of safety and noise protection distances to protect workers and the public, and describes the submission of flight plans and the actions of the Range Safety Officer (RSO) to develop operational safety parameters for the test operations.

1.4.5.1 Booster Safety Procedures. (U) The three safety issues of concern associated with the rocket boosters are explosive weight, liquid propellant handling, and noise.

(U) Each solid propellant booster contains chemicals that are categorized as explosive ordnance. The net explosive weight (NEW) of each booster is calculated to establish its hazard class and determine appropriate safety distances. Safety distances are

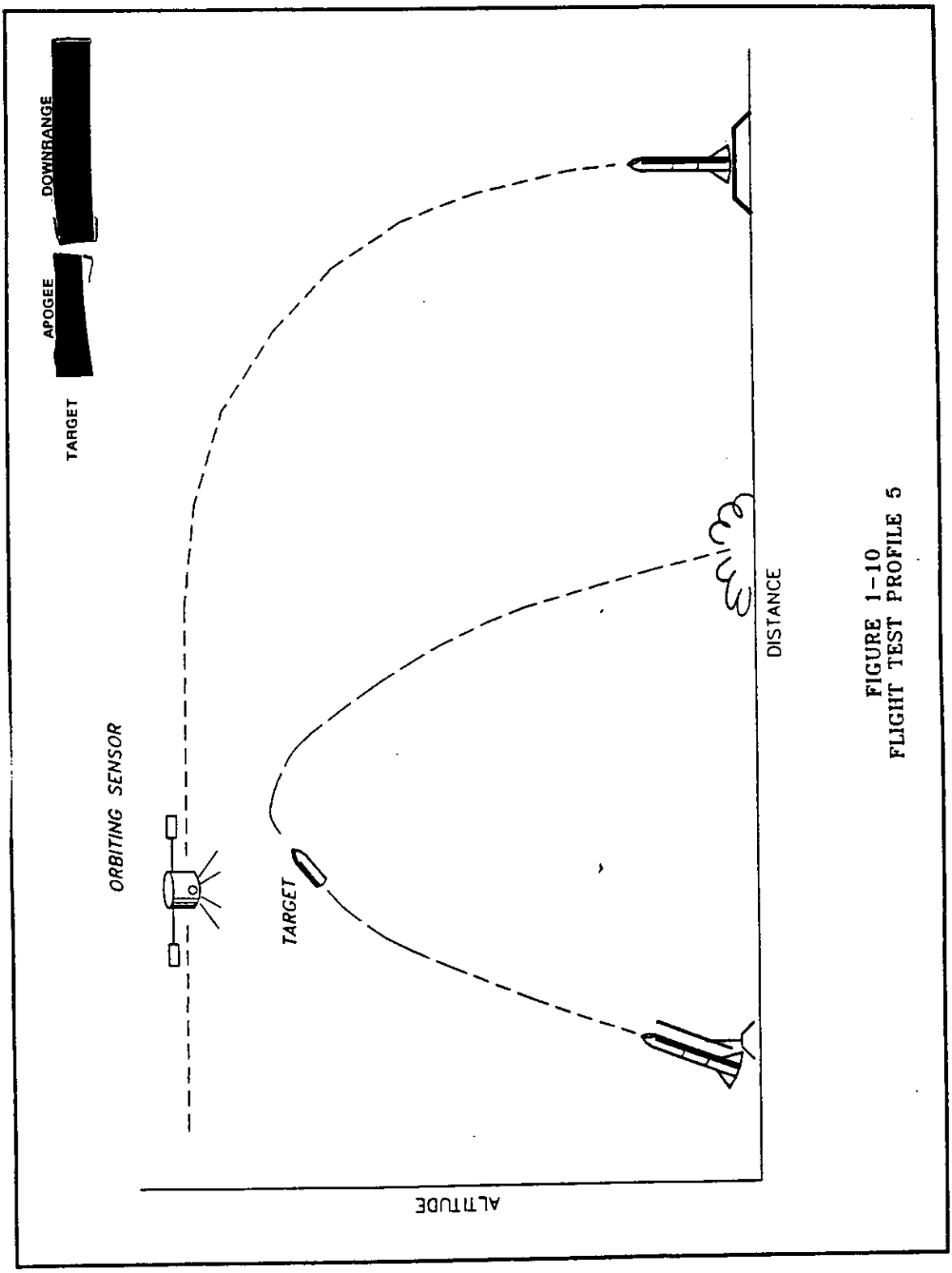


FIGURE 1-10
FLIGHT TEST PROFILE 5

established around storage buildings, Missile Assembly Buildings (MABs), and the launch pads. All unauthorized personnel are prevented from entering the safety clearance area, and these areas are monitored during prelaunch and launch countdowns to ensure that no unauthorized personnel are within the safety areas during operations. If any persons are within the areas, then launch countdown is halted until the area is cleared.

(U) For liquid propellant boosters and liquid fuel payloads, special safety precautions and procedures are applied to ensure that the liquid fuel and the oxidizer are kept separate until launch of the vehicle. If uncontrolled, mixture of the fuel and oxidizer would result in an explosion. In addition, the fuel and oxidizer are both highly toxic to humans; therefore, they must be handled in closed-loop systems to ensure that there is no release into the environment. Each of the test centers proposed for the BP Experiment Program will have closed-loop systems and spill containment facilities at the MAB, Payload Assembly Buildings (PABs), and the launch pad to collect any fuel that might spill. Any spills will be contained, collected, stored, and removed for disposal by a licensed hazardous waste disposer or special cleanup procedures will be applied to the neutralization of hydrazine and during fueling/defueling and any cleanup operations. Class B personal protection must be worn. The hydrazone fuel cells will be purged in a closed-loop system using chlorine-based bleach or HTH (swimming pool chemical) as the neutralizer. The resultant chemical product is water and some inert salts.

(U) The oxidizer (nitrogen tetroxide), if inadvertently released into the environment, would form a gaseous (ground) cloud; therefore, upload of the oxidizer will not take place in adverse weather conditions, such as inversion layers where the cloud would be trapped near ground level. The oxidizer will only be uploaded when wind conditions would carry an accidental release from inhabited areas. Areas around the upload sites will be monitored by sensors to detect release of the gas, and appropriate evacuation plans will be in place. The ground safety officer will calculate expected concentrations of oxidizer at the perimeter of the work area based on weather conditions, and upload operations will proceed only if the concentrations of an accidental release are below the 15-minute, short-term exposure limit value of 5 ppm or the 8-hour time-weighted average exposure limit of 3 ppm. Workers must wear Class B personal protection at all times while handling the oxidizer.

1.4.5.2 Noise. (U) Overall sound pressure levels for rocket launches can exceed 150 dB within 100 feet of the launch pad. To prevent damage to human hearing, personnel must be inside noise-insulated buildings or must be outside the flight hazard areas. Protection will be in place during launches to ensure that short-term noise events do not exceed the OSHA criterion of 115 dB for 15 minutes of exposure. Moreover, the flight dispersion patterns will be calculated to avoid exposure of any populated or sensitive areas to more than 90 to 95 dB for short-term noise exposure. Because rocket launches normally last less than a few minutes, no one area will be subjected to noise levels above the stated criteria.

1.4.5.3 Range Safety. (U) Program managers will develop flight and safety plans for their tests. The plans will be submitted to the flight test center RSO for review. The RSO will ensure that the flight plans meet the range safety requirements, and will calculate the predicted flight path of the test vehicle using reasonably foreseeable adverse wind conditions to establish the limits of the vehicle dispersion pattern. The RSO will also use reasonable foreseeable performance anomalies to predict the flight hazard and dispersion areas for the test flights. The flight dispersion pattern is defined as the areas over which the vehicle could fly if it follows its predicted limits or if it flies off course. Figure 1-11 presents a typical flight hazard or dispersion pattern plan. The dispersion pattern helps determine where populated areas will be overflown. The flight hazard area is defined as the predicted debris pattern if the flight terminates within the dispersion pattern. At some sites, the RSO can use a trajectory that eliminates potential problems outside of the flight hazard area, and the lack of abort capability in early stages is not considered a safety hazard. In other cases from the development of the flight dispersion pattern and flight hazard area, the RSO develops decision criteria for when to activate the flight termination system and when to give the go/no-go launch decision.

(U) The RSO controls the launch of the flight test vehicles. Only when the RSO is satisfied that all safety parameters have been met will the RSO launch the vehicle. Where restrictions have been placed on the launch due to winds, the launch go/no-go decision will be delayed until the RSO is sure that the winds will not cause the vehicle to exceed the predicted dispersion pattern or exit the flight hazard area at the wrong altitude or direction. The RSO is also responsible for ensuring the range is clear of ships, planes,

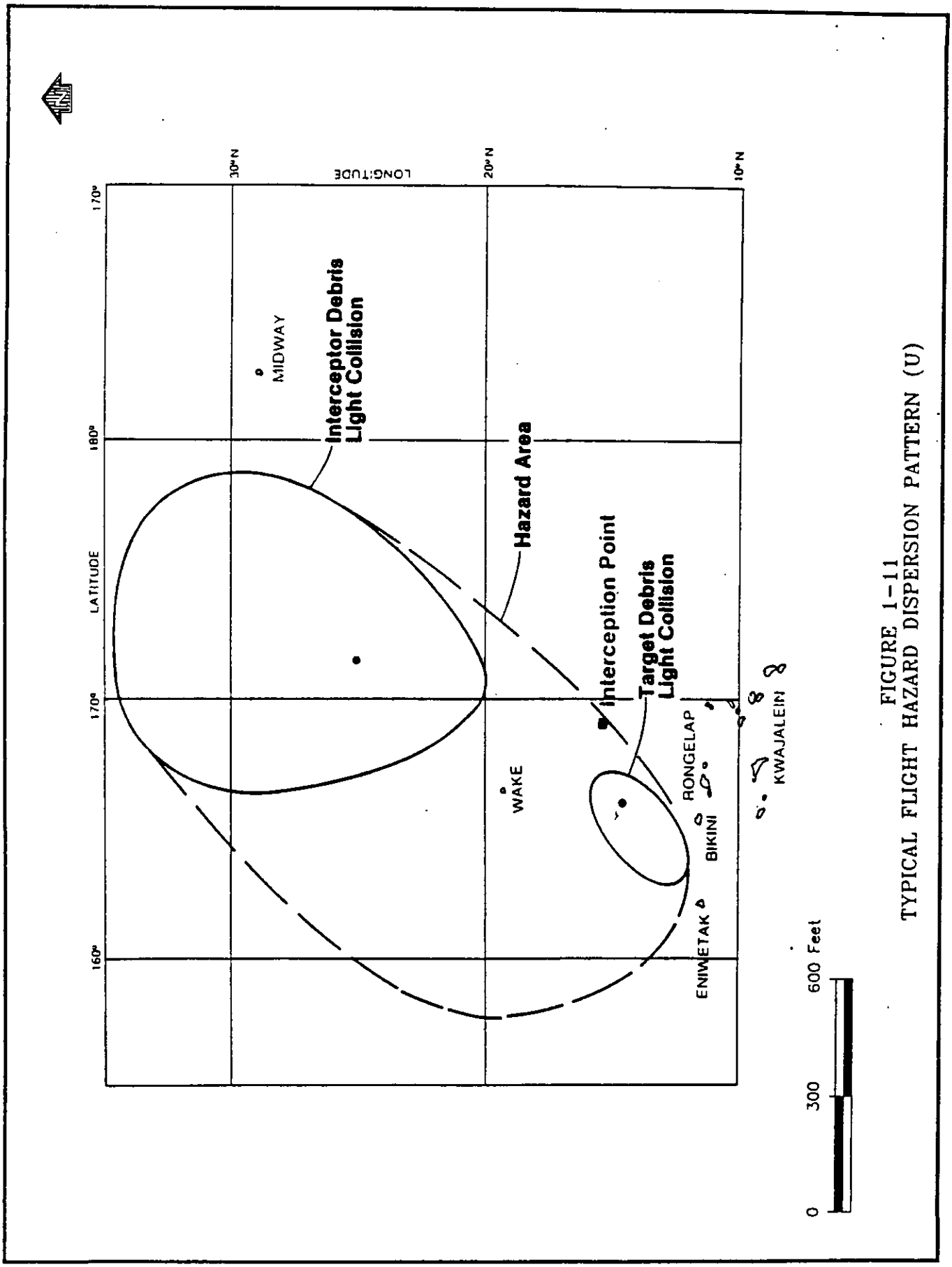


FIGURE 1-11
TYPICAL FLIGHT HAZARD DISPERSION PATTERN (U)

and people prior to launch and during flight operations. The range is constantly monitored by way of radars and optical sensors to ensure no encroachment into the hazard areas. Warnings are given by way of Notice to Airmen (NOTAM) and Local Notice to Mariners (LONOTE), in addition to the active surveillance, before launch.

(U) Finally, the RSO controls the flight of test vehicles by monitoring its flight path against the predicted flight plan and the perimeter of the dispersion pattern and flight hazard area. Should the vehicle stray from the predicted flight path and appear to exceed the limits of the dispersion pattern or flight hazard area, the RSO will destroy the vehicle using one of several flight termination systems. On some of the test vehicles, only certain stages will have flight termination systems. For those stages that do not, special precautions will be applied, such as lowering the angle of inclination for launch. This will enable the vehicle to fly farther downrange before allowing the payload vehicle to maneuver. This would eliminate any chance of an upper stage turning 180 degrees and flying back over land--a very remote possibility.

1.5 MODIFICATIONS TO SBI TESTING PROGRAM (U)

(U) The SBI is an orbiting weapon system whose mission is to intercept targets on a kinetic energy (KE) "hit-to-kill" basis during the target's boost, post-boost, and midcourse phases of flight. The SBI constellation would consist of several carrier vehicles (CVs), each carrying multiple interceptor vehicles (IVs) in near-Earth orbits.

(U) (S) The IV consists of axial motors and a KE "hit-to-kill" vehicle and is guided toward a Predicted Intercept Point (PIP) based on known interceptor position and target state vectors provided by the surveillance sensors. [redacted]

(U) (S) The SBI testing program is designed to resolve several technology areas, [redacted]

(U) Modifications to the SBI test program would involve curtailing the activities as described in the 1987 SBI Dem/Val EA. In particular, the flight tests would not be conducted at USAKA using the Roi-Namur Island and Meck Island facilities. The flight tests would evaluate the homing subsystem performance, guidance and control systems, and divert maneuver.

(U) Analyses, simulations, and component/subassembly ground tests for SBI would still be accomplished. The specific tests that are still proposed for SBI include the high-altitude seeker test conducted at Arnold Engineering Development Center (AEDC), A/C hover tests, HALO A/C integration test, and ballistics tests. These tests would use the AEDC Thruster Test Stand, Star 13 solid rocket booster, and HALO aircraft as the airborne sensor.

1.6 ALTERNATIVES TO THE PROPOSED ACTION (U)

1.6.1 No Action (U)

(U) The no action alternative is to continue with the current Dem/Val testing program as outlined in the 1987 EAs and the 1989 USAKA EIS without conducting the proposed BP testing activities at this time. Conduct of this alternative would provide the necessary information on the current baseline Candidate Phase I Architecture; however, insufficient information would be available from which to base future program decisions with regard to the SDS and the planned Brilliant Pebbles element.

2.0 AFFECTED ENVIRONMENT (U)

2.1 COMPONENT/SUBASSEMBLY GROUND TESTS AND SIMULATIONS (U)

2.1.1 Lawrence Livermore National Laboratory (LLNL) (U)

(U) The Lawrence Livermore National Laboratory (LLNL) was founded in 1952 and is operated by the University of California. The main facility is located near Livermore, California, approximately 40 miles east of San Francisco (Figure 2-1). Since the 1950s, the facility's mission has been research and development of nuclear weapons and magnetic fusion energy. Laser fusion and laser isotope separation, biochemical and environmental sciences, and applied energy technology are other major programs that have been added to the scope of LLNL's mission in recent years. The most recent major projects involve research on the free-electron laser and the Brilliant Pebbles (BP) Experiment Program for the Strategic Defense Initiative Organization (SDIO).

(U) Most facilities used for the BP Experiment Program at LLNL are existing and require only minor modifications. New facilities will be constructed near the northwest corner of the facility to expand LLNL research capabilities but will also be used for the BP Experiment Program. During World War (WWII), this area was near an airfield. The area subsequently reverted to vacant grassland and now includes only minor features, such as a paved road, part of an abandoned employee vegetable garden, and several graveled storage pads. LLNL personnel investigated the area for residual contamination from previous land uses; no contamination was found (DOE, 1982).

2.1.2 Sandia National Laboratories (SNL) (U)

(U) Sandia National Laboratories (SNL) is located on Kirtland Air Force Base (AFB), adjacent to and south and east of Albuquerque, New Mexico (Figure 2-2). The laboratory facilities comprise five technical areas where research and development of weapons systems, limited assembly of weapons system components, and other related activities are conducted.

(U) The proposed activities for the BP Experiment Program are normal operations at SNL. Based on existing environmental documentation, the potential for fire explosions, release of toxic and radiological materials, aircraft crashes, electrical failures, and high-power microwave emissions has been identified in the past as a public health and safety issue at SNL (USASDC, 1989b).

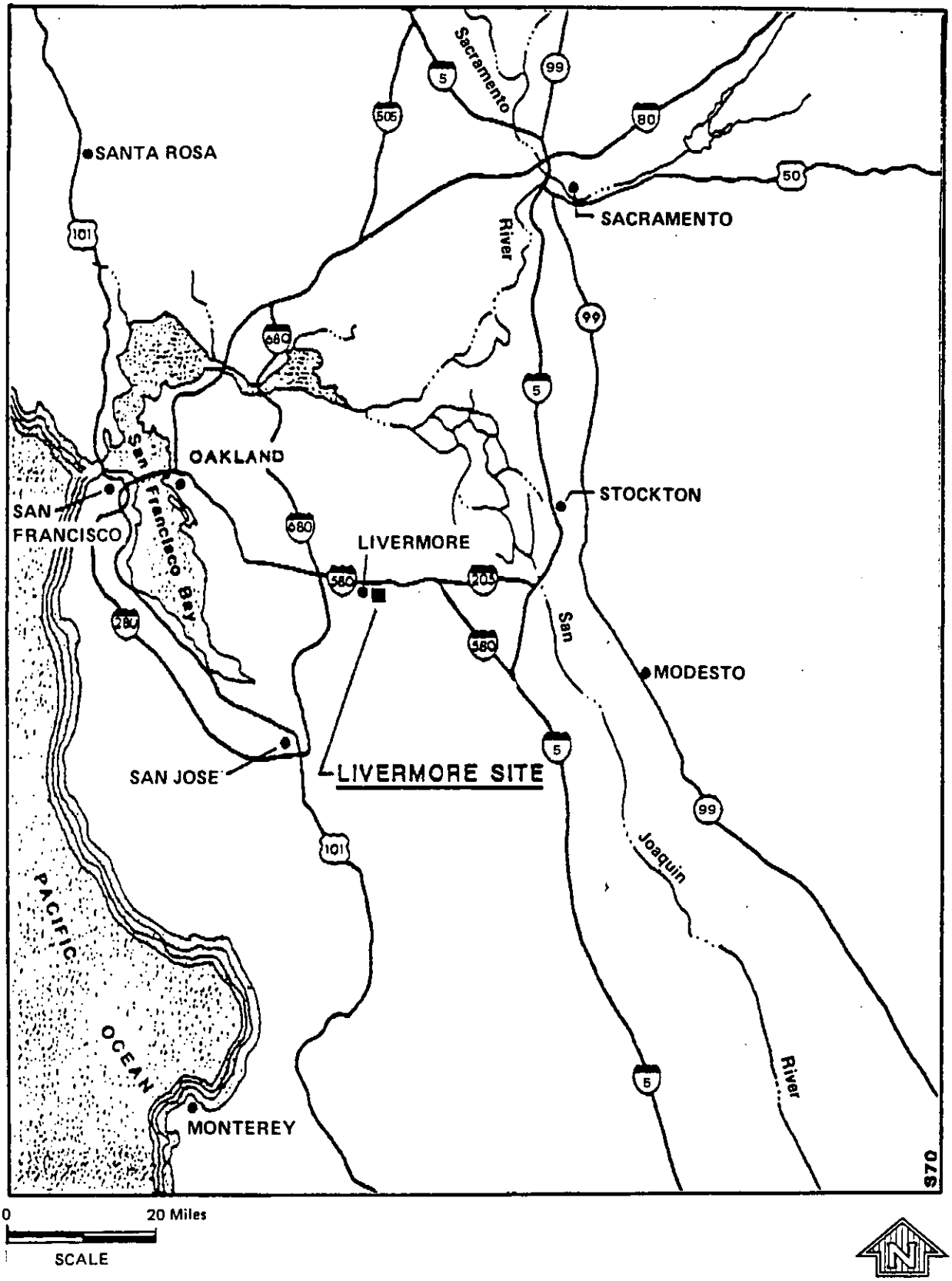


FIGURE 2-1
SITE LOCATION MAP FOR LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) (U)

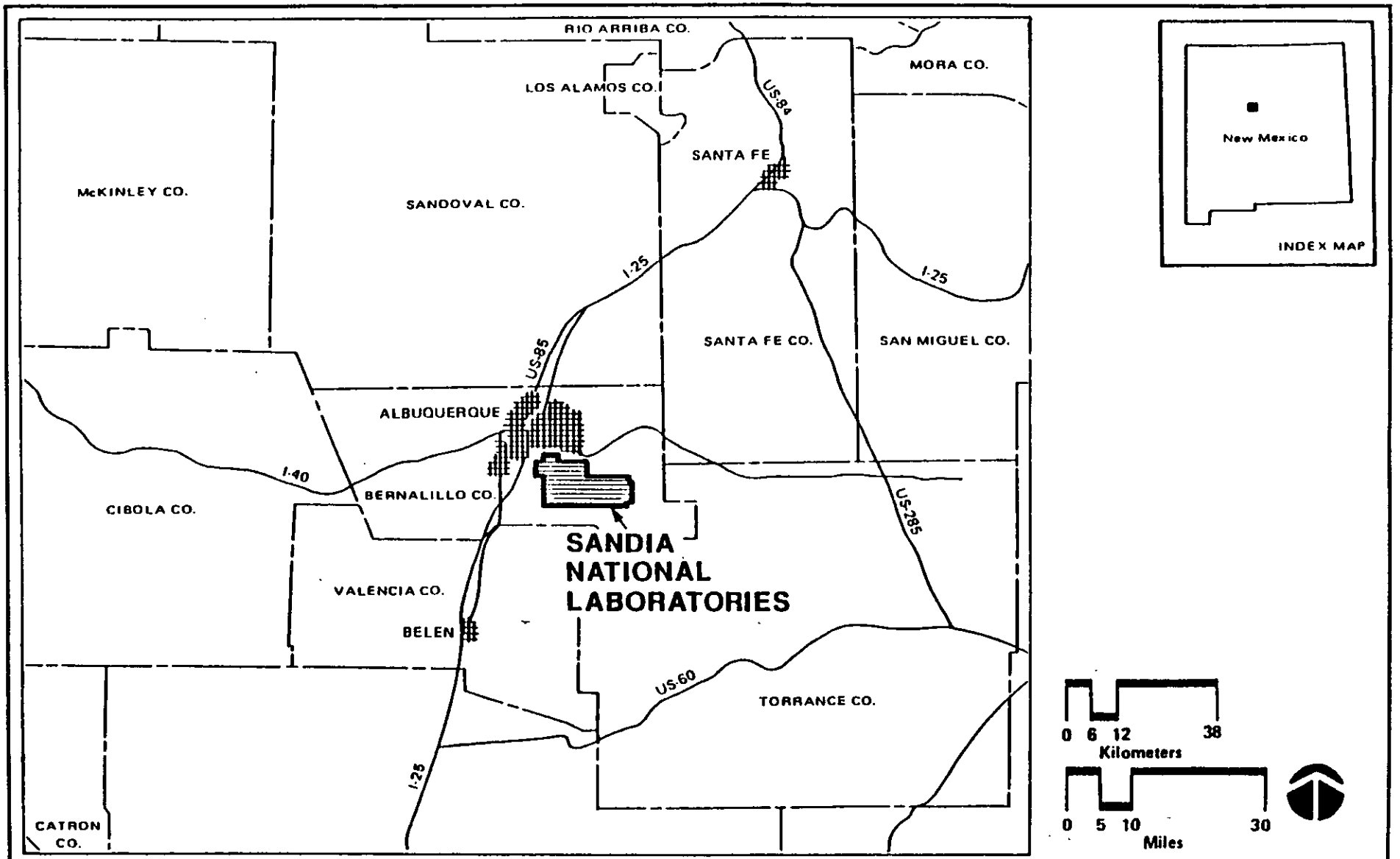


FIGURE 2-2
SITE LOCATION MAP FOR SANDIA NATIONAL LABORATORIES (SNL) (U)

2.1.3 Arnold Engineering Development Center (AEDC) (U)

(U) Arnold Engineering Development Center (AEDC)--the nation's largest complex of wind tunnels, jet and rocket engine test cells, space simulation chambers, and hyperballistic ranges--is located approximately 60 miles southeast of Nashville, Tennessee, and approximately 7 miles southeast of Manchester (Figure 2-3). The wind tunnels at this facility are routinely used to test missile components and assemblies in an environment that simulates actual high-speed flight.

(U) The proposed activities for the BP Experiment Program are normal operations at AEDC. According to existing environmental documentation, the only environmental problem associated with normal operations at AEDC is noise, which is sometimes in excess of safety levels within the test areas. However, AEDC takes mitigation measures to confine the noise levels to those areas (USASDC, 1989b).

2.1.4 National Test Facility (NTF) (U)

(U) The National Test Facility (NTF), which is currently under construction at Falcon Air Force Base (AFB), located approximately 12 miles east of Colorado Springs in El Paso County, Colorado, will be used in the future for analysis and application of data from flight tests (Figure 2-4). Until the NTF is constructed, the staff necessary to complete any current testing, such as that for the BP Experiment Program and other projects, will be located at an existing, interim facility. Environmental documentation has been prepared for both the NTF and the interim NTF located at the Consolidated Space Operations Center (CSOC), also at Falcon AFB (USAF, 1987a). The interim facility has qualified for a categorical exclusion in accordance with U.S. Air Force Categorical Exclusion 2X.

(U) According to existing environmental documentation, Falcon AFB (including the CSOC) is in compliance with Federal standards for air quality, water quality, and hazardous waste. No known threatened or endangered species exist on the base, and no significant cultural resources have been identified. Installation infrastructure demands are within capacity, and no land use or zoning conflicts have been identified. Noise levels are within acceptable limits, and no significant public health and safety issues have been raised (USAF, 1987a).

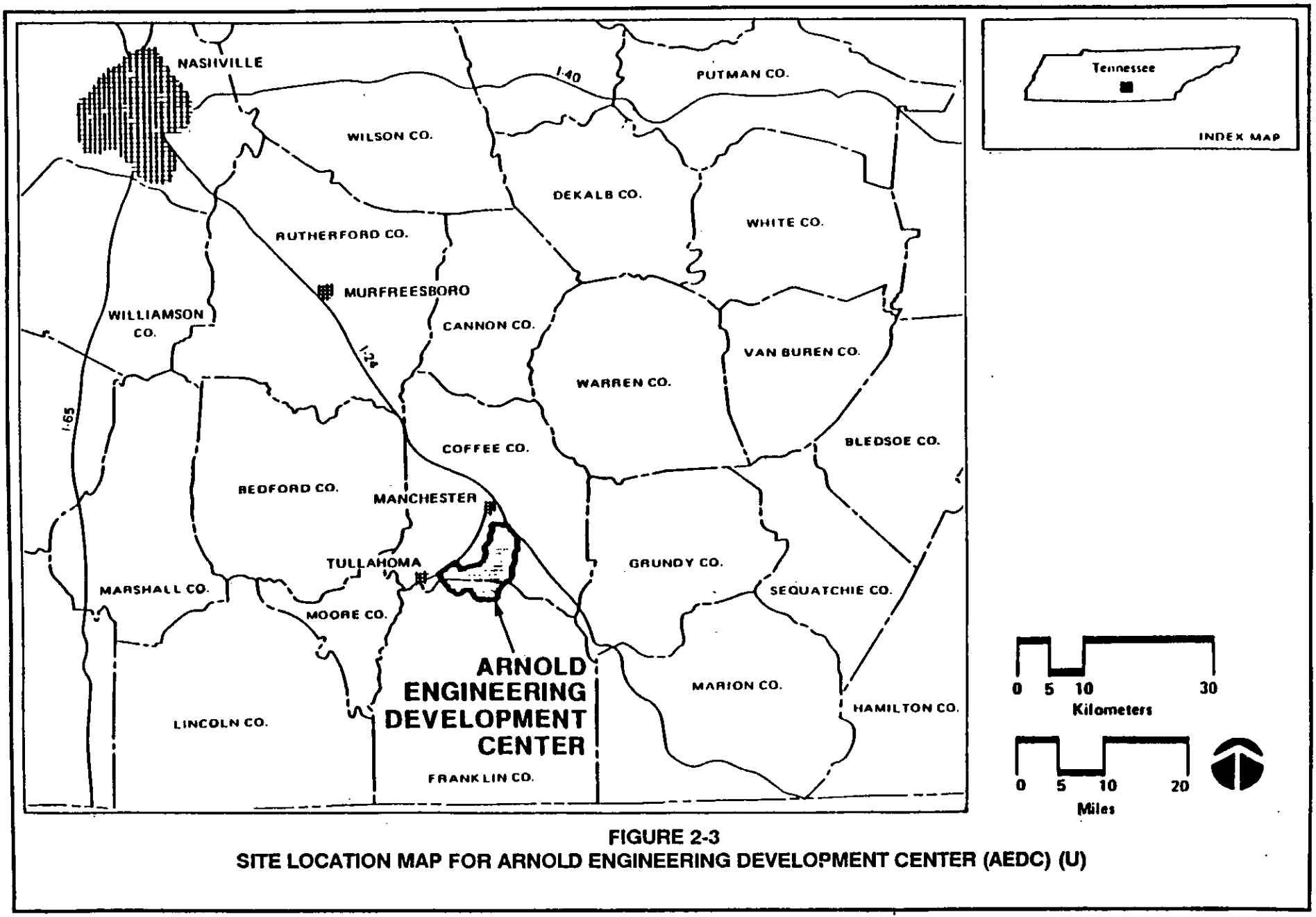


FIGURE 2-3
SITE LOCATION MAP FOR ARNOLD ENGINEERING DEVELOPMENT CENTER (AEDC) (U)

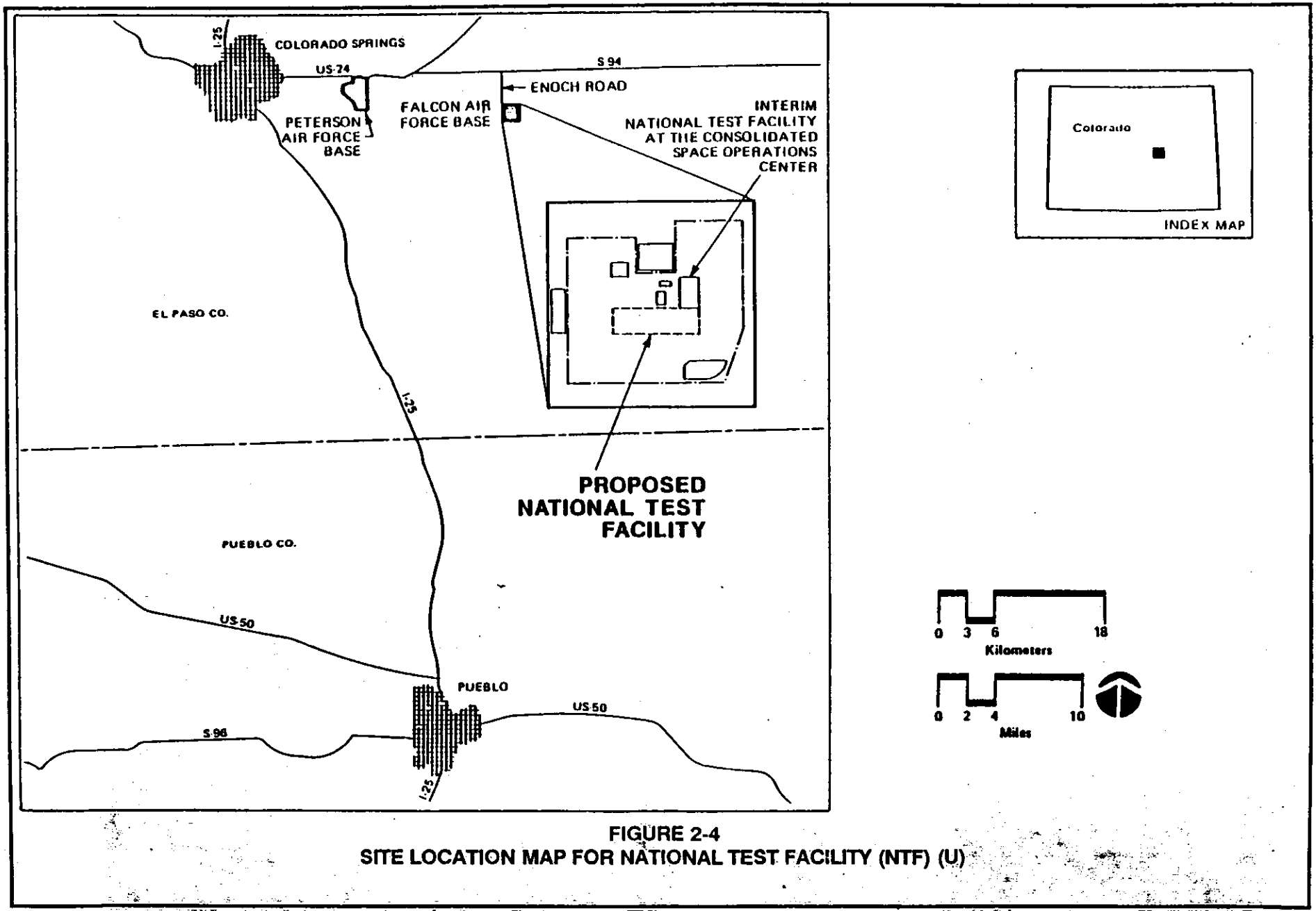


FIGURE 2-4
SITE LOCATION MAP FOR NATIONAL TEST FACILITY (NTF) (U)

2.1.5 Nevada Test Site (NTS) (U)

(U) The Nevada Test Site (NTS) is located adjacent to Nellis Air Force Range, approximately 65 miles northwest of Las Vegas in southeastern Nye County, Nevada (Figure 2-5). The NTS, which covers 864,000 acres, operates facilities for underground testing of nuclear devices and weapons testing. Exposure of materials and components to radiation is often an integral part of nuclear testing.

(U) Based on existing environmental documentation, the NTS is in compliance with Federal standards for air quality, water quality, and hazardous waste. Environmental documentation has already been prepared for the NTS (ERDA, 1977).

2.2 PREFLIGHT AND FLIGHT TEST SITES (U)

2.2.1 Edwards Air Force Base (EAFB) (U)

(U) Edwards Air Force Base (EAFB)--on the western edge of the Mojave Desert--is located roughly 100 miles north of Los Angeles, California (Figure 2-6). The U.S. Air Force Astronautics Laboratory (AFAL) at EAFB develops rocket propulsion technology in support of ballistic, air-launched, and space missile systems. The laboratory routinely completes range tests on sensors and thrusters, such as would be required for the BP Experiment Program, 10 to 15 times per year involving 10 to 15 staff members (DoD, 1987b).

2.2.2 Wallops Flight Facility (WFF) (U)

(U) Wallops Flight Facility (WFF)--in Accomack County, Virginia, on the Atlantic Coast of the Delmarva Peninsula--is located approximately 40 miles southeast of Salisbury, Maryland, and 70 miles north of the Chesapeake Bay Bridge Tunnel (Figure 2-7). WFF is the only flight test facility wholly owned and operated by the National Aeronautics and Space Administration (NASA) (NASA, 1990).

(U) The facility comprises three separate land areas--Wallops Island, the Main Base, and Wallops Mainland (Figure 2-8)--and is now considered an extension of the Goddard Space Flight Center located in Greenbelt, Maryland.

(U) The Main Base, comprising 1,833 acres, is bordered on the east by 4 miles of marshland, which separates it from Chincoteague Island. This area contains Wallops Headquarters, administrative offices, some tracking facilities, a range control center, rocket and fuel storage depots, rocket inspection facilities, several

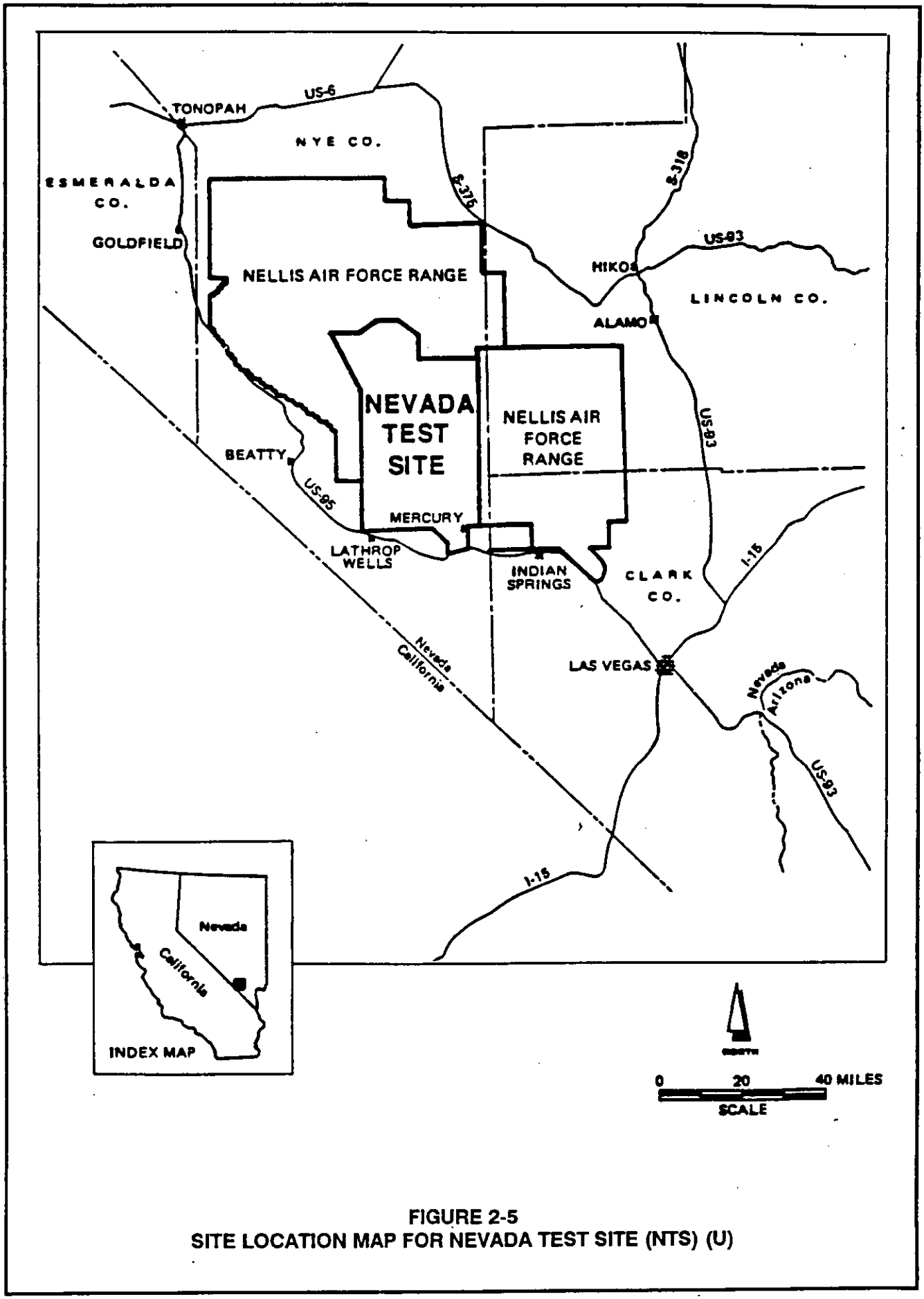


FIGURE 2-5
SITE LOCATION MAP FOR NEVADA TEST SITE (NTS) (U)

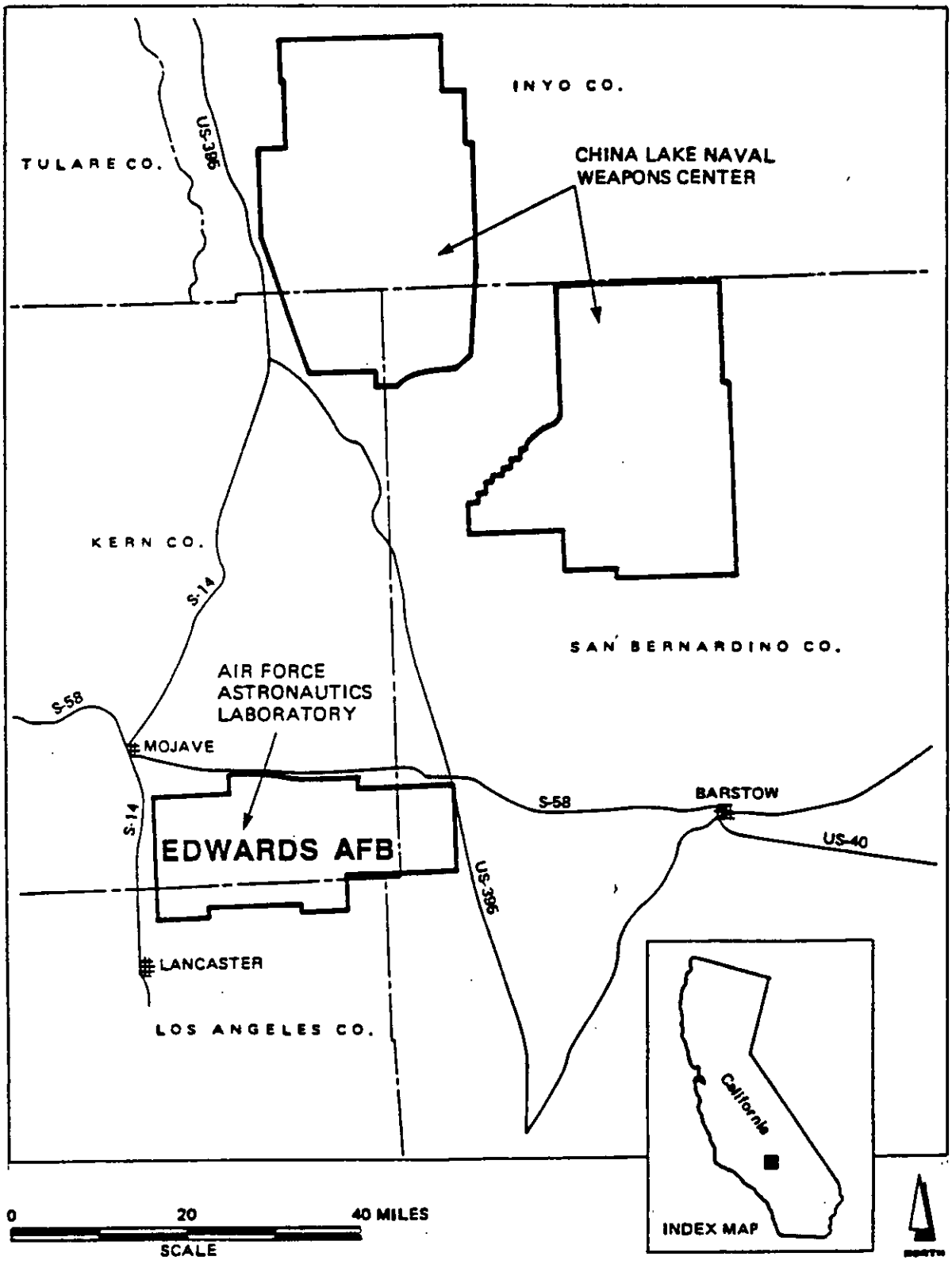


FIGURE 2-6
SITE LOCATION MAP FOR EDWARDS AIR FORCE BASE (AFB) (U)

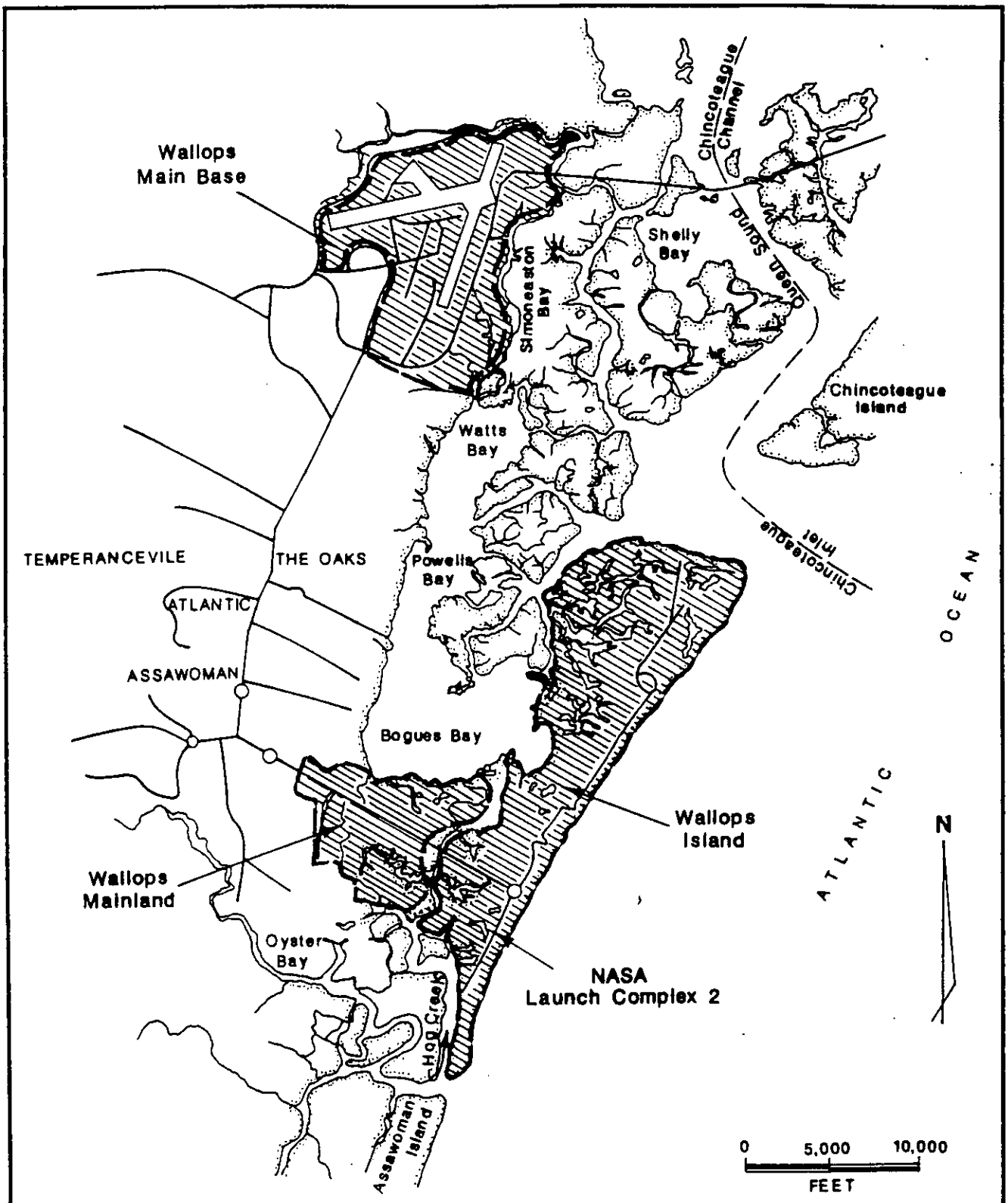


FIGURE 2-8
SITE LOCATION MAP FOR WALLOPS ISLAND, THE MAIN BASE,
AND WALLOPS MAINLAND (U)

support shops, family housing units, bachelor's quarters, and an operational airfield, as well as a number of office buildings and utilities.

(U) Wallops Island is used as the primary site for various launch and tracking facilities associated with the Sounding Rockets Program, with launch activities aimed seaward. Approximately 100 launches are currently supported per year (NASA, 1990). The island contains launch sites, blockhouses, rocket storage buildings, assembly shops, dynamic balancing facilities, tracking facilities, an open burn area, and other related service support facilities. Wallops Mainland, a strip of land comprising approximately 100 acres, is located 2 miles west of the island on the main peninsula. It provides a site for long-range radar, communications, and optical tracking installations. Approximately 1,100 people are employed by WFF, of which 100 to 150 work on Wallops Island (NASA, 1990).

(U) Housing at WFF is found only on the Main Base; there are no housing facilities on Wallops Mainland or Wallops Island. The U.S Navy provides 28 family housing units, 100 bachelor enlisted quarters, and 16 bachelor officer quarters. The remainder of the on-base housing is used by the U.S. Coast Guard and comprises 25 family housing units (NASA, 1988). Nearly 1,000 workers live in nearby towns, smaller communities, and rural areas. Temporary workers live in nearby communities and resort areas.

(U) The biotic environment of WFF is characteristic of local coastal areas and barrier islands throughout the unglaciated segment of the Atlantic coastline. The Nature Conservancy, the National Park Service, and the U.S. Fish and Wildlife Service (USFWS) have major land holdings in the general area of Wallops Island, including the Chincoteague National Wildlife Refuge and Assateague National Seashore. One of the federal and state listed threatened species on the Wallops shoreline is the Piping Plover. Measures are in place to protect this species including an active program to protect the nest sites during incubation through the fledgling period (NASA, 1990).

(U) Air and water quality at WFF are good. Utility services are adequate at all three of the major areas of the facility. Because of the infrequent launches, short duration of a launch, and a distance of 4 or 5 miles to offsite communities, offsite noise is not a problem. Existing range and safety procedures protect onsite personnel.

2.2.3 U.S. Army Kwajalein Atoll (USAKA) (U)

(U) The U.S. Army Kwajalein Atoll (USAKA), formerly known as Kwajalein Missile Range, is a subordinate command of the U.S. Army Strategic Defense Command (USASDC). It is located in the Republic of the Marshall Islands, 2,100 nautical miles (nm) southwest of Honolulu, Hawaii (Figure 2-9). Kwajalein Atoll is a crescent-shaped coral reef that encloses the world's largest lagoon. The land area of the Atoll is only 5.6 square miles, and the surface area of the enclosed lagoon is 1,100 square miles.

(U) Launching, sensing, and tracking are essential functions performed at USAKA. Activities that support these functions are base operations, construction, and range support. In 1989, USASDC prepared an EIS on proposed actions at USAKA (USASDC, 1989c). For purposes of the EIS, current and planned activities at USAKA were assumed to continue. Proposed SDI activities were analyzed as part of the proposed use of USAKA, and the continuing activities were considered as present and future baselines against which the actions proposed in support of SDI were compared.

(U) The baseline (non-SDI) activities included continuation of USAKA mission activities--missile launches for test flights, meteorological data gathering, radar calibration, sensing and tracking of incoming reentry vehicles (RVs) for U.S. Department of Defense (DoD) test programs, and space surveillance, all of which are supported by radar and optical sensing equipment, telemetry, communications, and other technical range support activities. These base operations included all activities--transportation, utilities, housing, community support, maintenance, and repair services--required to support a community of 3,000 people.

(U) The proposed action analyzed in the USAKA EIS was the conduct of several construction and test projects directly associated with SDI, together with ongoing and planned non-SDI activities (no action alternative). Five major construction projects in support of base operations were included as related actions. In addition, the USAKA EIS analyzed a change of duration alternative, which would have scheduled some elements of SDI testing over a more extended period. The proposed SDI actions involve 13 programs, including test flights [e.g., Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS), Space-Based Interceptor (SBI), and Strategic Target System (STARS)] and others. Some of these activities will use solid rocket propellant (ammonium perchlorate based) for launch and payloads containing liquid propellant [i.e., ERIS divert propulsion system will contain monomethyl hydrazine (MMH) and nitrogen tetroxide (N_2O_4)] (USASDC, 1989c).

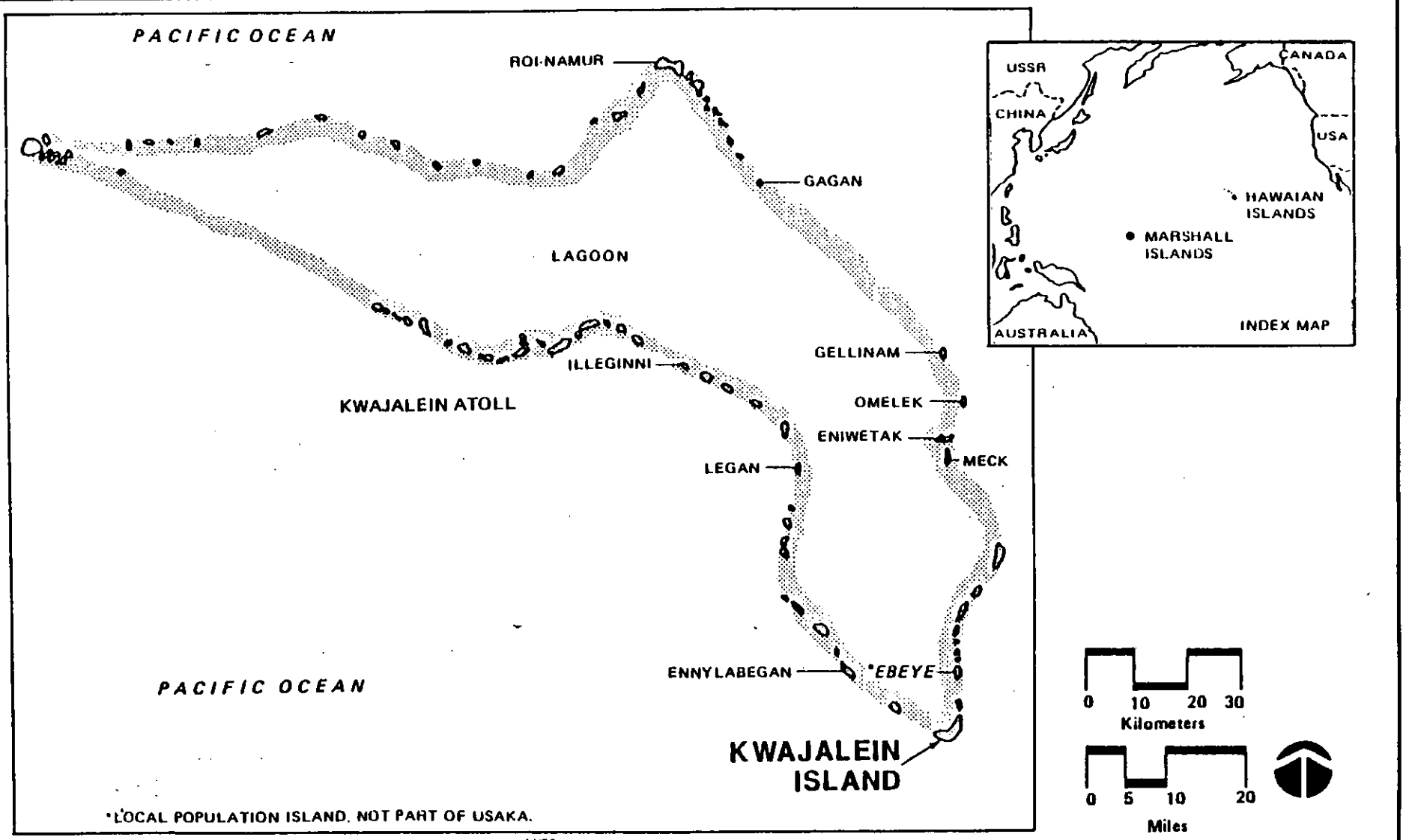


FIGURE 2-9
SITE LOCATION MAP FOR U.S. ARMY KWAJALEIN ATOLL (USAKA) (U)

(U) Housing is a major issue. All residents of USAKA are either employees in support of the defense mission or are dependents of those personnel. The availability of housing is problematic because of the island's remote location and extreme environmental conditions. Utilities, including solid and hazardous waste disposal, pose a serious problem because of the inadequacies of the existing system and the fact that they are currently at full capacity.

(U) Mitigation measures include the upgrade of utilities, including solid and hazardous waste facilities, and the construction of additional housing. These measures would mitigate all significant SDIO-related impacts, except for the housing problem. However, according to the USAKA EIS, there is a severe housing problem even without SDI activities. Proposed mitigation activities would include new housing that would reduce the impacts, but the housing shortage would still be significant (USASDC, 1989c).

2.2.4 Wake Island (U)

(U) Wake Island--a coral atoll comprising three islands (Wake, Wilkes, and Peale)--is located 2,300 miles west of Honolulu, Hawaii (Figure 2-10). The total land area is approximately 2,600 acres, and the three islands form a "V" approximately 5 miles long on one side. In 1934, the U.S. Navy was given responsibility for Wake Island, which soon became a refueling stop for trans-Pacific airliners and an outlying naval air station. Use of the island has diminished since the 1970s. It is currently in caretaker status, with a small U.S. Air Force detachment and approximately 200 civilian support contractors on the island.

(U) In 1987, USASDC completed an Environmental Assessment (EA) for Project Starbird construction and operation on Wake Island (USASDC, 1987b). According to the information in the EA, Wake Island proper has a 10,000-foot runway, a shorter WWII-era runway, administrative offices, service and maintenance shops, a large rainwater catchment area, and two housing areas that are mostly abandoned. There are petroleum storage facilities on both Wake and Wilkes Islands. No threatened or endangered terrestrial species of plants or animals are known to occur on Wake Island. Several species of threatened or endangered turtles inhabit or may inhabit the near shore waters; however, none are believed to nest on the island. Other legally protected species include mammalian dolphins, which have been reported in the lagoon. These animals are protected under the Marine Mammal Protection Act, and migratory sea birds are protected under the Migratory Sea Bird Treaty Act.

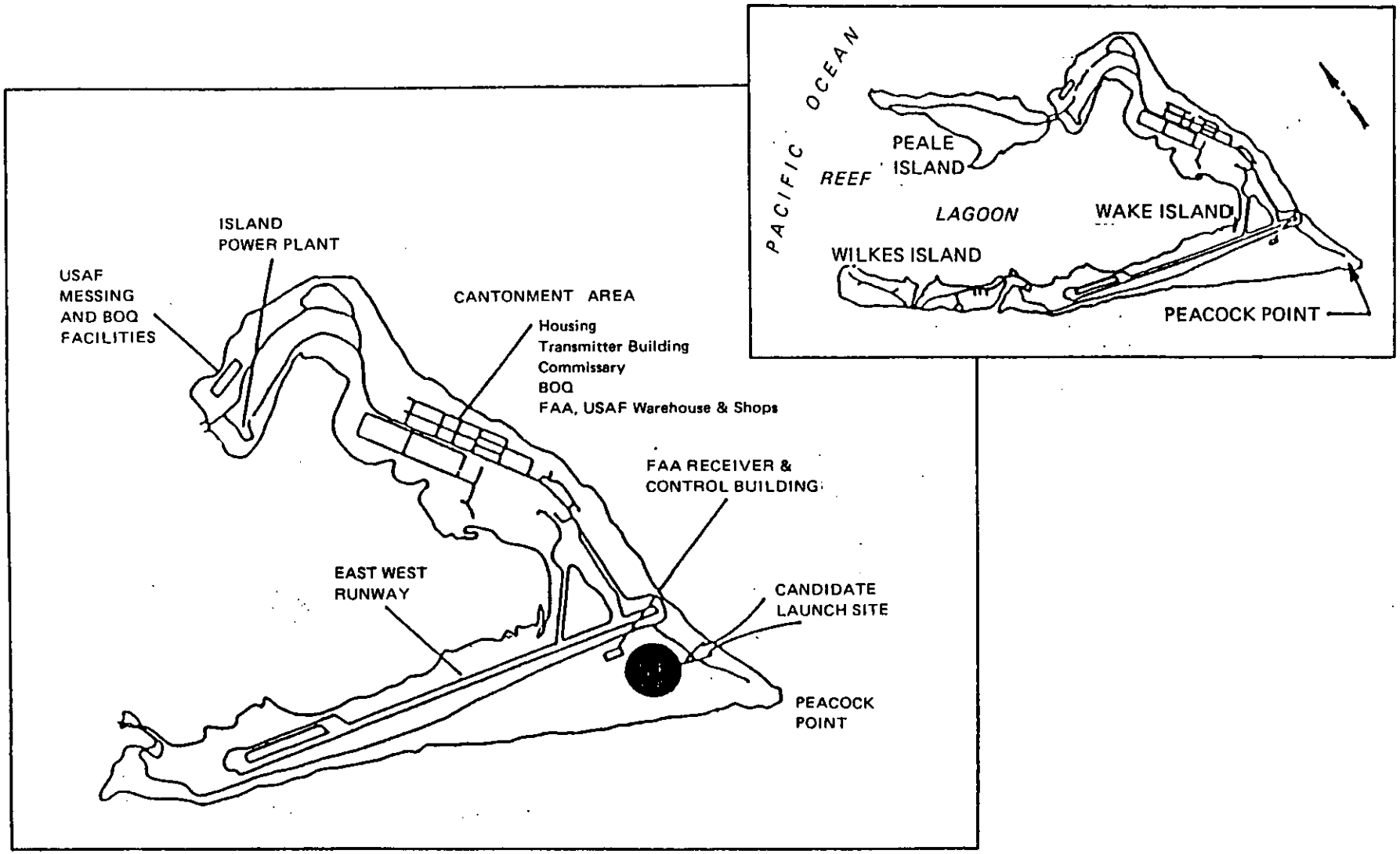


FIGURE 2-10
SITE LOCATION MAP FOR WAKE ISLAND (U)

(U) Wake Island has recently (October 1985) been designated as a National Historic Landmark because of the remaining WWII-era structures and the significance of the island in WWII history. This designation commits the Federal Government to protect this landmark to the maximum extent possible. Any agency proposing an action that may directly or indirectly affect the landmark is also required to provide the Advisory Council on Historic Preservation with a 30-day comment period on the proposed action.

(U) Current knowledge of the potential hazards to humans and environmental health and safety from the use of a wide variety of chemicals indicates that the methods used at Wake Island in the past for handling and disposal of hazardous materials were not safe by today's standards. In past years, contaminated fuels and used lubricants were disposed of by dumping or were otherwise allowed to percolate into the ground (USASDC, 1987).

2.2.5 Pacific Missile Range Facility (PMRF) (U)

(U) The Pacific Missile Range Facility (PMRF) is located on the west side of Kauai, Hawaii, at Barking Sands (Figure 2-11). The installation is a long, narrow site that is bordered on the west by the Pacific Ocean and on all other sides by agricultural and undeveloped land. PMRF comprises both land- and water-based facilities in support of U.S. Navy test programs. In addition, three separate launch facilities are used to launch test flights of tactical missiles and other projectiles.

(U) The Department of Energy (DOE) Test Readiness Facility, also called the Kauai Test Facility (KTF), is a rocket preparation and launch facility operated by Sandia National Laboratories (SNL). The KTF is a tenant on PMRF, and is located on the northern portion of the installation. The tenant agreement is for land only; all facilities maintenance and repairs are handled by DOE. There is an EA for the KTF in process by SNL (SNL, 1989).

(U) Between 1961 and 1988, approximately 310 rockets were launched from KTF, beginning with the High Altitude Nuclear Testing Program in 1962 and the Test Readiness Program in 1963. KTF has been and is being used to test rocket systems with science and technology payloads, to advance development of maneuvering target vehicles, to study the atmosphere and exoatmosphere, and to support other programs. Existing support facilities include a wind radar site, missile launchers, maintenance operations facilities, warehouse and shipping/receiving building, and Missile Assembly Building (MAB).

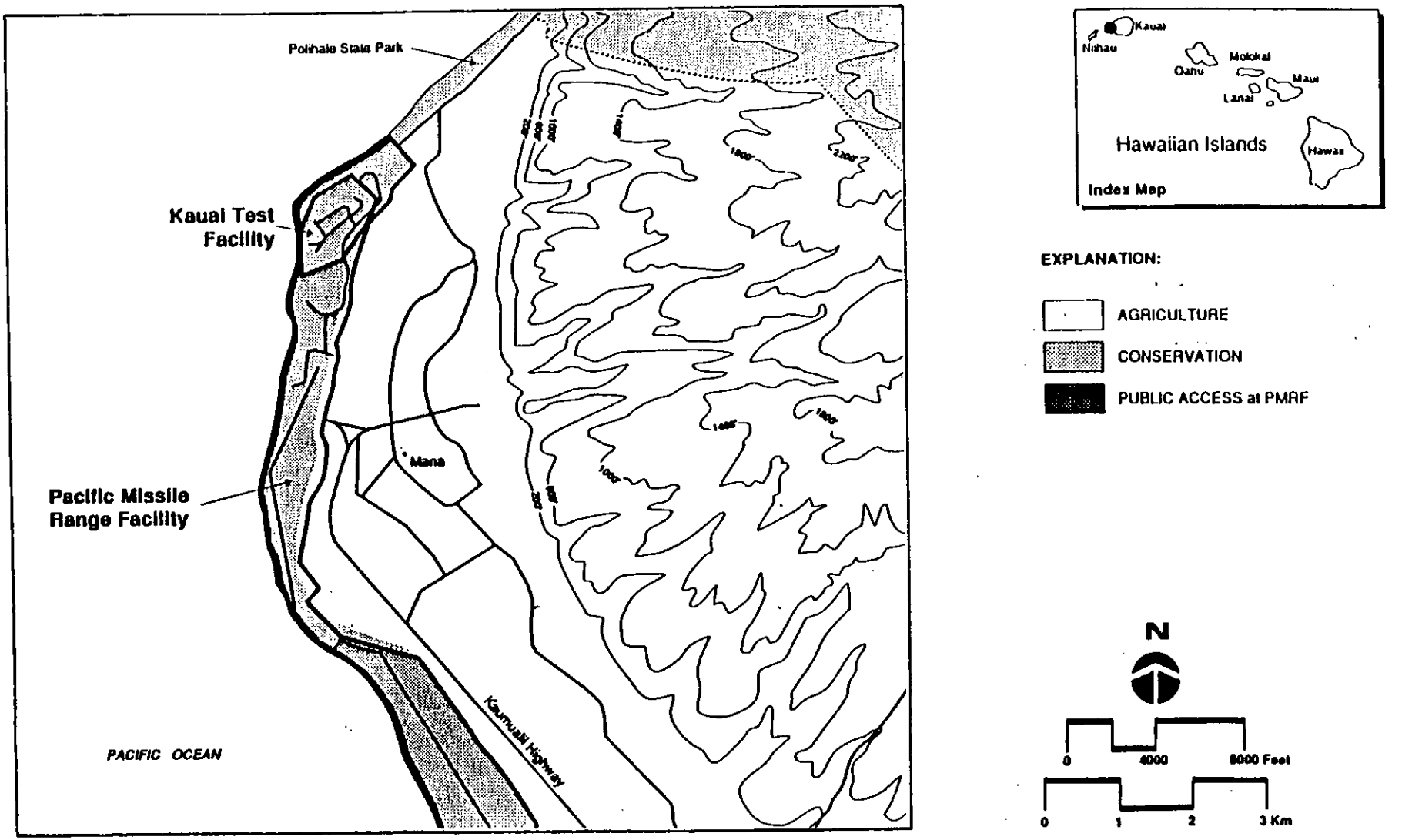


FIGURE 2-11
SITE LOCATION MAP FOR PACIFIC MISSILE RANGE FACILITY (PMRF) (U)

(U) PMRF is on State-owned land that was transferred to the installation by authority of Executive Orders. The transfer was made with the understanding that public access to PMRF's coastline be allowed. Public access beaches, which are outside PMRF but within explosive safety areas, are cleared prior to launch.

(U) PMRF complies with Federal standards for air and water quality and hazardous waste. Installation infrastructure demands may be within capacity, though some concerns have been expressed over the main base sanitary sewer system, which is already at full capacity. Power is supplied by the Kauai Electric Company; additionally, onsite diesel generators are available. Solid waste is handled by the county. Land use is in accordance with the installation's Draft Master Plan (USASDC, 1990).

(U) The primary noise sources on PMRF are various types of aircraft operations and rocket launches. A review of the facilities and land uses indicates that all facilities are sited in acceptable noise level areas. The nearest residential area is Mana, which is located approximately 2 miles from the facility; no noise complaints have been noted.

(U) The dune area on PMRF is ecologically important and has been designated as such by the County of Kauai. It is occupied by a well-developed native strand community.

(U) Adequate housing is available at PMRF. There are 56 family housing units and 25 additional units to be completed by 1992, 68 bachelor quarters/dorms, and 26 transient housing units (USASDC, 1990). Temporary housing is available nearby.

2.2.6 Vandenberg Air Force Base (VAFB)/Western Test Range (U)

(U) Vandenberg Air Force Base (VAFB)--the largest Air Force base in the United States--is located northwest of Santa Barbara on the coast of California (Figure 2-12). The base has existing launch facilities to test-launch intercontinental ballistic missiles (ICBMs), including Minuteman, Peacekeeper, and Atlas missiles. The southwestern and northwestern areas of the base are dedicated to missile launch facilities. Approximately 17 to 28 missiles are launched annually from launch facilities at VAFB into the Western Test Range. The Western Test Range includes a broad area of the Pacific Ocean that extends offshore from VAFB to the Indian Ocean, and functions as the test area for space and missile operations. It includes a network of tracking and data gathering facilities throughout California, Hawaii, and the South Pacific, supplemented by instrumentation on aircraft.

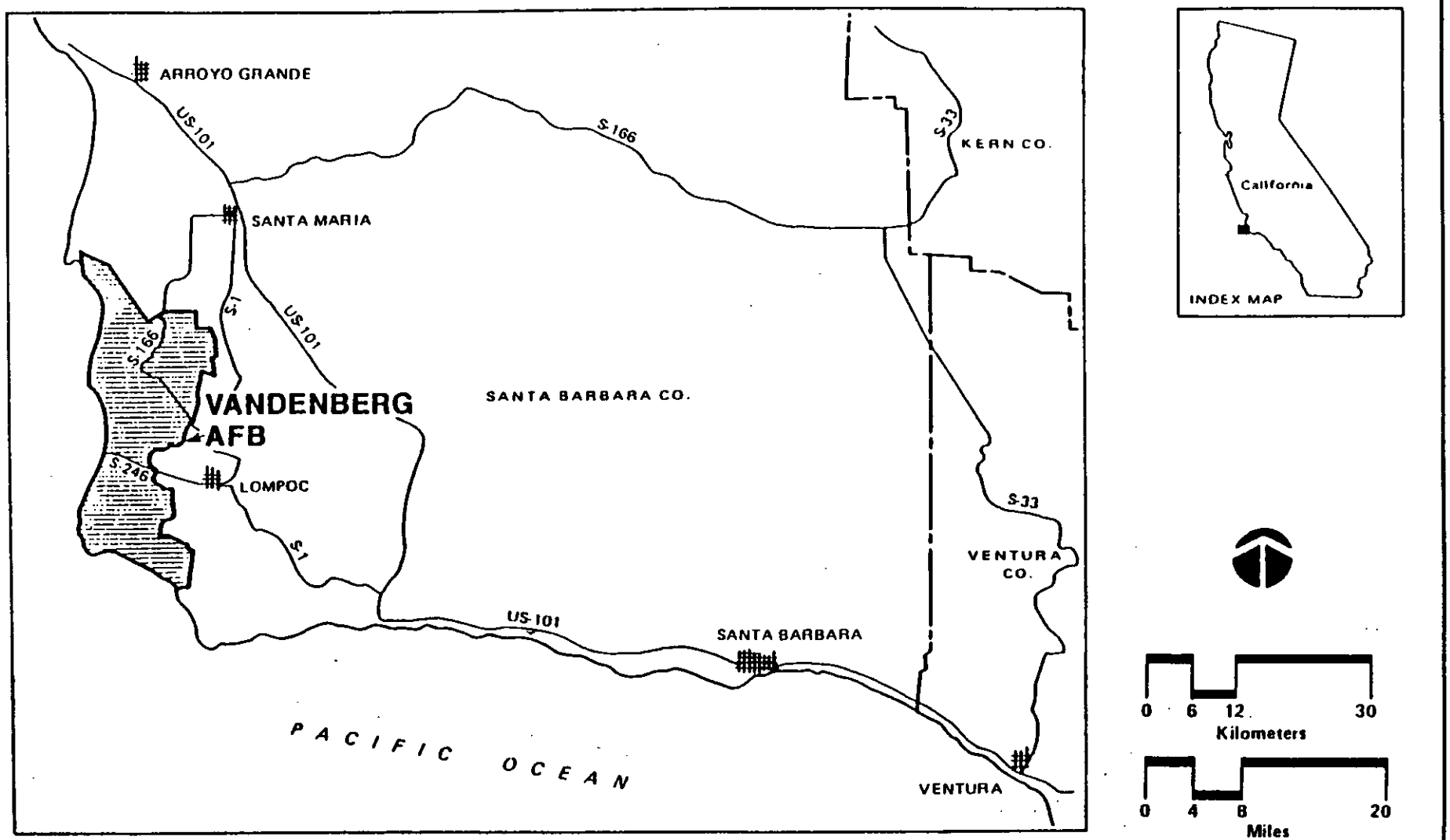


FIGURE 2-12
SITE LOCATION MAP FOR VANDENBERG AIR FORCE BASE (VAFB) (U)

(U) VAFB complies with all Federal standards for air quality, water quality, and hazardous waste (USAF, 1988b). Mitigation measures to minimize impacts to air quality from launches are incorporated into the existing VAFB launch program as process control, which involves air pollution control equipment, and operational control, which is discretionary and based on actual and predicted conditions. The payload propellant loading vapors will be vented to the N_2O_4 burner or to the vapor incinerator, as appropriate (USAF, 1988b).

(U) The Toxic Hazard Corridor (THC) forecast is another mitigation measure that minimizes impacts to air quality. Because of the wind patterns (onshore) and inversion in the Vandenberg area, it is important to consider the forecast prior to basing the decision to launch. The uncontrolled areas are 4 miles from the launch area, and exposure of humans and other forms of life to unhealthful air quality is possible under adverse events and conditions.

(U) Installation infrastructure demands are within capacity. Potential contamination of groundwater resulting from the discharge of deluge and washdown water is minimized through adherence to waste discharge requirements to be set forth by the California Regional Water Quality Control Board, Central Coast Region (RWQCB). Surface water potential impacts due to accidental spills of propellant are mitigated through the use of spill containment structures surrounding the fuel handling area, oxidizer handling area, and the ready storage vessel area. Any potential contaminant collected will be disposed of in accordance with Federal and State regulations. VAFB has a sanitary landfill on base.

(U) Land use is in accordance with the Base Master Plan, and no additional mitigation measures are required. Noise levels have not been identified as a problem, though they are monitored closely. Protective measures are required to protect workers at the launch facility and in surrounding areas from very high noise levels. All workers at the launch area should wear protective hearing devices or be inside acoustically protected buildings. No significant public health and safety issues have been identified (USAF, 1988b).

(U) There are five federally listed endangered animal species (the California brown pelican, California least tern, least Bell's viro, American peregrine falcon, and unarmored three-spine stickleback), and two threatened animal species (the southern sea otter and the Guadeloupe fur seal) on the base (USASDC, 1989a); there are no federally listed threatened or endangered plants.

3.0 ENVIRONMENTAL CONSEQUENCES (U)

(U) The proposed action has the potential to affect the natural and human environment. The following sections identify potential areas, resources, and issues of concern for the Brilliant Pebbles (BP) Experiment Program. The section is organized into two major subdivisions--program analysis and site-specific analysis.

(U) The program analysis deals with the BP experiments in isolation from any specific test facility. Essentially, the program analysis evaluates the environmental impacts of BP as a technology and a series of experiments, determines whether BP or its testing program causes any significant environmental effects, and provides information on mitigation measures that will avoid or minimize significant impacts. The purpose of the broad program analysis is to ensure that the environmental impacts from the design, test, and development of BP are revealed and understood. Where feasible, impacts from BP will be avoided or minimized by affecting the technology design and the way it is tested.

(U) The site-specific analysis evaluates the testing of BP at specific test facilities. In this analysis, the interaction of the BP Experiment Program is dealt with narrowly, because the actual test duration, place, and time are known. To avoid duplication, broad technology issues are not dealt with in the site-specific analysis. Only unique environmental issues that arise from the testing of BP at a specific test facility will be discussed. The purpose of the site-specific analysis is to determine whether the BP test activities cause any significant impacts due to site conditions or the interaction of the BP experiments with the environmental conditions at the site. Where feasible, impacts from BP will be avoided or minimized by affecting the way it is tested or by taking steps to protect the potentially affected resource.

3.1 PROGRAM IMPACTS (U)

3.1.1 Land Use (U)

(U) Land use considerations include the present use and condition of a test site and adjoining land, proposed alterations to the use, and potential conflicts with adjacent uses. Negative land use impacts due to testing could include disturbance of sensitive areas, soil contamination, erosion of soil, and interference with the use and enjoyment of adjoining land. Impacts to land use could occur during component/subassembly ground tests and simulations or preflight and flight tests.

(U) The BP Experiment Program will use existing test and launch facilities and will not involve the alteration of the use of a facility, nor will the BP Experiment Program construct new Payload

Assembly Buildings (PABs), Missile Assembly Buildings (MABs), or launch pads, thereby minimizing any disturbance of soil. However, there is the potential for BP test activities to cause soil contamination from the use of liquid propellants. Hydrazine in its various forms is a toxic substance. Contact with the soil could destroy plants and prevent new growth. Hydrazine is poisonous to humans if inhaled, ingested, or absorbed through the skin.

(U) As described in Section 1.4.5, each BP test facility where liquid propellant will be handled will have sufficient containment to prevent release of the propellant to the ground. Closed-loop fuel/defuel/purge systems will be used to minimize the risk of exposure. Therefore, no significant impacts to land use are anticipated.

3.1.2 Water Resources (U)

(U) Potential water resource concerns center on two issues--adequate water supply and water contamination. The BP Experiment Program is not a large user of water. Some water will be used to wash down launch pads and assembly areas but not in quantities large enough to adversely affect existing water supplies.

(U) Impacts on water resources could occur during component/subassembly ground tests and simulations or preflight and flight tests. Without proper mitigation and protection measures, surface water and groundwater contamination could result from accidental spills of the liquid propellants and solvents or from washdown of areas with fuel or solvent residues. These runoff products could enter the soil and percolate to groundwater or enter nearby surface water. Residues could be toxic to fish and water plants, as well as poisonous to humans, if the residues enter the drinking water supply.

(U) As discussed previously, protections will be in place at BP test facilities to contain spills. Floors will be bermed and sloped with drains that are isolated from the sanitary sewer system. Spill residues will be collected and properly stored, treated, and disposed of as hazardous materials or waste. Therefore, no significant impacts on water resources are anticipated.

3.1.3 Air Quality (U)

(U) Air quality impacts can occur from BP test activities through the release of solvents, fuel, and oxidizer to the air; emissions from launch of the boosters; and emissions from vehicle failure. Release of air pollutants from the BP Experiment Program can occur during component/subassembly ground tests and simulations and preflight and flight tests.

(U) The Federal Clean Air Act empowers the various states to regulate the emissions to ambient air by controlling criteria air pollutants on a regional basis and by restricting hazardous air pollutants at the source. Criteria air pollutants--particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead--are measured against the National Ambient Air Quality Standards (NAAQS). Ambient air quality is measured for both primary (health) and secondary (welfare) standards (Table 3-1). If an air region is in compliance with the NAAQS for a criteria pollutant, then it is said to be in attainment for that pollutant. If the NAAQS are not met, then the region is a nonattainment area.

(U) Component/subassembly ground tests and simulations will primarily involve the use of existing facilities where similar tests are routinely accomplished. Experiments would involve the release of minor amounts of solvents and fuel products into the atmosphere. The products will be used in well-vented areas, and fueling operations will use closed-loop systems to minimize releases. No significant impacts are anticipated during ground tests.

(U) During preflight tests, the same potential exists for spills and releases of solvents and fuel products. Facilities to contain spills and systems to minimize releases will minimize any impacts.

(U) Flight activity sources of air pollutants include ignition of liquid and solid propellants and catastrophic failure of the booster. Launch emissions from rocket exhausts are caused by the combustion of fuel. The primary fuels involved are ammonium perchlorate (for solid-fuel boosters) and hydrazine (for liquid-fuel boosters). Hydrazine could be in the form of monomethyl hydrazine (MMH) or aerozine-50, which is a 50/50 mixture of hydrazine N_2H_4 and unsymmetrical dimethylhydrazine(UDMH).

(U) The primary emissions from ammonium perchlorate during combustion are carbon monoxide and dioxide (CO and CO_2), hydrogen and hydrogen chloride (H and HCl), nitrogen and nitrogen oxides (N and NO_x), and aluminum oxide (Al_2O_3) (USAMC, 1988). Quantities of these pollutants are shown for each booster type anticipated for use during the BP Experiment Program in Table 1-1. Carbon monoxide, nitrogen oxides, and aluminum oxide (a particulate) are considered criteria air pollutants. Large quantities of these pollutants released to the atmosphere could have an adverse effect on NAAQS. However, NAAQS apply to long durations (i.e., hours, days, years) of emissions. Because launches are of short duration (less than 4 minutes) and are infrequent, the release of pollutants is not likely to have adverse effects.

TABLE 3-1

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	EPA Standard PPM (ug/m^3)
Particulate Matter (PM10)	24-hour	-- (150)
	Annual	-- (50)
Nitrogen Dioxide (NO_2)	Annual	0.05 (100)
Carbon Monoxide (CO)	1-hour	35 (40,000)
	8-hour	9 (10,000)
Sulfur Dioxide (SO_2)	3-hour	0.5 (1,300)
	24-hour	0.14 (365)
	Annual	0.03 (80)
Ozone (O_3)	1-hour	0.12 (235)
Lead	Calendar quarter	-- (1.5)

SOURCE: 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards (USASDC, 1989c).

(U) The effects of aluminum oxide particulates are not well defined. High concentrations of metal oxide dust (greater than 100,000 mg/m^3) could irritate lungs and eyes. However, aluminum and its compounds are not considered to be highly toxic, and they have in fact exhibited very low toxic potential. Recently, research has shown a correlation between aluminum and Alzheimer's disease. So far, the research has been speculative and inconclusive because the cause of Alzheimer's is unknown. Whether aluminum is a cause or effect of the disease, or whether they are related at all, is still undetermined.

(U) For liquid fuel launches, the fuel will be some form of hydrazine (N_2H_4, MMH, or UDMH), and the oxidizer will be nitrogen tetroxide (N_2O_4). Byproducts from combustion of these fuels are carbon monoxide and dioxide, hydrogen, water, nitrogen and nitrogen oxides, and oxygen (USDOT, 1986). Of these, only carbon monoxide and nitrogen oxides are identified as criteria air pollutants by EPA.

(U) The U.S. Army Kwajalein Atoll (USAKA) Environmental Impact Statement (EIS) evaluated the impacts from the same type of boosters planned for the BP experiments. Specifically, the USAKA EIS looked at emissions from the ARIES II, the Polaris A3, and sounding rockets of the Black Brant type. The only combustion product from solid rocket launches that is a criteria pollutant on the NAAQS (Table 3-1) is CO. In the USAKA EIS, impacts from CO emissions were expected to be insignificant because, while the 1 hour NAAQS standard is 35 ppm, the predicted impacts from rockets similar to or larger than those to be launched at USAKA are 3 ppm for "instantaneous peak centerline impacts."

(U) Although not criteria pollutants on the NAAQS (Table 3-1), the other major combustion products of concern are HCl and Al_2O_3. The USAKA EIS presents modeling data for the highest launch emission scenario; the HCl and Al_2O_3 are below guideline concentrations developed by the National Academy of Sciences.

(U) BP launches will use the same booster types as were analyzed in the USAKA EIS. Although wind conditions aloft can change the calculations of emission concentrations from rocket launches, it is not anticipated that BP flight tests would result in concentrations of emissions that are substantially different from those calculated at USAKA. Therefore, air quality impacts from solid boosters are considered to be insignificant.

(U) Studies have been conducted to estimate the effects of propellant combustion constituents on the upper atmosphere. The research has focused on carbon dioxide, water, HCl, and NO_x. Major effects identified in the studies include compositional effects in the atmospheric layers (e.g., effects on the ozone layer) and

climatic effects. The USAKA EIS analyzed the potential for impacts from these compounds on the upper atmosphere and found there was no conclusive evidence of impacts. Because the same combustion constituents will be present from BP tests, no impacts are anticipated.

(U) In the event of an in-flight failure during the early stages of launch, the vehicle destruct system ignites the propellant. For liquid propellant, the rupturing of the propellant tanks is enough to cause ignition. If the destruct system fails, the vehicle might impact the ocean and release the entire quantity of propellant. The N_2O_4 reacts with water to form nitric acid, which then forms ionic compounds such as sodium nitrate, a commercial fertilizer, with minerals in sea water. Hydrazine and UDMH degrade over a period of hours in pure water in contact with the atmosphere. Their degradation is hastened by the presence of minute amounts of metal ions present in sea water. The degradation products include ammonia, a commercial fertilizer, and gaseous nitrogen and hydrogen, which represent no biological hazard. Therefore, the hydrazine is expected to degrade over a short period of time to less toxic compounds. UDMH undergoes similar reactions (USDOT, 1986).

(U) A launch pad abort could cause a fire or a propellant spill, resulting in ground-level concentrations of pollutants. Models of on-pad catastrophic failures involving Deltas, Atlas/Centaur, Titan IIIE, and Scout show the resulting concentrations of HCl, CO, and Al_2O_3 to be below exposure criteria.

(U) In spills that involve only the release of the oxidizer (nitrogen tetroxide), the concentrations of the ground cloud would be of concern. If inhaled for prolonged periods, N_2O_4 can cause serious lung injury or death. Under ordinary meteorological conditions, the concentration of nitrogen tetroxide within three kilometers downwind of the release would be less than the 15-minute, short-term exposure limit of 5 parts per million (ppm) or the 8-hour, time-weighted average exposure limit of 3 ppm (American Conference of Governmental Industrial Hygienists, 1988-89). Therefore, no significant adverse impacts are expected.

(U) Under certain adverse conditions, such as inversion layers with light winds, concentrations at the 3 and 5 ppm exposure limits may persist for distances of up to 6 kilometers. BP experiments will not be conducted under such conditions (USDOT, 1986).

3.1.4 Noise (U)

(U) The BP Experiment Program will generate potentially significant noise levels during ground and flight tests. Sources of noise are static firing of boosters during the ground tests of

sensors, preflight hover tests, and the actual launch of the test vehicles. Noise at high levels and for long durations can cause temporary or permanent hearing loss, a lessening of hearing sensitivity to certain frequencies, and irritability. To evaluate noise impacts, it is necessary to consider not only the overall sound level but also the frequency spectrum and the duration of exposure.

(U) Several methods have been devised to relate noise exposure over time to human response. The U.S. Department of Defense (DoD) uses the day-night average sound level (Ldn) as the rating method to discern long-term annoyance from environmental noise. An Ldn of 65 is considered the standard for daytime noise exposure, while 55 Ldn is considered the nighttime standard. The Occupational Safety and Health Administration (OSHA) has established noise limits to protect workers. Under OSHA criteria, a time-weighted noise exposure of 90 dBA is allowable for an 8-hour day. The maximum exposure level is 115 dBA for 15 minutes or less.

(U) The preflight hover tests will be conducted indoors and will generate noise that may exceed the 15-minute, short-duration standard. However, workers will be isolated from the hover chamber and will wear proper ear protection to minimize noise impacts.

(U) The operation of the launch vehicle generates noise at levels above 150 dBA within 100 feet. Workers exposed to these levels could be injured by the noise. However, as stated in the description of the proposed action, workers in the vicinity of launches will be sheltered inside facilities insulated against noise (e.g., blockhouses or bunkers). Where necessary, workers will wear ear protection to ensure exposure does not exceed the OSHA criteria.

(U) Communities in the vicinity of the launch activities could experience noise above 65 dBA during rocket launches. The launches are of such short duration and reach altitude quickly enough that no launch will exceed the Ldn criteria set by DoD. Therefore, noise impacts to humans are considered to be insignificant.

(U) Some threatened or endangered species of animals can be sensitive to noise. During the site-specific analysis, these species will be identified and mitigations devised to protect them. Mitigations will include surveys to ensure that the species are not within noise zones, delay of launches where species exist, and postponement of launches during breeding and other sensitive seasons (USDOT, 1986; VAFB,1988; NASA, 1989).

3.1.5 Flora and Fauna (U)

(U) Potential areas of concern for flora and fauna include disturbance of habitats, destruction of vegetation, displacement of wildlife, and disruption of migration and breeding patterns. The impacts on flora and fauna are best analyzed in the site-specific discussion (Section 3.2). However, the program analysis of impacts can provide some insight into planning factors and mitigations that will help avoid or minimize impacts.

(U) Of particular concern is damage to the habitat and the taking of threatened and endangered species. Areas must be presurveyed to determine if any such species or habitats could be affected by the BP Experiment Program. If the activities do not fall within the scope of the actions already coordinated with the U.S. Department of Interior, then a further review is required. Formal consultation and a biological assessment may be required if a threatened or endangered species is affected.

(U) All of the test facilities that will support the BP Experiment Program have been conducting similar activities over the past several years, except for Wake Island. All of the facilities have been surveyed for threatened and endangered species and supporting habitat. The site-specific analysis discusses the potential issues at the test facilities and the mitigations that will be implemented.

(U) For planning purposes, mitigations that will help avoid or minimize impacts to wildlife and habitat include rescheduled activities to avoid seasonal sensitivity of a species, limited number of personnel in the area, controlled access, minimal disturbance to the site, immediate repair of damage or restoration of the resource, transplanting, and creation of new habitat.

3.1.6 Archaeology and History (U)

(U) There is minimal potential for impacts on archaeological, historical, or cultural resources as a result of the BP Experiment Program. Increased human activity near these resources could cause inadvertent damage, disturbance, or destruction. However, all of the test facilities associated with the BP Experiment Program are in existing, developed locations. Their use will be consistent with past uses, and they have negligible potential for significant adverse effects.

(U) All of the BP Experiment Program facilities have been presurveyed to identify the presence of important archaeological, historical, or cultural sites. There are no such sites near the proposed facilities. Mitigation measures are already in place at all of these sites to protect archaeological, historical, or cultural resources.

(U) Should any BP activities encounter archaeological, historical, or cultural resources, then certain mitigating actions will be implemented. First, the area will not be further disturbed until it can be surveyed and the significance of the find can be assessed. Second, coordination with the state historic preservation officer will take place. Third, if the find is significant, then steps will be taken to record data, document the area, or preserve the find. Because BP activities will take place in previously disturbed areas, there is minimal risk of causing a significant impact to these resources.

3.1.7 Socioeconomics (U)

(U) The BP Experiment Program will not add any new personnel to the test facilities for the component/subassembly ground tests of the technology. Therefore, no socioeconomic impacts should arise during the ground tests. However, during preflight and flight activities, approximately 25 to 50 people will be onsite during the target launches and the early proof-of-hardware flights (Flight Test Profiles 1 and 2). All of these people will be temporarily at the site for no more than 90 to 120 days. Such small numbers can be easily absorbed into the existing population without affecting the socioeconomic environment.

(U) For more complicated BP launches, such as launches of the BP payload during Flight Test Profiles 3, 4, and 5, 30 to 50 people will be needed to support the launches for a period of 6 to 9 months. Even this amount of people should not have an effect on the socioeconomic environment, unless there is a shortage of the basic infrastructure supplies needed to support them. Areas of concern could be housing, transportation, demographics, schools, employment opportunities, recreation, hospitals, and community issues, such as sewer treatment, sanitary disposal, utilities, and communication.

(U) The addition of 30 to 50 people to an area does not normally cause an impact. During BP tests, most of the people would be located in populated areas [e.g., Vandenberg Air Force Base (VAFB)]. Where infrastructure support is limited, such as at USAKA, care will be taken to avoid oversaturating the facility. (Substitution of the BP flight tests for the SBI flight tests will not result in a net population increase at USAKA). The USAKA EIS

addresses such a situation and as mitigation there is proposed housing construction. Such impacts must be analyzed on a site specific basis and appropriate mitigations developed.

3.1.8 Utilities (U)

(U) Component/subassembly ground tests will be conducted at existing facilities and use utilities already in place at those sites. These activities will comprise only a small portion of the overall activities at those sites. Only small amounts of solvents will be used (less than 50 milliliters) (e.g., for booster refurbishment). Small amounts of electricity and water will be used, and there will be no increase in employees to add to sewage treatment or solid waste generation. None of the tests will impose large demands on the utilities; therefore, the activities can be readily accommodated within the existing resources.

(U) Utility requirements for preflight and flight tests will vary with the number of personnel, the duration of each test activity, and the type of test involved. The number of personnel can affect the demand for potable water, sanitary sewage, solid waste handling/disposal capacity, and energy. The BP Experiment Program will take place at existing facilities with utilities in place. The numbers of personnel are not anticipated to overtax the existing utilities infrastructure, because they will only represent a small increase in the overall population at the facilities. Therefore, no significant impacts on utilities are anticipated from the increase of personnel.

(U) However, the BP preflight and flight test programs have the potential to affect utilities. For example, liquid rocket fuel, when released, becomes a hazardous waste and must be properly managed. Test equipment and environmental controls inside assembly buildings use electricity. Transportation of the boosters and payloads requires the use of fuel for trucks, barges, and airplanes. Test activities will generate solid waste for disposal. There should be insignificant amounts of hazardous waste, except for the liquid propellant.

(U) No more than 55 gallons of liquid propellant will be used for the BP payload at any one time. Liquid plume targets will use no more than 300 pounds of liquid propellant. Even if all of the propellant had to be disposed of as hazardous waste, the quantities are small compared to the volume normally disposed of by a test facility and are not expected to have a significant impact on the handling capacities of receiving facilities. The major consumption of electricity for the BP preflight and flight experiments will be

(U) During the launch, the RSO will monitor the flight path of the booster to ensure that it does not fly outside the limits of the flight dispersion pattern or flight hazard area. The flight dispersion areas or flight hazard areas will be precleared to ensure that no personnel, ships, or aircraft are in the vicinity. Any debris from the explosion should fall harmlessly into the ocean. Areas will be constantly monitored during flight activities to prevent encroachment by personnel, ships, or planes, and warnings will be given by way of Notice to Airmen (NOTAM) and Local Notice to Mariners (LONOTE). No launch will occur if the integrity of the flight hazard area is compromised.

(U) Accidental Liquid Fuel Release. Some BP payloads and target Vehicles will contain liquid propellants. Accidental release of these propellants on the launch pad or after launch could cause environmental damage to soil and groundwater, or to humans, plants, and animals. The liquid propellant used in the BP Experiment Program is hydrazine in various forms. Hydrazine is toxic to humans, plants, and animals. If released into soil or groundwater and uncontrolled contact is made, the effects could be injurious. Specifically, hydrazine in the form of UDMH is a suspected carcinogen. Exposure limits for hydrazine have been established by OSHA.

(U) Hydrazine will be handled only when workers are wearing Class B personal protection equipment. Fueling, defueling, and purging operations will be accomplished by using closed-loop systems to minimize worker and environmental exposure. Should the liquid propellant accidentally escape the booster, evacuation procedures for nonessential personnel will be ordered. The fueling/defueling operations will take place only when weather or wind conditions will not allow concentrations at the periphery of the launch area to exceed recommended exposure limits. Launch pad areas will have sufficient containment facilities to collect and store any accidental release of the liquid propellant. Containment facilities will be designed to ensure that the liquid propellant is not released to the adjacent soil or groundwater. Emergency cleaning personnel will be required to wear Class B personal protection equipment, and all waste will be handled as toxic/hazardous materials waste in accordance with OSHA and Resource Conservation and Recovery Act (RCRA) cleanup, storage, treatment, and disposal requirements.

(U) Explosion of the booster after launch could cause the release of the liquid propellant into the atmosphere. The liquid propellant most likely would react with the oxidizer and burn up during the explosion, leaving nontoxic gases (N_2, CO_2, CO, H_2) and water vapor as byproducts. These products would have no toxic effect on the atmosphere or the environment. The quantities of propellants anticipated for use during the BP Experiment Program

environmental controls (air conditioning) for the assembly buildings. However, these buildings are not operated specifically for BP, and they would use the electricity in any event. The amount of electricity would be small compared to the overall use at the test facilities. Transportation of the boosters and payloads would consume some fuel, but the consumption would be small compared to the overall use of fuel at the test facilities. The same applies to solid waste generation, because the BP preflight and flight activities will generate small amounts of waste compared to the overall contribution. Therefore, no significant impacts are anticipated.

3.1.9 Safety (U)

(U) There are safety issues involved in each of the basic segments of the BP Experiment Program. During component/subassembly ground tests and simulations and preflight tests, activities will occur at existing Government and contractor facilities. Routine activities would be conducted under directives and formal safety programs already in effect at the facilities. These programs also include procedures for addressing circumstances for which there are no readily applicable procedures or standards [i.e., OSHA or National Institute of Occupational Safety and Health (NIOSH)]. To preclude problems and avoid accidents, the extensive work force training and operator certification programs include quality control inspections, spill prevention, control and countermeasure plans, contingency plans, and active operations monitoring.

(U) Ground activities that will require procedures specifically adapted to BP include the operation of sources of ionizing and non-ionizing electromagnetic radiation (EMR) and the preflight testing of integrated test vehicles. Testing that involves EMR is typically performed underground or in a heavily shielded laboratory. Protection of workers during testing is the major operational concern. Protection includes exposure limits for EMR, controlled access to areas with high EMR-potential during an accident, medical monitoring, and training programs.

(U) Preflight testing of test vehicles will also occur within existing laboratories that have been specially constructed for hover testing. Again, the protection of workers from actions such as exposure to or inhalation of fuels or exhaust products, noise injuries, and accidents resulting from a runaway vehicle is the major operational concern. Protection procedures include conduct of testing from remote-control rooms and monitoring of chamber air prior to entry of personnel after tests. It is anticipated that the worker protection programs can be readily adapted, if required, to the specific needs of the BP Experiment Program.

(U) Open air testing of laser communications devices will require specific operational procedures. Because eye hazard is a concern during laser operations, restrictions include minimum eye-safe distance, trained personnel, filtration devices, and other control procedures. Other safety procedures include optical checking of laser alignment prior to tests, and visual checks for intrusions on test airspace.

(U) Various safety precautions are taken to prevent and mitigate the impacts resulting from an accident. The facilities would be monitored for safety violations and hazards, which would then be corrected. Medical and firefighting personnel and equipment must be available for emergency response. The substances (e.g., chemicals) involved in a personal injury or fire would be identified so that proper action could be taken. In the case of a major release of toxic vapors, the services of meteorologists would be available to predict the vapor movement so that the affected area could be cleared. All facilities where an employee could be injured by accidental contact with chemical substances would be equipped with emergency showers and eyewash fountains. Facilities where an explosion or fire could occur would be equipped with automatic deluge systems in addition to the standard fire hoses and extinguishers. Facilities that could experience the release of colorless, odorless gases would be equipped with detectors that sense the dangerous condition and alert the area with visible and audible signals. Whenever hazardous operations might occur, a safety zone would be established in advance, and noninvolved persons would be dismissed from the area. Such operations could be scheduled for periods when casual traffic is at its lowest.

(U) All persons whose duties could require them to encounter a hazardous situation would need to attend classes and lectures on the use of safety equipment and become familiar with the escape routes and procedures for a particular area.

(U) Safety issues associated with the BP Flight Test Program include all issues discussed under ground safety. In addition, specific flight safety issues associated with BP include accidental explosion of the booster on the launch pad or immediately after launch, accidental release of liquid fuel on the launch pad or during launch, firing of the lasers during flight tests, EMR, and debris from intercepts and reentry.

(U) Lasers used in space for communications links to the ground could potentially cause eye or skin damage to a person who might view the laser beam at its source while traveling in an aircraft. The potential laser links are of low power and would not be detectable on the ground by the human eye.

(U) Aircraft occupants would be partially shielded by the aircraft's skin or windows, reducing exposure hazard. To further mitigate any potential eye or skin hazard, flights over the area would be controlled by the Federal Aviation Agency (FAA) during laser operations. Also, laser operations would be controlled by observers who could terminate firing if any aircraft enter the control area. Therefore, no significant impacts are anticipated from laser operations in space (USAF, 1987c).

(U) Accidental Explosion. Just before launch, the boosters are armed to ignite. At this time, as well as shortly after launch, boosters could prematurely explode because of defective hardware. However, this is a very unlikely occurrence. The premature explosion of the solid propellants also could result in a concentrated release of air pollutants in the vicinity of the launch facility (USDOT, 1986).

(U) The explosion of the solid propellants essentially is a rapid chemical reaction, which would send pieces of the booster and the payload outward in a radial direction. Personnel or facilities within the explosive hazard area could be injured or damaged by the force of the explosion. An explosion just after launch would shower debris on personnel or facilities. Exposure to concentrated levels of byproducts of the explosion could be hazardous to humans (particulates) or flora and fauna (HCl).

(U) Impacts from the accidental explosion of the booster could be significant if personnel were allowed within the vicinity of the launch pad in an unprotected state. Facilities within the launch area that were not designed to withstand the force of an explosion could be damaged. Flora or fauna species that are susceptible to injury or damage from debris or release of air pollutants could also be significantly impacted by the explosion.

(U) As described in Section 1.2.4, the Range Safety Officer (RSO) will calculate the net explosive weight (NEW) of the boosters and establish an explosive quantity safety distance (EQSD). During all launch activities while the booster is armed, the RSO will require that all personnel observe the EQSD and stay clear of the launch pad. Launch control activities will take place in facilities that are designed to withstand the force of an explosion equivalent to the NEW of the booster without substantial damage and injury to launch personnel. All the facilities will be either positioned outside the EQSD or similarly designed. Areas will be constantly monitored to ensure that no unauthorized personnel encroach on the EQSD during the launch. The areas will also be resurveyed to ensure that no sensitive flora or fauna species will be in the area at the time of launch.

would cause minimal, if any, impacts on the environment, including the ocean. Control of the booster flight path using the flight dispersion pattern and flight hazard area will ensure that no personnel, ships, or planes are inadvertently exposed to an accidental release of liquid propellants.

3.2 SITE-SPECIFIC IMPACTS (U)

(U) The site-specific analysis below applies to the concept feasibility phase of the BP Experiment Program; however, it is anticipated that the technology validation activities would be similar in scope and projected impacts. As more specific information is identified, these activities will be reevaluated as required.

3.2.1 Component/Subassembly Ground Tests and Simulations (U)

(U) All component/subassembly ground tests and simulations and preflight and flight tests proposed for the BP Experiment Program at contractor facilities are routine operations at those facilities. The contractor will certify compliance with all local, state, and Federal environmental laws and regulations.

3.2.1.1 Lawrence Livermore National Laboratory (LLNL). (U) Site activities at Lawrence Livermore National Laboratory (LLNL) will be conducted at existing facilities. Facilities currently being used by the BP Experiment Program are discussed in the LLNL site-wide EIS (DOE, 1982). These activities are common at LLNL and are covered by procedures for safe operation and worker protection. Total employment (both new and reassignments) is not expected to exceed a few dozen personnel, which is a small portion of LLNL's total staff. Therefore, no significant impacts are expected.

(U) Light detection and ranging (LIDAR) and other laser equipment will be used to gather performance information. All safety procedures will be adhered to.

(U) Eye hazards are the greatest concern during laser operations, such as outdoor LIDAR tests, and operational restrictions will include minimum eye-safe distance, trained personnel, filtration devices, and other control procedures, as discussed in Section 3.1.9 (USDOT, 1986).

3.2.1.2 Sandia National Laboratories (SNL). (U) All proposed BP Experiment Program activities planned to take place at Sandia National Laboratories (SNL) are routine operations and tests for this facility. No significant environmental impacts are expected.

3.2.1.3 Arnold Engineering Development Center (AEDC). (U) All proposed BP Experiment Program activities planned to take place at Arnold Engineering Development Center (AEDC) are routine for this facility. No significant environmental impacts are expected.

3.2.1.4 National Test Facility (NTF). (U) All proposed BP Experiment Program activities planned to take place at National Test Facility (NTF) are routine operations and tests for this facility. No significant environmental impacts are expected.

3.2.1.5 Nevada Test Site (NTS). (U) All proposed BP Experiment Program activities planned to take place at the Nevada Test Site (NTS) are routine operations and tests for this facility. No significant environmental impacts due to BP Experiments are expected.

3.2.2 Preflight and Flight Tests (U)

3.2.2.1 Edwards Air Force Base (EAFB). (U) All proposed BP Experiment Program activities planned to take place at Edwards Air Force Base (EAFB) are routine operations and tests for this facility. No significant environmental impacts are expected.

3.2.2.2 Wallops Flight Facility (WFF). (U) The proposed BP Experiment Program flight activities at Wallops Flight Facility (WFF) will use existing launch and tracking facilities associated with sounding rocket activities. Approximately 100 launches are supported per year. The BP Experiment Program is proposing a series of approximately five launches during a 1-year period. Therefore, the BP Experiment Program in combination with other launches at WFF would increase the number of launches by 5 percent or less, depending on the launch frequency of other vehicles at the facility.

(U) The operation of the BP Experiment Program is consistent with existing land use at Wallops Island and would not change present land use patterns or increase the offsite population.

(U) Potential impacts to groundwater at WFF would be limited to an accidental release of liquid propellant (hydrazine) during the fueling process. However, a bermed catchment area of an impervious material is placed on the launch pad, and all fueling operations use a closed-loop system with minimal potential for leaks or spills. Any release of fuel would not contact the ground surface or enter the groundwater, and the propellant would be removed from the catchment area and disposed of by a certified hazardous waste contractor. Therefore, no impacts to the groundwater would be expected. Although the cumulative impacts of previous launches at WFF are unknown, cumulative impacts to the groundwater as a result of BP Experiment Program activities would not be expected.

(U) Other potential surface water impacts could come from storm water runoff at the launch site and the waste water treatment system on Wallops Island. The waste water treatment system is currently in compliance with State of Virginia and Federal standards, and the activities associated with the BP Experiment Program would not exceed their current capacity. Currently, all launch operations at WFF require safety plans and procedures for handling any potential environmental contaminants. Therefore, cumulative surface water impacts would not be expected.

(U) (U) Potential air quality impacts resulting from the BP Experiment Program include emissions from prelaunch processing and the periodic launches of the Black Brant X (BBX). Various ground support activities associated with each launch could cause relatively minor emissions of volatile organic carbons (VOCs) from miscellaneous transport vehicles or diesel-fired backup electrical generators. These amounts would be very minor and would only have a temporary effect on local air quality near the support facilities.

(U) The primary combustion products generated by the BP Experiment Program launch vehicles are insignificant compared with other launch vehicles. Delta or Titan rockets contain considerably more propellant--approximately 200 times more for the Delta and 1,000 times more for the Titan. Recent Environmental Assessments (EAs) for the Delta and Titan programs at Cape Canaveral Air Force Station found that emissions of Al_2O_3 were not a significant environmental hazard. NO_x emissions would rapidly react with other naturally occurring compounds in the air to form nontoxic compounds.

(U) Because of the brief, sporadic nature of atmospheric emissions associated with the BP Experiment Program and other launch programs at WFF, the short- and long-term cumulative air quality impacts of the combined launch programs at WFF are not expected to be significant.

(U) Noise would be generated during the launch vehicle assembly, but would be confined to the immediate vicinity of the launch site and would not affect offsite populations. Occupational exposure to unsafe noise levels would be reduced to acceptable levels by the use of hearing protection equipment. Therefore, no significant impacts would be expected. Workers directly associated with launch activities would wear hearing protectors and would be in blockhouses or bunkers during the actual launch.

(U) The BBX is a smaller vehicle than the Scout, which produces peak launch noise in the 90 db range at a distance up to 5.3 miles for a duration of 1 to 2 seconds (equivalent to the sound of a heavy truck passing through the area). Potentially affected areas include the communities of Chincoteague and Atlantic, Virginia. Because the BBX launches would occur infrequently at relatively low frequencies, and would involve very short exposure duration, no impacts would be expected.

(U) BP Experiment Program operations would overlap other activities at WFF, but because launches do not occur simultaneously, a cumulative impact of noise intensity would not result at a given point in time.

(U) No impacts to the surrounding vegetation or wildlife would occur as a result of the prelaunch processing. However, potential impacts on vegetation and wildlife could result from launch emissions and noise. Launch emissions from the first stage of the BBX would be produced in very small quantities and would disperse rapidly in the environment. Therefore, no impacts to vegetation or wildlife are anticipated. With respect to noise, the BP Experiment Program activities are similar to ongoing activities at Wallops Island; because of the low noise frequency, short duration, and low number of BP Experiment Program launches, wildlife impacts are not expected.

(U) Current activities at WFF do not appear to adversely impact local wildlife. Many different species commonly use the island for nesting and feeding habitats. The U.S. Fish and Wildlife Service (USFWS) is considering declaring Wallops Island an Area of Critical Habitat for the piping plover due to its breeding success on the island. As mentioned previously there is an active program in place to protect the species including closing off access to nesting areas during breeding season. Because the addition of BBX launches represents only a 5 percent or less increase in total launches, no cumulative impacts to wildlife are expected. (Contact was made with USFWS regarding Threatened and Endangered species, as described in an attached letter dated April 11, 1990).

(U) Launch emissions would disperse before contacting surface waters of the inland waterway or near shore Atlantic waters, and spill containment procedures discussed for fueling activities would prevent any contaminants from entering surface waters. Therefore, no impacts to aquatic habitats are anticipated.

(U) Ongoing efforts at WFF to stabilize the shoreline have been approved by the U.S. Army Corps of Engineers and the State of Virginia for coastal zone management activities. Activities and launches for the BP Experiment Program, including the launching of the BBX, would not contribute to any flooding or wetlands impacts at WFF.

(U) No site construction or enlargement of existing facilities will be required; however, minor modifications to existing facilities will be required, including the establishment of a secured building to support the BP Experiment Program activities. Approximately six additional personnel will travel to WFF to observe the launches, but no additional personnel will be assigned to WFF on a permanent basis. Therefore, no impacts on the economy, demographics, housing, schools, or other services are expected.

(U) No archaeological sites were found in a 1980 study by the Virginia Research Center for Archaeology on Wallops Island, and no cultural or historical sites have been identified at WFF. Therefore, no impacts to cultural, archaeological, or historical resources would be expected from the proposed project.

(U) Operations of the BP Experiment Program are within the power and water capacities at WFF and are not expected to impact the demand for these resources in the region. The small number of temporary personnel onsite to observe BP Experiment Program launches are not expected to have any impact on transportation networks.

(U) Onsite wastewater treatment and landfill capacity in Accomack County are adequate for the short-term increase in onsite personnel. No hazardous wastes are expected to be generated during project operations.

(U) Launch trajectories addressed in the Flight Safety Plan for the BBX launch program will be slightly different from the standard trajectories used at Wallops Island. The trajectories will not pose any increased safety risk to the surrounding areas, including the Assateague National Seashore or nearby populated areas.

(U) Rocket assembly will follow existing procedures for WFF. Safety and handling of the hydrazine fuels will conform to already established procedures (Grant, 1989b).

(U) The BP Experiment Program activities at WFF are not expected to cause significant impacts, and SDIO will implement all mitigation measures (i.e., closed-loop fueling/defueling, spill containment, etc.) as described. These measures will ensure that there are no impacts to personnel or other resources at WFF.

3.2.2.3 U.S. Army Kwajalein Atoll (USAKA). (U) Three probe flights and one target flight are currently planned from Meck and Roi-Namur Islands, respectively, and additional flights are likely to be launched from USAKA for BP follow-on testing. At this time, no modifications or construction is planned specifically for BP Experiment Program activities at USAKA. In addition, transport of components, handling of materials, launch activities, and sensing and tracking activities all fall within current proposed SDI activities in terms of the types and scale. Staffing levels similar to those already required for other proposed SDI launch activities are expected.

(U) In 1989, the U.S. Army Strategic Defense Command (USASDC) prepared an EIS on proposed actions at USAKA (USASDC, 1989c). For purposes of the EIS, current and planned activities at USAKA that were not associated with SDI were assumed to continue. These continued activities were also considered as present and future baselines against which the actions proposed in support of SDI were compared.

(U) The USAKA EIS outlined analyses of potential impacts for current non-SDI activities and the proposed SDI activities. A series of mitigations to reduce potentially significant impacts and a series of monitoring activities to review the effectiveness of the mitigation activities were outlined. Mitigation measures directed specifically toward SDI activities were in the areas of hazardous and solid waste materials handling and management practices, water supply, and housing. Construction of a desalination plant for water supply and a new waste water treatment plant, and upgrading of solid waste management operations are commitments made in the USAKA EIS to mitigate these impacts. The preceding measures will mitigate all significant impacts, except for the housing problem. Currently, there is a shortage of housing at the facility and some existing housing is substandard. The SDI-activities assessed in the EIS include new housing; the impacts would be reduced but still significant.

(U) The proposed action (BP Experiment Program) would substitute BP for Space-Based Interceptor (SBI) as a system element in the Candidate Phase I Architecture. Modifications to the SBI test program would involve not conducting a flight test program at USAKA. That flight test program, which was assessed in the USAKA EIS, would have included two suborbital tests with two missiles

each--[redacted]and an SBI homing subsystem from Meck Island. Other SDI flight test programs scheduled to use the same USAKA launch facilities as BP are the High Endoatmospheric Defense Interceptor (HEDI) program (two flights) and Exoatmospheric Reentry Vehicle System (ERIS) (four flights). All flights would occur during a 4-year period (1990-1993).

(U) ~~(S)~~ Substitution of BP flight tests for SBI flight tests at USAKA results in no net increase in the total launches (four) at the range, though the tests are on a different schedule than SBI and a different mix of launch sites (between Roi-Namur and Meck Islands). Normal range scheduling modifications are anticipated to compensate for adjustments and overlap in the respective schedules for BP, HEDI, and ERIS. The SBI EA projected a 5 percent increase (125 staff and dependents) in the facility population for the program over a 1-year period. As described in Section 1.0 of this document, no more than 50 additional staff will be required at any one time for BP launch activities. These personnel would be temporary. Therefore, proposed BP Experiment Program activities would be covered in the proposed actions of the USAKA EIS. The BP Experiment Program would not represent an incremental increase over proposed SDI activities and therefore not result in potentially significant impacts. The mitigations that apply to the proposed SDI activities should also apply to the BP Experiment Program, and no additional mitigations specific to BP will be necessary.

(U) Should the proposed BP Experiment Program activities change as testing requirements become better defined (i.e., if construction, extra staffing, etc., are needed), or should the assumption that BP Experiment Program activities can be scheduled to interface with certain other activities at USAKA no longer apply, additional environmental analyses will be required, and this document will be supplemented.

3.2.2.4 Wake Island. (U) Flight activities planned to take place at Wake Island will be conducted at existing launch facilities. Existing launch facilities at Wake Island have been positioned and mitigations taken as listed in the Project Starbird EA (USASDC, 1987b). The EA determined that potential impacts and required mitigations were primarily associated with construction activities. Loss of vegetation was found to be insignificant to the ecosystem functioning of the island. No threatened or endangered species are known or suspected to exist on Wake Island. Because of the slight possibility that nests of protected sea birds could have been found in the construction area, affirmative measures were undertaken to identify such nests prior to construction and avoid them where feasible. Consultation with the USFWS was included as part of the mitigation plan (USASDC, 1987b).

(U) Because Wake Island is a National Historic Landmark, the launch facilities were constructed away from historical resources, and additional mitigation was included in operating plans to prevent other direct or indirect impacts on these resources (USASDC, 1987b).

(U) Similarly, impacts from hazardous waste sites were avoided through layout of the facilities. Housing and utility support of the project work force was found to be within the capacity of the island's existing facilities.

(U) Operational activities at Wake Island associated with the BP Program are anticipated to be similar to those required for Project Starbird. Where BP activities at Wake Island differ from those described in the EA, SDIO will implement the program mitigations discussed in Section 3.1. Of specific concern is the handling of liquid propellant at the site. SDIO will implant the specific mitigations associated with liquid propellant fueling at Wake Island, including launch pad containment; closed-loop fueling/defueling/purging; cleaning, handling, treatment, and disposal; as well as the personal protective measures outlined in Section 3.1. These measures, once implemented, will ensure that there are no significant impacts on personnel, flora and fauna, or water resources at Wake Island.

(U) BP Experiment Program activities are not expected to cause significant adverse impacts on the environment at Wake Island. Similar to mitigation for Project Starbird, SDIO will include the results of its mitigation monitoring in a report at the conclusion of BP activities on the island.

3.2.2.5 Pacific Missile Range Facility (PMRF). (U) Proposed flight activities to be conducted at PMRF are planned to use the Strategic Target System (STARS) launch facilities and boosters. STARS activities are currently being assessed in a draft EA for the Kauai Test Facility (KTF), a Department of Energy (DOE) rocket preparation and launch facility operated by SNL and located at PMRF.

(U) The draft EA for KTF will be finalized before any STARS flights associated with the BP Experiment Program are scheduled to occur. Mitigation measures adopted in association with STARS will be implemented for any STARS flights associated with the BP Experiment Program.

(U) The draft EA for KTF describes several potentially significant issues in relation to the STARS projects. Several federally listed endangered species exist at PMRF. The facility is located in an ethnographically sensitive area, and there are also sensitive and unique habitats, such as the Barking Sands dunes (SNL, 1989).

(U) Mitigation measures, such as those described in Section 3.1, to ensure the protection of threatened and endangered species, unique and sensitive habitats, and cultural resources would have to be implemented by others before any activities at PMRF take place.

(U) The major potential problems identified in the draft EA for KTF are environmental consequences of a rocket system abort. In such an event, the predominant environmental consequence would arise at the KTF site. SNL and PMRF procedures for incident mitigation, such as emergency response and evacuation procedures, cleanup, etc., would be followed.

(U) The draft EA describes that to mitigate the effects of a pad detonation, the U.S. Department of Defense Exposures Safety Board quantity/distance separations from inhabited buildings and public traffic routes have been incorporated in KTF facility design, and the Launch Operations Building has been reinforced against blast overpressure and fragments that could come from such a detonation.

(U) Construction activities at PMRF specifically for the BP Experiment Program are not anticipated, and operational activities are anticipated to be similar to those required for the STARS program. Therefore, the mitigations by others described previously and to be presented in the final KTF EA are anticipated to be appropriate for the BP Experiment Program. SDIO will structure the BP Experiment Program to be consistent with those mitigations.

(U) Where BP Experiment Program activities at PMRF differ from those described in the KTF EA, SDIO will implement program mitigations discussed in Section 3.1. Of specific concern is the handling of liquid propellants. SDIO will implement the specific mitigations associated with liquid propellant handling, including launch pad containment; closed-loop fueling/defueling/purging; cleaning, handling, treatment, and disposal; as well as the personnel protective measures outlined in Section 3.1. These measures, once implemented, will ensure that there are no significant impacts on personnel, flora and fauna, or water resources at PMRF.

(U) Should the planned activities change or the draft EA for KTF result in the need for an EIS, the decision to use PMRF for BP target launches will be reassessed, and this document will be supplemented.

3.2.2.6 Vandenberg Air Force Base (VAFB). (U) Proposed flight activities at VAFB may include probe or target launches and will be conducted at existing facilities. These launches will be dedicated but will be planned within the yearly range of numbers already launched from VAFB. Several proposed launch vehicles are under consideration, such as Minuteman, Scout, and Titan. All are routinely launched from VAFB. The Titan IV is the largest. Potential impacts were assessed in a 1988 EA on Titan IV Space Launch Modification and Operation at VAFB, which addressed construction and modifications of a launch complex and associated facilities for processing and launching. Potential impacts were identified for surface water and groundwater quality and hazardous waste. Mitigation measures developed for VAFB are described in Section 2.2.6 (USAF, 1988b).

(U) Operational activities at VAFB for the BP Experiment Program are anticipated to be similar to ongoing activities at VAFB. Therefore, the mitigations described previously would be appropriate for the BP Experiment Program activities and will adhere to all mitigation measures and monitoring programs. Proposed BP Experiment Program activities are not expected to cause significant adverse impacts on the environment at VAFB.

3.3 MODIFICATIONS TO THE SPACE-BASED INTERCEPTOR (SBI) TESTING PROGRAM (U)

(U) Modifications to the SBI would include curtailing testing programs [i.e., no conduct of the flight tests for demonstration/validation as outlined in the EA for SBI (DoD, 1987b)]. The flight tests would be conducted at USAKA to evaluate homing subsystem performance, guidance and control systems, and divert maneuver, and would use facilities at Roi-Namur and Meck Islands. This would include upgrading existing facilities and constructing new facilities. The potential consequences of these activities were addressed in an EIS on proposed actions at USAKA (USASDC, 1989c).

(U) A summary of the potential impacts and mitigations for proposed SDI activities, which include SBI flight testing activities, is found in Section 2.0.

3.4 NO ACTION ALTERNATIVE (U)

(U) As described in Section 1.0, the no action alternative is to continue with current SBI, Space-Based Surveillance and Tracking System (SSTS), and Ground-Based Surveillance and Tracking System (GSTS) demonstration/validation activities without conducting the proposed BP Experiment Program.

(U) The environmental consequences of the SBI, SSTS, and GSTS activities have been analyzed in several EAs and an EIS (USASDC, 1989c; DoD, 1987b, 1987c, 1987d).

REFERENCES

Accomack-Northampton Planning District Commission, 1989. Accomack County Comprehensive Plan, Accomack, Virginia.

Accomack-Northampton Planning District Commission, 1988. Eastern Shore of Virginia: 1988-1989 Community Profile, Eastern Shore of Virginia Economic Development Commission, Accomack, Virginia.

American Conference of Government Industrial Hygienists (ACGIH), 1988-1989.

Apo, LtCol, 1990. Personal communication between Kathleen Schmidt, Dames & Moore Special Services, and LtCol Apo, Strategic Defense Initiative Organization, T&E Management, February 5 and 16, 1990.

Ball Aerospace, 1989. Flight Safety Plan for the Black Brant X.

Brattstrom, B.H., and M. C. Bondello, 1983. "Effects of Off-Road Vehicle Noise on Desert Vertebrates," Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions, R.H. Webb and H.G. Wilshire (eds.), Springer-Verlag, New York, pp. 167-206.

Davis, J.M., Schanfein, M., and Pearman, D.W., 1990. FY 1990 Military Construction Project Data, Department of Defense Form 1391.

Doerle, Walt, 1990. Personal Communication between Michon Prillman, Dames & Moore Special Services and Walt Doerle, Acting Manager, General Electric Systems Effectiveness Engineering. May 3, 1990.

The Earth Technology Corporation, 1989. Meeting minutes for July 27-28 site visit at Pacific Missile Range Facility, July 31, 1989.

EBASCO, 1989. Goddard Space Flight Center, Wallops Flight Facility, Initial Site Characterization, Aviation Fuel Tank Farm, Wallops Flight Facility, Wallops Island, Virginia, prepared for National Aeronautics and Space Administration (NASA).

EBASCO, 1988. RCRA Part B Permit Application for Open Burning at Wallops Flight Facility, Wallops Island, Virginia, prepared for National Aeronautics and Space Administration (NASA).

Energy Research and Development Administration (ERDA), 1977. Final Environmental Impact Statement, Nevada Test Site, Nye County, Nevada.

Grant, D.E., 1989a. Ground Safety Plan for Black Brant X CRE Mission, prepared for National Aeronautics and Space Administration (NASA).

Grant, D.E., 1989b. A Safety Plan for Storage and Transfer of Unsymmetrical Dimethylhydrazine (UDMH) and Monomethyl Hydrazine for the Ball Aerospace Systems Group CRE Program to be Conducted at the Wallops Flight Facility, prepared for National Aeronautics and Space Administration.

Hagan, J., and T. Mueller, 1990. Personal communication between Kathleen Schmidt, Dames & Moore Special Services, and Jim Hagan and Ted Mueller, The Johns Hopkins University Applied Physics Laboratory, February 27, 1990.

Mueller, T., 1990. Personal communication between Kathleen Schmidt, Dames & Moore Special Services, and Ted Mueller, The Johns Hopkins University Applied Physics Laboratory, February 28, 1990.

Mulé, J., 1990. Personal communication between Kathleen Schmidt, Dames & Moore Special Services, and John Mulé, ANSER, February 28, 1990.

National Aeronautics and Space Administration (NASA), 1990. Draft Environmental Resources Document for the Wallops Flight Facility, Goddard Space Flight Center.

National Aeronautics and Space Administration (NASA), 1989. Final Environmental Impact Statement, Space Shuttle Advanced Solid Rocket Motor Program, John C. Stennis Space Center, George C. Marshall Flight Center.

National Aeronautics and Space Administration (NASA), 1988. Goddard Space Flight Center Facilities Master Plan, Volume 3, Wallops Flight Facility, Wallops Island, Virginia.

National Aeronautics and Space Administration (NASA), 1973. Final Environmental Impact Statement for National Aeronautics and Space Administration, Office of Space Science - Sounding Rocket Program.

National Park Service (NPS), 1984. National Register of Historic Places, Nomination Form--Wake Island, NPS, Denver, Colorado.

Naval Surface Warfare Center (NSWC), 1982. Environmental Assessment for the Construction, Installation, and Operation of AEGIS Combat Systems Center on Wallops Island, Virginia.

Sandia National Laboratories (SNL), 1989. Draft Environmental Assessment for The Kauai Test Facility.

Stoessell, A.L., 1990. Personal communication between Craig Swanson, SPARTA, Inc., Kathleen Schmidt, Dames & Moore Special Services, and A.L. Stoessell, Program Manager, Space-Based Interceptor, Brilliant Pebbles Support, Strategic Defense Initiative Organization, January 29, 1990.

Teledyne Brown Engineering, 1988. Noise Measurements of Three Pershing II Rocket Motors During Static Test Firing, Submitted to U.S. Army Missile Command as part of Pershing missile elimination environmental studies.

The Traverse Group, Inc., 1988. Natural Resources Management Plan, Pacific Missile Range Facility, Barking Sands, Hawaii.

U.S. Department of the Air Force (USAF), 1989. Environmental Assessment, U.S. Air Force Medium Launch Vehicle (MLV II) Program, Cape Canaveral Air Force Station, Florida.

U.S. Department of the Air Force (USAF), 1988a. Environmental Assessment, U.S. Air Force Space Division, Medium Launch Vehicle Program, Cape Canaveral Air Force Station, Florida.

U.S. Department of the Air Force (USAF) 1988b. Environmental Assessment, Titan IV Space Launch Vehicle Modification and Operation, Headquarters Space Division, Vandenberg Air Force Base, California.

U.S. Department of the Air Force (USAF), 1987a. Environmental Assessment, National Test Facility, Electronic Systems Division, SDIO/NTB Program.

U.S. Department of the Air Force (USAF), 1987b. Memo to Anne B. Jennings on requested CATEX information, Headquarters Space Command, Peterson Air Force Base, Colorado.

U.S. Department of the Air Force (USAF), 1987c. Environmental Impact Analysis Process, Environmental Assessment, Relay Mirror Experiment.

U.S. Army Materiel Command (USAMC), 1988. Propellant Disposal Practices.

U.S. Army Strategic Defense Command (USASDC), 1990. Coordinating Draft Environmental Assessment, Exoatmospheric Discrimination Experiment (EDX).

U.S. Army Strategic Defense Command (USASDC), 1989a. Environmental Assessment, Ground-Based Radar (GBR).

U.S. Army Strategic Defense Command (USASDC), 1989b. Draft Environmental Assessment, High Endoatmospheric Defense Interceptor (HEDI).

U.S. Army Strategic Defense Command (USASDC), 1989c. Draft Environmental Impact Statement, Proposed Actions at U.S. Army Kwajalein Atoll (USAKA).

U.S. Army Strategic Defense Command (USASDC), 1987a. Environmental Assessment, Exoatmospheric Reentry Vehicle System Demonstration Validation.

U.S. Army Strategic Defense Command (USASDC), 1987b. Environmental Assessment, Project Starbird.

U.S. Department of the Army (DOA), 1988a. Environmental Assessment for the Proposed Elimination of Intermediate-Range Missiles Pursuant to the INF Treaty.

U.S. Department of the Army (DOA), 1988b. Environmental Assessment for the Proposed Elimination of Intermediate-Range and Shorter-Range Missiles Pursuant to the INF Treaty.

U.S. Department of the Army (DOA), 1988c. Plume Characterization Study, Static Firing of a Pershing II First-Stage Rocket Motor at Pueblo Army Depot Activity, Volume 1.

U.S. Department of Defense (DoD), 1987a. Environmental Assessment, Exoatmospheric Reentry Interceptor System (ERIS), Demonstration/Validation Program, SDIO Systems Engineering, Washington, D.C.

U.S. Department of Defense (DoD), 1987b. Environmental Assessment, Space-Based Interceptor, SDIO Systems Engineering, Washington, D.C.

U.S. Department of Defense (DoD), 1987c. Environmental Assessment, Space-Based Surveillance and Tracking System (SSTS), SDIO Systems Engineering, Washington, D.C.

U.S. Department of Defense (DoD), 1987d. Environmental Assessment, Ground-Based Surveillance and Tracking System (GSTS), Demonstration/Validation Program, SDIO Systems Engineering, Washington, D.C.

U.S. Department of Energy (DOE), 1988. State of the Laboratory: Energy and Technology Review.

U.S. Department of Energy (DOE), 1982. Final Environmental Impact Statement, Lawrence Livermore National Laboratory and Sandia National Laboratories--Livermore Sites, DOE/EIS-0028, Livermore, California.

U.S. Department of Transportation (USDOT), 1986. Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs.

University of California, 1987. Final Environmental Impact Report for the University of California Contact with the Department of Energy for Operation and Management of Lawrence Livermore National Laboratory, SCH-85112611.

Vandenberg Air Force Base (VAFB), 1988. Environmental Assessment, Titan IV Space Launch Vehicle Modification and Operation. Headquarters Space Division, Vandenberg Air Force Base, California.

Virginia Department of Game and Inland Fisheries, 1990. Threatened and Endangered Faunal Species Fact Sheet.

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