93-F-0822

LEAP PROGRAM ENVIRONMENTAL ASSESSMENT

1.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations implementing NEPA (40 CFR 1500-1508), and the U.S. Department of Defense (DoD) Directive 6050.1 direct that DoD officials take into account environmental consequences when authorizing or approving major Federal actions. This environmental assessment (EA) presents an analysis of the environmental consequences of conducting activities in support of the Lightweight ExoAtmospheric Projectile (LEAP) Test Program.

Section 1.0 of this EA describes the purpose and need for the proposed action, the proposed action, and alternatives, including the no-action alternative. Section 2.0 describes the environment to be affected by the proposed action. Section 3.0 assesses the potential environmental consequences of the proposed activities on the environmental components identified in Section 2. If a particular activity has the potential to have a significant effect on the environment, mitigation measures have been incorporated into the proposal to reduce the potential significant effects to insignificant levels. These mitigation measures will be implemented as part of the proposal.

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

As part of its responsibilities for developing a viable and effective Strategic Defense System (SDS), the Strategic Defense Initiative Organization (SDIO) must demonstrate the capability to acquire, track, and intercept targets from various trajectories at varying altitudes. The LEAP Test Program is an SDI experiment program being funded to demonstrate compliance with this requirement.

The purpose of the LEAP Test Program is to design, develop, and demonstrate the capability of a miniaturized, lightweight projectile to intercept targets in the exoatmospheric

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region. These tests are required so that the SDIO Director can make a decision concerning the effectiveness of these technologies and their role in a strategic defense system.

1.2 PROPOSED ACTION

The proposed action is to design, develop, and demonstrate space test projectiles capable of intercepting targets in the exoatmosphere. The LEAP Test Program is funded to demonstrate compliance with this requirement. Activities required to support this program are execution of component/assembly tests, pre-flight activities, and flight test activities. Additionally, construction of test facilities at Phillips Laboratory on Edwards Air Force Base (AFB), and modification of launch facilities at Wake Island will be required.

The following discussion is a brief description of the concept of the LEAP technology program and a detailed description of the activities required to support the proposed action for these technologies. The proposed action also covers activities which include the manufacture of flight test articles unique to the experiments, and the operation of relevant facilities at the host installations.

1.2.1 Background and Concept of the LEAP Test Program

The LEAP projectile is a miniaturized projectile being designed by several program participants and integrated by SDIO for demonstration. Other interceptor technology programs, such as the Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS), have demonstrated that a large interceptor vehicle is capable of intercepting targets in the exoatmosphere; however, the main objective of the LEAP Test Program is to demonstrate the possibility of interception by a lightweight, miniature vehicle.

Two technological approaches to the development of LEAP technologies are simultaneously under investigation. The first approach is being coordinated by the U.S. Air Force through the Phillips Laboratory, Edwards AFB, California. The second is being coordinated by the U.S. Army through the U.S. Army Strategic Defense Command. The approaches are similar and both employ liquid bi-propellant engines for divert maneuvering. The liquid bipropellants used are hydrazine or monomethylhydrazine as the fuel and nitrogen tetroxide as the oxidizer. They differ only in the avionics technology applied to the projectile's sensor, guidance, stabilization, and control subsystems (SDIO/TNS, 1990).

Execution of the LEAP Test Program will take place at the following facilities: Boeing Aerospace and Electronics, Seattle, Washington; Hughes Aircraft Company, Missile Systems Group, Canoga Park, California; Orbital Sciences Corporation, Space Data Division, Chandler, Arizona; Phillips Laboratory, Edwards AFB, California; White Sands Missile Range (WSMR), New Mexico; U.S. Army Kwajalein Atoll (USAKA); and Wake Island.

As currently configured, the LEAP Program will consist of ground tests, four test flights with rocket vehicles launched from White Sands Missile Range (WSMR), New Mexico (Figures 1 and 2) and two test flights at U.S. Army Kwajalein Atoll (USAKA) (Figure 3) with the target launches from Wake Island (Figure 4).

Existing launch facilities (Launch Complex [LC 36] and Sulf Site at WSMR, Meck Island at USAKA, and Wake Island) will be used at all locations. The launches proposed for USAKA will be examined in the context of existing environmental documentation. Specifically, the Environmental Impact Statement (EIS) for Proposed Actions at U.S. Army Kwajalein Atoll (USASDC, 1989a) is summarized in the appropriate sections. The mission profiles for LEAP launches at USAKA are identified in Section 1.2.5.1 of this document. If, through further planning and design, the scope of these later flights is different than those analyzed in this document, further environmental documentation would be prepared.

1.2.2 Construction

Minor construction and modification activities are associated with the LEAP Test Program. This includes expansion of a component/assembly and testing facility at Phillips Laboratory and modification of existing launch facilities on Wake Island.

1.2.2.1 Phillips Laboratory

Component/Assembly and testing activities at Phillips Laboratory to support the LEAP Program will require the modification of test facilities and construction of a new integration area.

The proposed integration area would consist of a new 4,000 square foot enclosure, 80 feet long and 50 feet wide. The enclosure would contain a clean room for vehicle integration, work areas for electronics integration, and storage areas. No explosives storage or handling activities would occur in the new area.

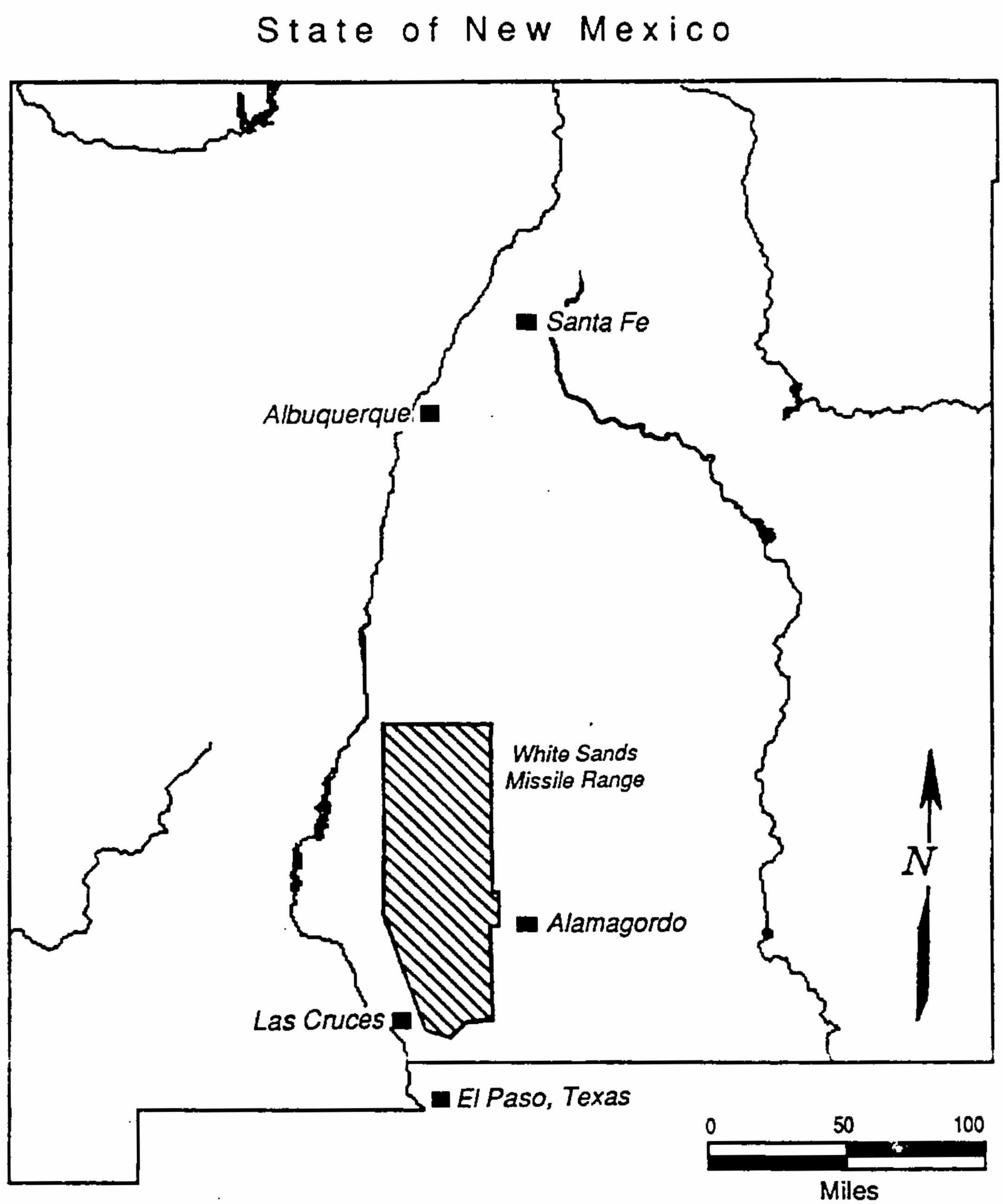
The new facility will be constructed adjacent to the existing control room (Building 8840). The area where the expansion will occur has previously been graded. Existing utilities will be used to provide water, power, and sewer services to the expanded structure.

1.2.2.2 Wake Island

Target launches at Wake Island will require the modification of some new facilities and the remodeling of selected existing facilities. Required modification activities are described herein.

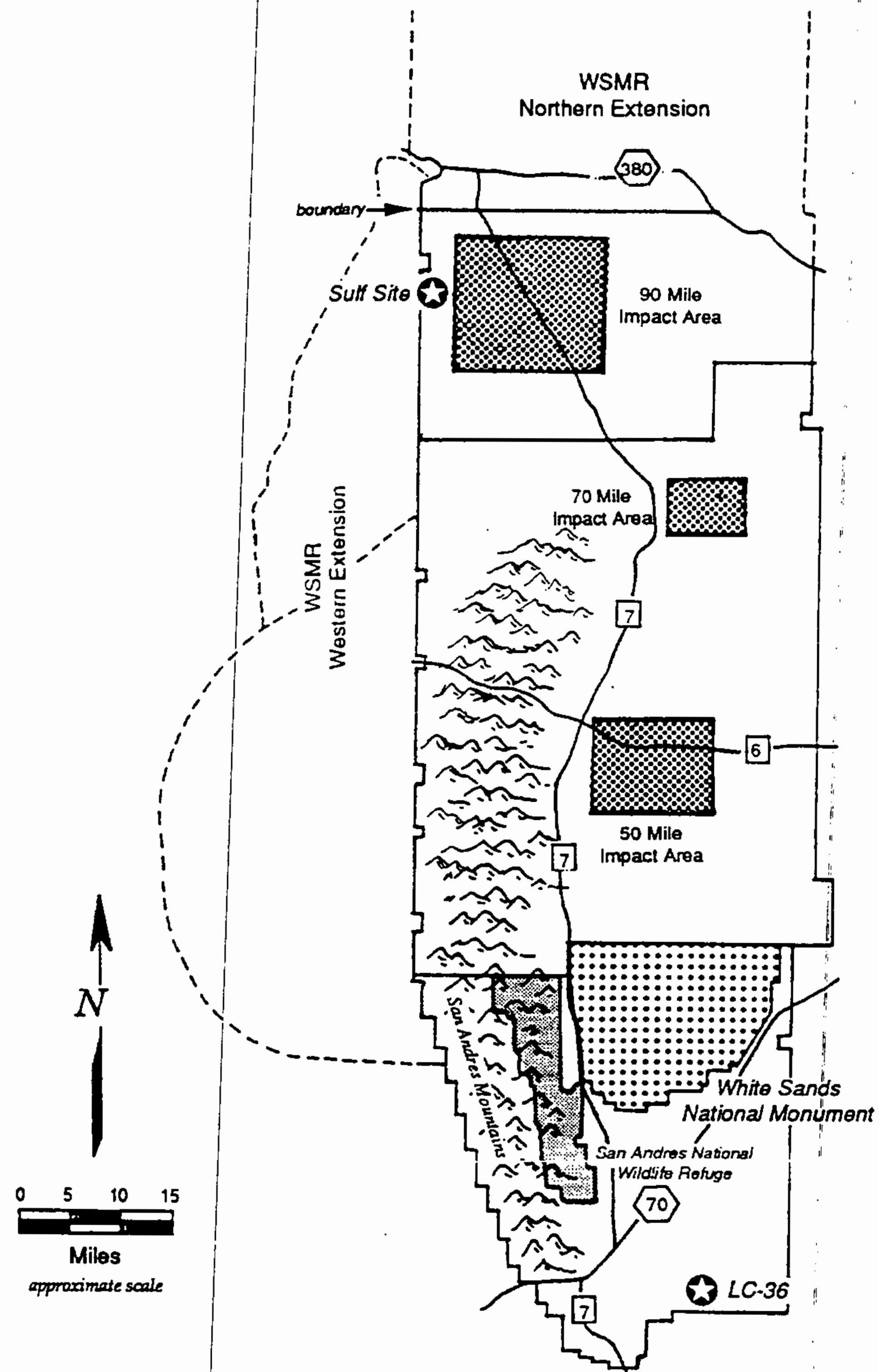
Existing facilities at Wake Island were constructed for the Starbird program for launches on a 62° launch azimuth. LEAP target flights, which will launch on a 140° launch azimuth, will use Starbird facilities (assessed in USASDC, 1987). These facilities will require modification to accommodate a different booster and launch azimuth.

Figure 5 shows the principal airfield activity areas on Wake Island and the proposed locations of new activities. Additional land for the LEAP launches will not be required because Starbird and existing base facilities will be modified to meet the programs' specifications. Mitigation measures for Starbird activities on Wake Island have already



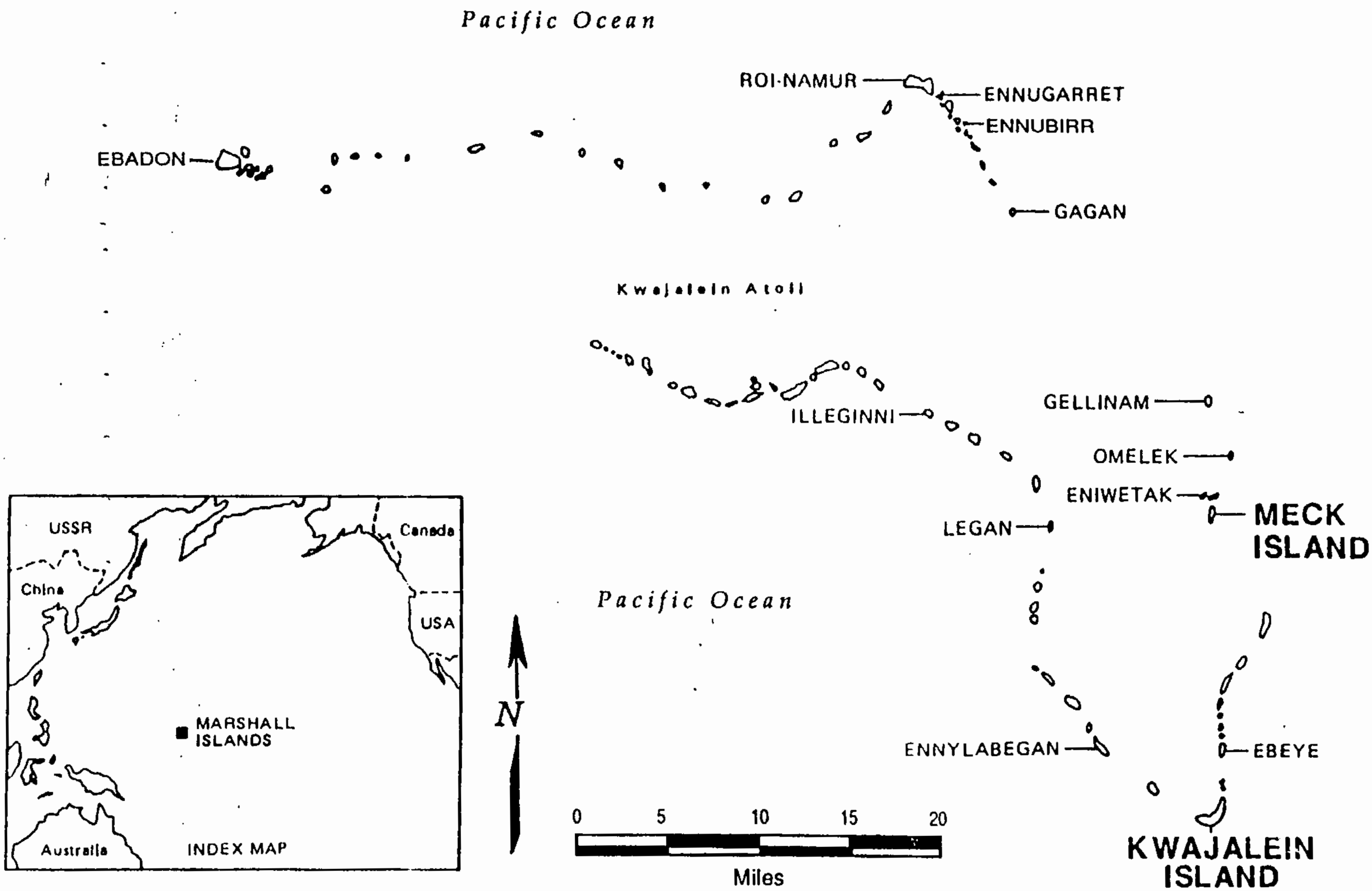
LEAP ENVIRONMENTAL ASSESSMENT	NEW MEXICO AND WHITE SANDS MISSILE RANGE

Figure 1



LEAP ENVIRONMENTAL ASSESSMENT	WHITE SANDS MISSILE RANGE

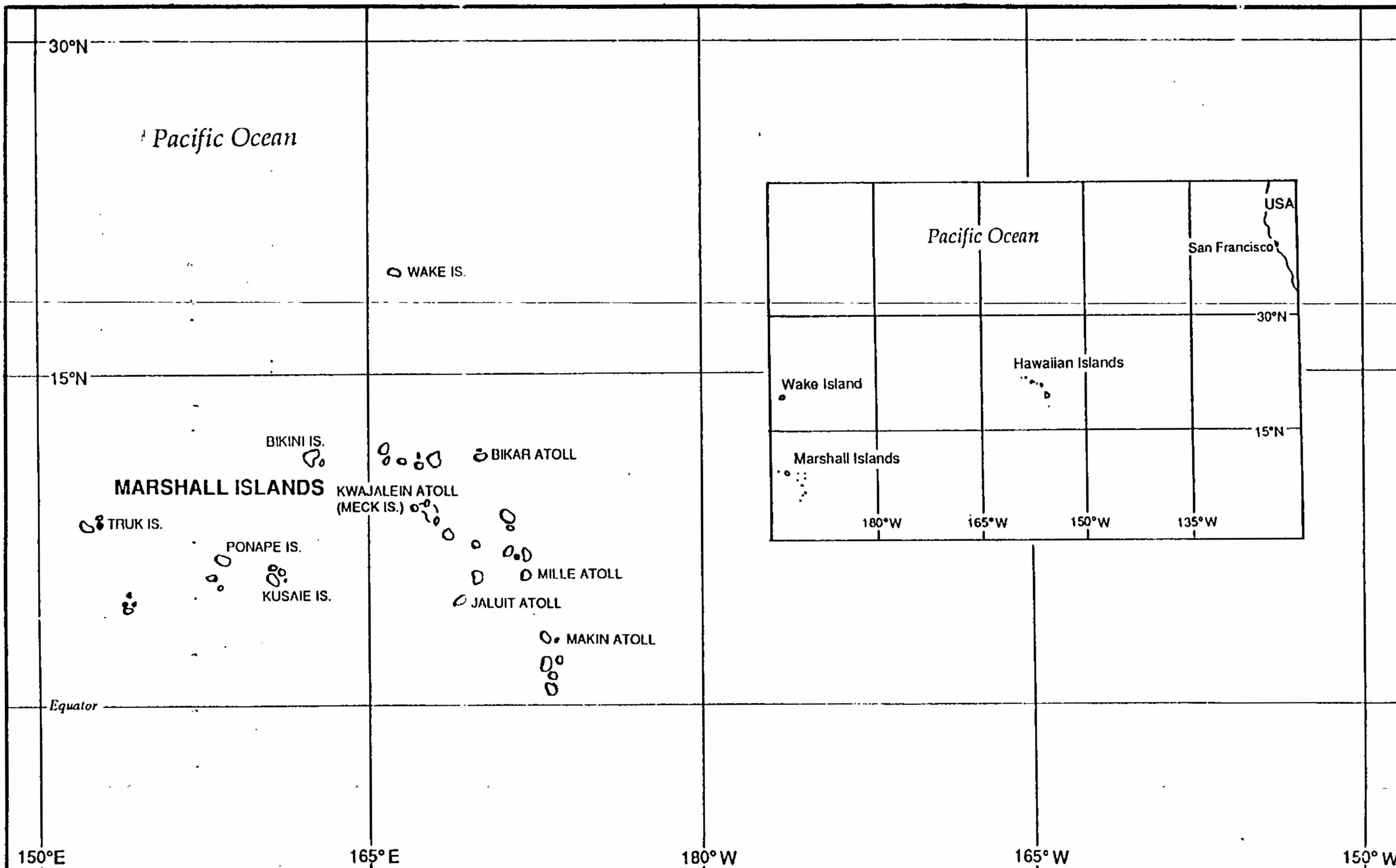
Figure 2



Source: SDIO, 1987.

LEAP ENVIRONMENTAL ASSESSMENT	KWAJALEIN ATOLL

Figure 3



LEAP ENVIRONMENTAL ASSESSMENT

LOCATION OF WAKE ISLAND

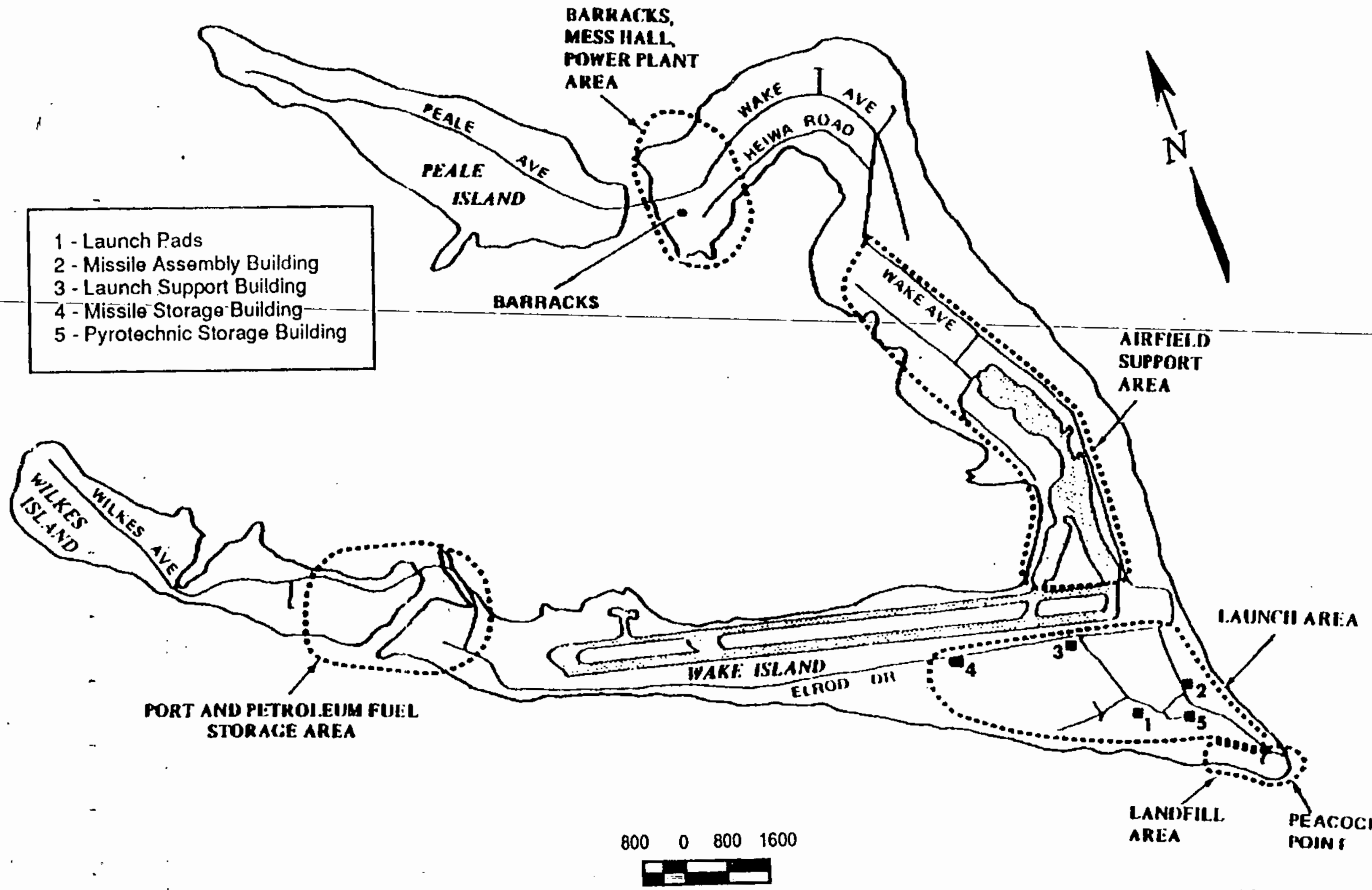
Figure 4

been adopted (USASDC, 1987) or have been agreed upon by the Advisory Council on Historic Preservation (ACHP) and the U.S. Fish and Wildlife Service (USFWS). These measures were primarily motivated by the historic stature of Wake Island's role during World War II and the possible presence of protected species on the island and in its near-shore waters. The mitigation measures require the use of existing facilities where possible, minimum disturbance of the environment, limitation on human intrusion into certain undisturbed parts of Wake Island, and specific protection and monitoring activities to minimize disturbance to cultural resources and protected species. LEAP related activities at Wake Island are similar in scope to those of the Starbird program, and as such these mitigations are incorporated into the LEAP program to protect biological and cultural resources at Wake Island.

The LEAP program activities will occur at eight facilities that were constructed, renovated, or provided for the Starbird Program: 1) Launch Pad 1; 2) the Missile Assembly Building (MAB); 3) the Launch Support Building (LSB); 4) the Missile Storage Building (MSB); 5) the Pyrotechnic Storage Building (PSB), launch control equipment at the Mobile Real Time System (MRTS) site, and the radar/telemetry sites. In addition, a Personnel Barrack will be renovated to house temporary personnel. All but the MSB, PSB, and MRTS will require modifications to support LEAP; however, these will be minor and will be conducted by the on-site operations contractor.

The Missile Assembly Building will be modified for the LEAP target flights. A thru-wall air conditioning system, requiring a "lean to" for the mechanical room, will be installed. In addition, the hibay louvers will be sealed, the bridge crane will be load tested and refurbished, and the battery room will be refurbished.

Launch Pad 1 will be modified for LEAP use. These modifications result from the change from launches to the northeast (Starbird) to launches to the southeast (LEAP). Conduits for control systems must be relocated due to the changed azimuth; therefore, cable trays and a launch equipment building (LEB) foundation must be constructed. In addition,



SOURCE: SDIO

LEAP ENVIRONMENTAL ASSESSMENT	WAKE ISLAND, WILKES ISLAND, AND PEALE ISLAND

Figure 5

lightning poles, pad conduits, pad mounted transformer switch and mechanical skids will be relocated as required. All modifications in the launch pad area will be minor and occur in areas previously disturbed for Starbird construction.

The old Wake Island Federal Aviation Administration (FAA) tower complex Building 1601 was renovated for the Starbird Launch Support Building. This renovated interior will be reconfigured for the LEAP Launch Operations Control Center (LOCC).

Temporary areas prepared for use of mobile Starbird radar/telemetry equipment are planned to be used for LEAP flights. Because of the different launch azimuth, LEAP launches may require different Radar/Telemetry Sites than the previously proposed Starbird launches. Final radar and telemetry sites for LEAP launches are to be determined; however, it is intended that sites would be located in existing clear, level areas such as roadways, parking lots, or other areas that have been previously cleared and graded. Based on site reconnaissance, it is expected that such sites can be found and that no ground disturbance activities will be required. Radar/telemetry sites would be expected to be less than 0.25 acre in size.

If radar/telemetry sites are required to be located on Wilkes Island (Figure 5), nesting habitat of seabirds could be adversely affected by the proximity of the sites. However, mitigations adopted for the STARBIRD program will be used to minimize disturbances in these areas.

One existing Personnel Barrack (Building 1172 or 1173) will be renovated for the LEAP launches, requiring rework of the interior, which is in disrepair, and modest exterior renovations.

1.2.3 Component/Assembly Ground Test Activities

To support the LEAP Program, various ground tests will occur at contractor and Government facilities in the continental United States. The following discussion presents an overview of these ground test activities and the locations at which they occur (Table 1).

1.2.3.1 Boeing Aerospace & Electronics (BAE), Kent, Washington

BAE, located in Kent, Washington near Seattle, is responsible for the design, fabrication, inspection, assembly, interface tests, and integration of the LEAP projectile, including its avionics unit. This includes inspection and Air Force interface tests. Additionally, BAE will be involved in monitoring the vehicle assembled by SDD.

Existing areas at BAE will be used for the production of the Air Force LEAP components, component/assembly testing, and integration. These activities will occur in an existing facility that requires no modification or refurbishment. No additional personnel will be required to support LEAP activities. BAE has confirmed compliance with the Clean Air Act, the Clean Water Act, and other relevant Federal, state, and local regulations (Arbuckle, 1991).

1.2.3.2 Hughes Aircraft Company (HAC), Missiles Systems Group, Canoga Park, California

Hughes provides system level tests and integration of the Army LEAP projectile, integration of the auxiliary equipment and the LEAP, and tests of the auxiliary equipment in the LEAP prior to shipment to SDD. These are routine activities at Hughes. Component and assembly tests at Hughes include checkout of the LEAP auxiliary equipment, which consists of power supplies and auxiliary cryogenic refrigeration, and pre-shipment tests of the auxiliary equipment and the LEAP projectile.

TABLE 1

LEAP TEST PROGRAM

LEAP	PLANNED LAUNCH DATE	LOCATIONS	TEST ACTIVITY	COMPONENT ASSEMBLY	PREFLIGHT FLIGHT
		Boeing Aerospace & Electronics Kent, Washington	Air Force Projectile Production Assembly Testing, Integration	X	
		Hughes Aircraft Company-Missile Systems Group, Canoga Park, CA	Army LEAP Projectile Production, Component/Assembly Testing, Integration	X	
		Space Data Division Chandler, AZ	Production of Launch Vehicle Components; Component/Assembly Testing; Component Integration	X	
		Phillips Laboratory Edwards AFB, CA	Component/Assembly Testing and Integration; LEAP Projectile Hover Testing	X	
1	July 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
2	Aug 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
3	Nov 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
4	FY92/93	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
5	FY92/93	U.S. Army Kwajalein Atoll, Marshall Islands, Wake Island	Integration and Checkout; Flight Test		X
6	FY93	U.S. Army Kwajalein Atoll, Marshall Islands, Wake Island	Integration and Checkout; Flight Test		X

No additional personnel will be required to support LEAP activities. The LEAP activities will occur in an existing facility that requires no modification or refurbishment. Hughes has all applicable Federal, state, and local permits and authorizations necessary for current operations (Smith, 1991).

1.2.3.3 Space Data Division (SDD), Orbital Sciences Corporation, Chandler, Arizona

Space Data Division provides flight test services for the integrated launch vehicles for all LEAP flight tests. At its Chandler facility, SDD is responsible for assembly, integration, and inspection of the launch vehicles including: avionics, interstage hardware and wiring, a payload module bus (PMB) that will contain the LEAP, propulsion systems, and target vehicles. SDD is also responsible for receipt, checkout, installation and integration of the LEAP projectiles with the payload bus units. They are responsible for final assembly checkout tests at the Chandler facility, and launch sites at WSMR, USAKA, and Wake Island. These final checkout tests are to determine system acceptance; basically, mechanical tests using vibration tables and thermal chambers of the primary technology elements.

Existing facilities at SDD will be used for LEAP Test Program activities and require no modification or refurbishment. No additional personnel are required to conduct LEAP related tests. SDD has all applicable Federal, state, and local permits and authorizations necessary for current operations (SDD, 1990).

Hazardous materials are managed in accordance with the Hazardous Materials Management Plan, Technical Manual (TM)-4789, dated 2 May 1990.

1.2.3.4 Phillips Laboratory, Edwards Air Force Base, California

Phillips Laboratory is responsible for acquiring and integrating vehicle hardware for the first LEAP Program flight at WSMR. Currently employed Phillips personnel will be involved in these activities. Phillips has all applicable Federal, state, and local permits and authorizations necessary for current operations (Phillips, 1990). LEAP activities at Phillips will necessitate the construction of a new facility which is described in Section 1.2.3.1.

Strap down and hover tests will be performed at the Phillips National Hover Test Facility (NHTF). A strapdown test is a standard requirement for all vehicles which pass through the NHTF. The vehicle is secured to a test bench and test fired. This test is performed as a check for flaws in the propulsion system prior to a free flight test. The hover tests involve the LEAP resting on a cradle in a netted cage. The LEAP will use an artificial target, such as a light bulb, located approximately 200 meters (656 feet) away. At Time = 0 seconds, the LEAP will acquire the artificial target, rise to a level of about 3 meters (10 ft), and hover for approximately 7 seconds using its divert thrusters. During this time LEAP will maintain a lock on the artificial target. At the end of this period, the LEAP will drop to a safety net suspended below it, ending the test.

The LEAP projectile has bi-propellant thrusters that utilize a liquid oxidizer and fuel (nitrogen tetroxide and monomethylhydrazine). The carts for handling oxidizer and fuel will be supplied by the test facility. The test facility has the necessary permits to use the various fuels and substances needed for the LEAP hover test (Phillips, 1990). LEAP hover test activities at Phillips are covered by existing environmental documentation (Phillips, 1990). The necessary permits and exemptions have been obtained for the strapdown test from the Kern County Air Pollution Control District (Paxson, 17 December 1990 in Section 4 of this report).

Rocketdyne Division of Rockwell International, Canoga Park, California, is participating in activities at Phillips, and is responsible for the design, fabrication, assembly, and integration of the first LEAP Test Program flight. Rocketdyne's activities will occur at Test Area 125 at Phillips. Currently employed Rocketdyne personnel will be involved in the LEAP Test Program activities. Rocketdyne and Phillips have all applicable Federal, state, and local permits and authorizations necessary for current operations (Phillips, 1990).

1.2.4 Preflight and Flight Test Activities

LEAP target launch preflight activities will include transporting various vehicle components, fuels, and testing equipment to the launch site. Inspection of the various components of the LEAP vehicle, assembly, and fueling operations will take place at the launch pad. Flight test activities begin at the completion of final checkout at the launch pad when the launch vehicle is turned over to launch personnel. Flight test activities include the launch, monitoring, and control of the vehicle during flight, flight safety, and retrieval of data from the flight. Preflight and flight test activities will take place at two major U.S. Government test ranges (WSMR and USAKA) and at a U.S. Government installation that has the necessary facilities (Wake Island Airfield) but is not currently staffed for rocket launches. This section outlines the details of these activities.

1.2.4.1 Flight Profiles

Currently, three types of flight experiments are planned for the LEAP Program. These include:

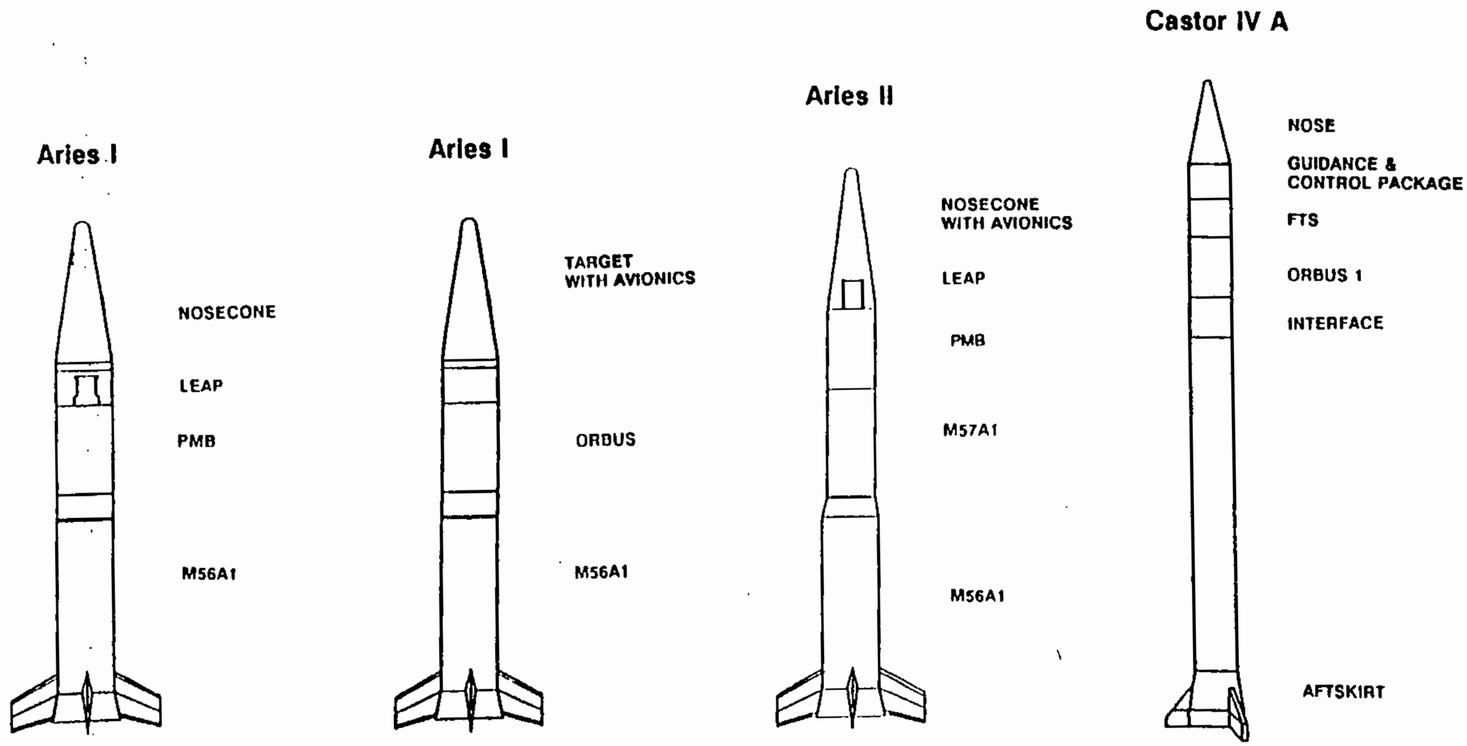
1) Mission Operations Checkout Flight (MOCF);
2) Single Rocket Launch with LEAP projectile and Target;
3) Two Rocket Launch with LEAP projectile and Target in Separate Launch Vehicles.

All three types of experiments will occur at WSMR using Aries rocket boosters. Three of the experiments will use a single stage solid fuel booster (the Checkout Flight and the Single Rocket Launch with PMB and target). A fourth experiment will be a two-rocket launch with PMB and target in separate launch vehicles. Both types of LEAP flight vehicles can be seen in Figure 6.

In addition to these flights, two LEAP flights will occur at USAKA. Both flights will be two-rocket launches with the LEAP projectile and target in separate launch vehicles. The

TWO VEHICLE MISSION

TWO VEHICLE MISSION



LEAP Launch Vehicle

WSMR

Target Launch Vehicle

WSMR

LEAP Launch Vehicle

USAKA

Target Launch Vehicle

WAKE IS.

LEAP ENVIRONMENTAL ASSESSMENT	LEAP FLIGHT VEHICLES

Figure 6

LEAP projectiles will be launched from USAKA. Two target vehicles will be launched from Wake Island. All Wake Island target launches will use a Castor IV rocket configuration (Figure 6).

LEAP vehicles at WSMR will be launched into a non-orbital trajectory by Aries boosters. All debris from the LEAP experiments is anticipated to land in the dispersion areas identified for the individual test flights. These dispersion areas are identified in Figures 7A - 7D. Debris dispersion areas for the USAKA flights are illustrated in Figure 8.

The following discussion presents more detailed descriptions of the three types of flight profiles associated with the LEAP Program and support operations which include ground tests, preflight and flight activities.

Mission Operations Checkout Flight - WSMR

The first flight profile is a mission operations checkout flight (MOCF), without LEAP hardware, to be launched from LC 36 at WSMR. Personnel requirements include approximately 25 persons for both preflight and flight activities for approximately 35 days.

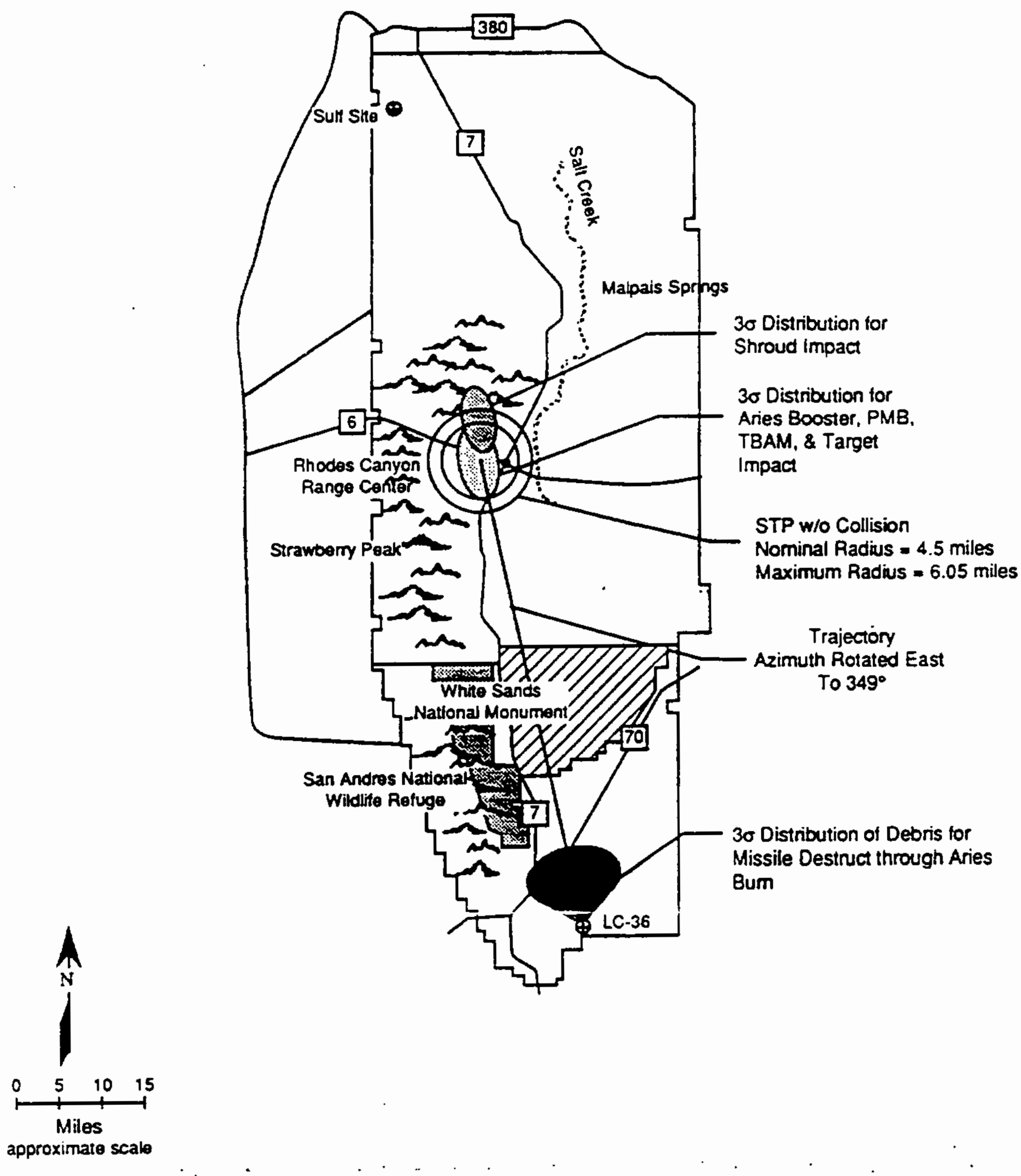
The MOCF launch vehicle is shown as Vehicle 1 in Figure 6. Its five major assemblies are:

1) an M56A1 solid-fuel rocket motor with attached interstage section;
2) a PMB;
3) a Target Boost Assist Module (TBAM);
4) a Free Flyer Observation Vehicle (a LEAP surrogate);and,
5) a Cold-body Target within a nose cone.

The PMB contains the free flyer, telemetry units, TV camera, and general support equipment. The PMB separates from the booster after reaching the exoatmospheric region.

The target, mounted to the top of the PMB, separates from the PMB at an altitude above 100 kilometers (km) (62 miles). The target vehicle contains a cold-gas nitrogen (GN_2)

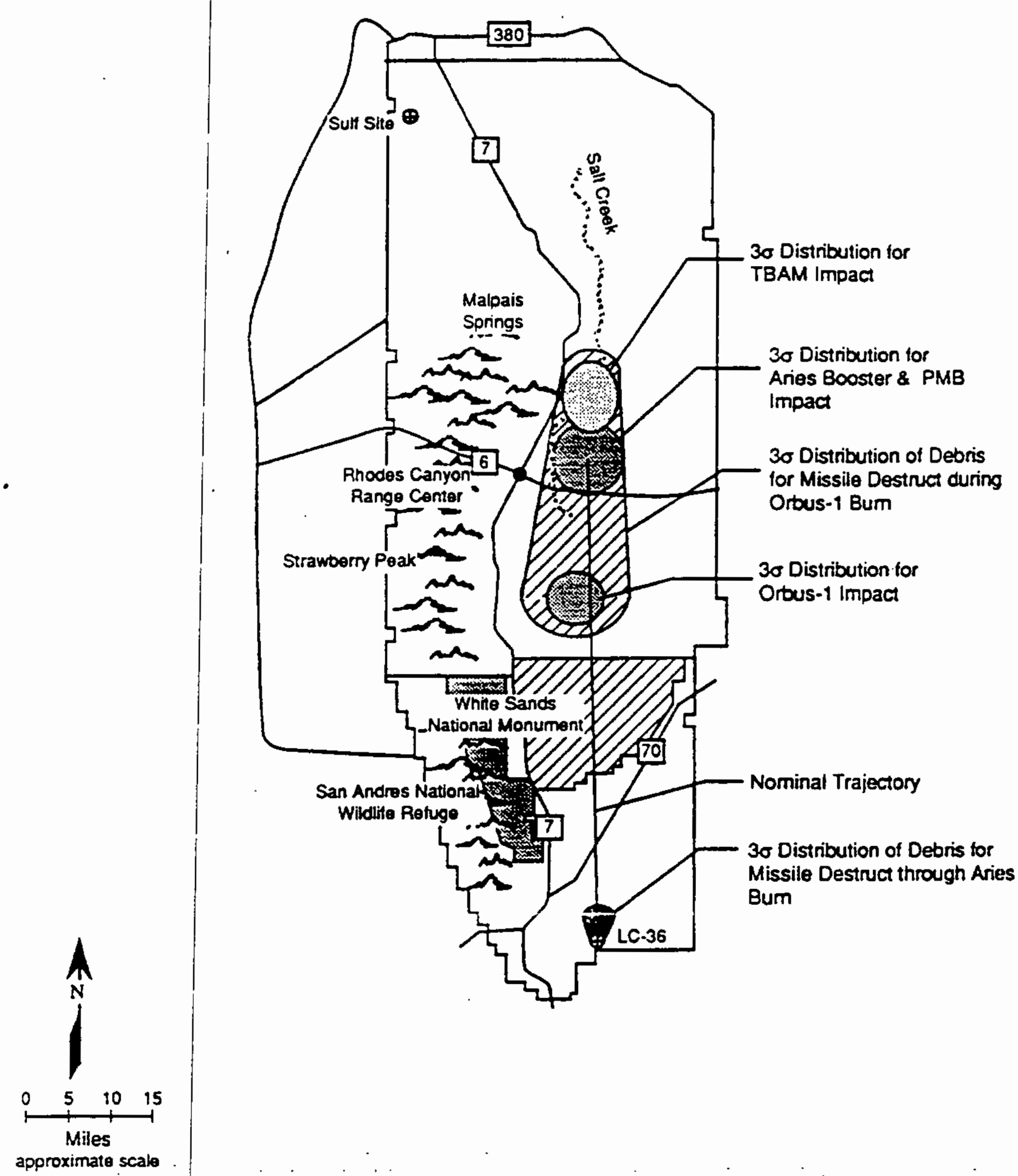
LEAP 1 & 2



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

Figure 7A

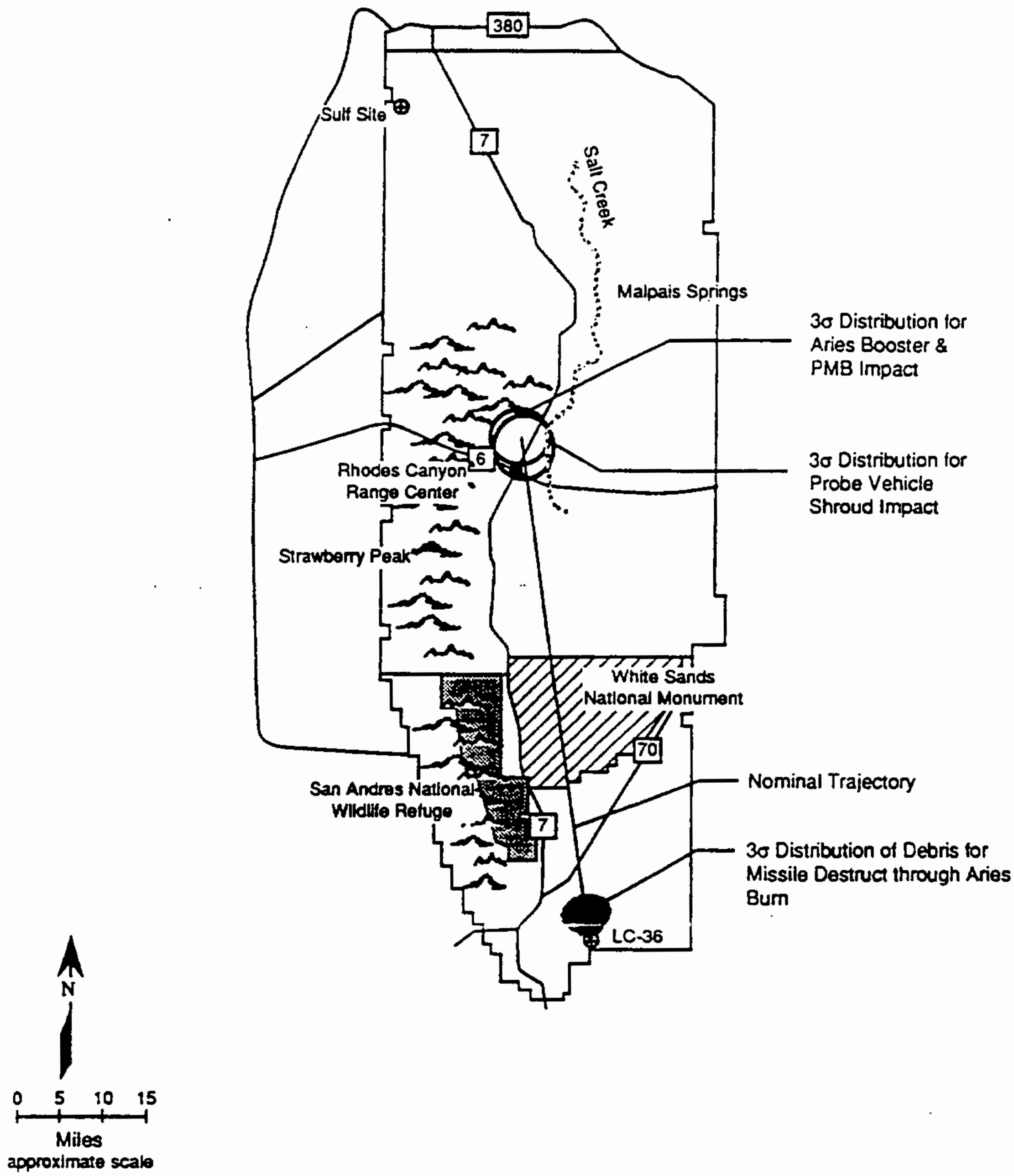
LEAP 3



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

Figure 7B

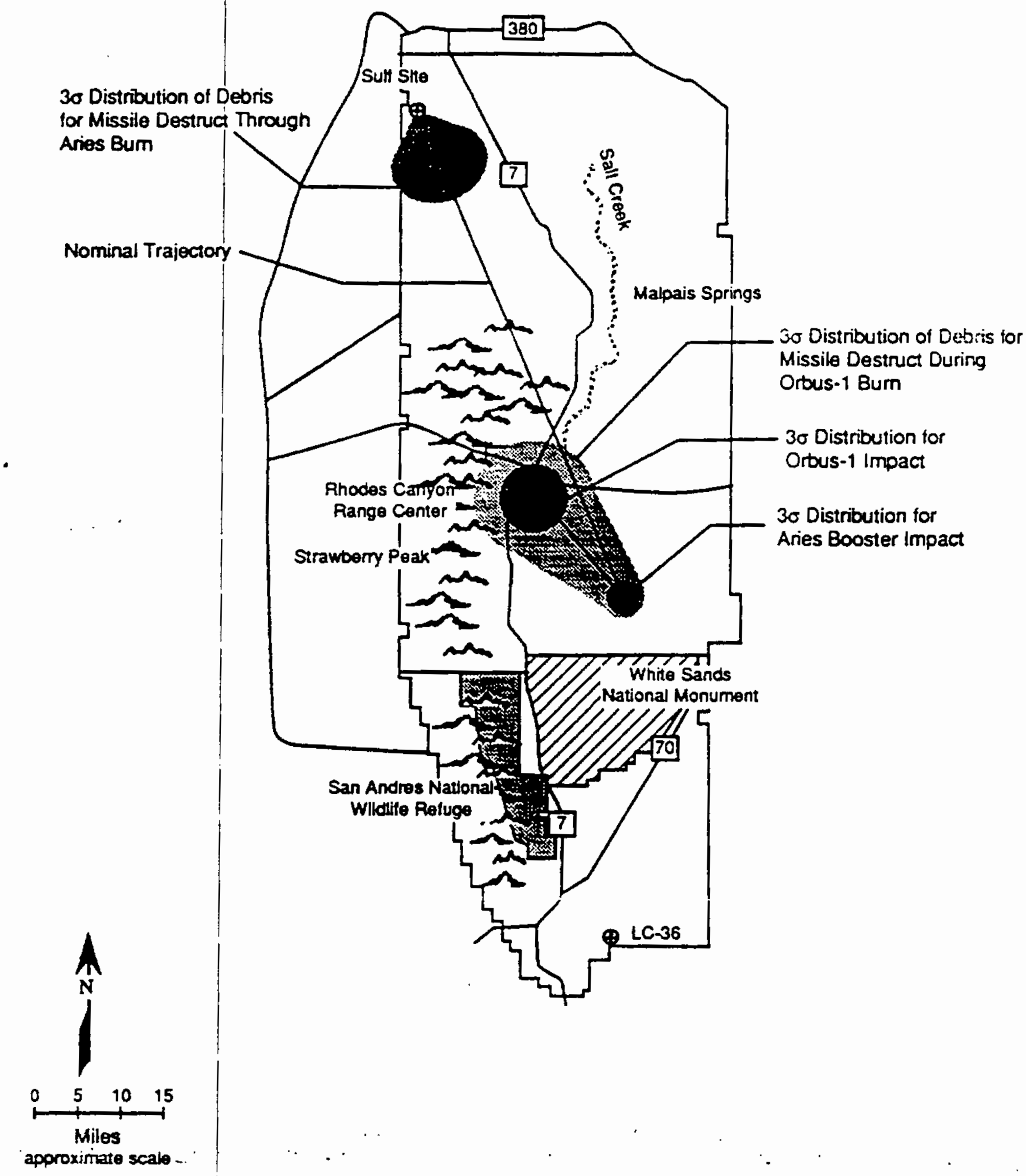
LEAP 4 PROBE LAUNCH VEHICLE



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

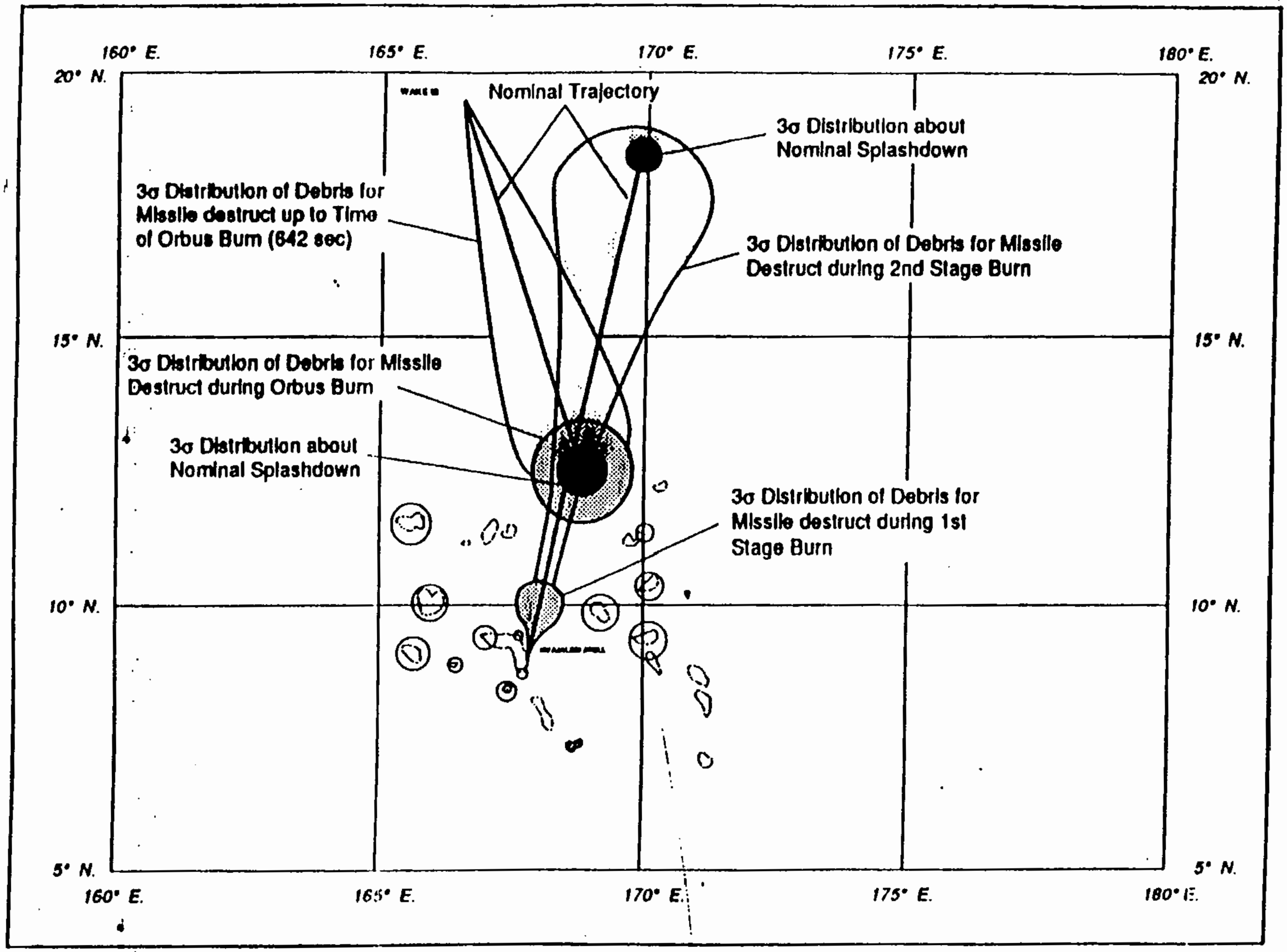
Figure 7C

LEAP 4 TARGET LAUNCH VEHICLE



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

Figure 7D



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS USAKA/WAKE ISLAND

Figure 8

attitude control-subsystem (ACS), a fast-burn solid rocket motor, a complete guidance package and a telemetry unit.

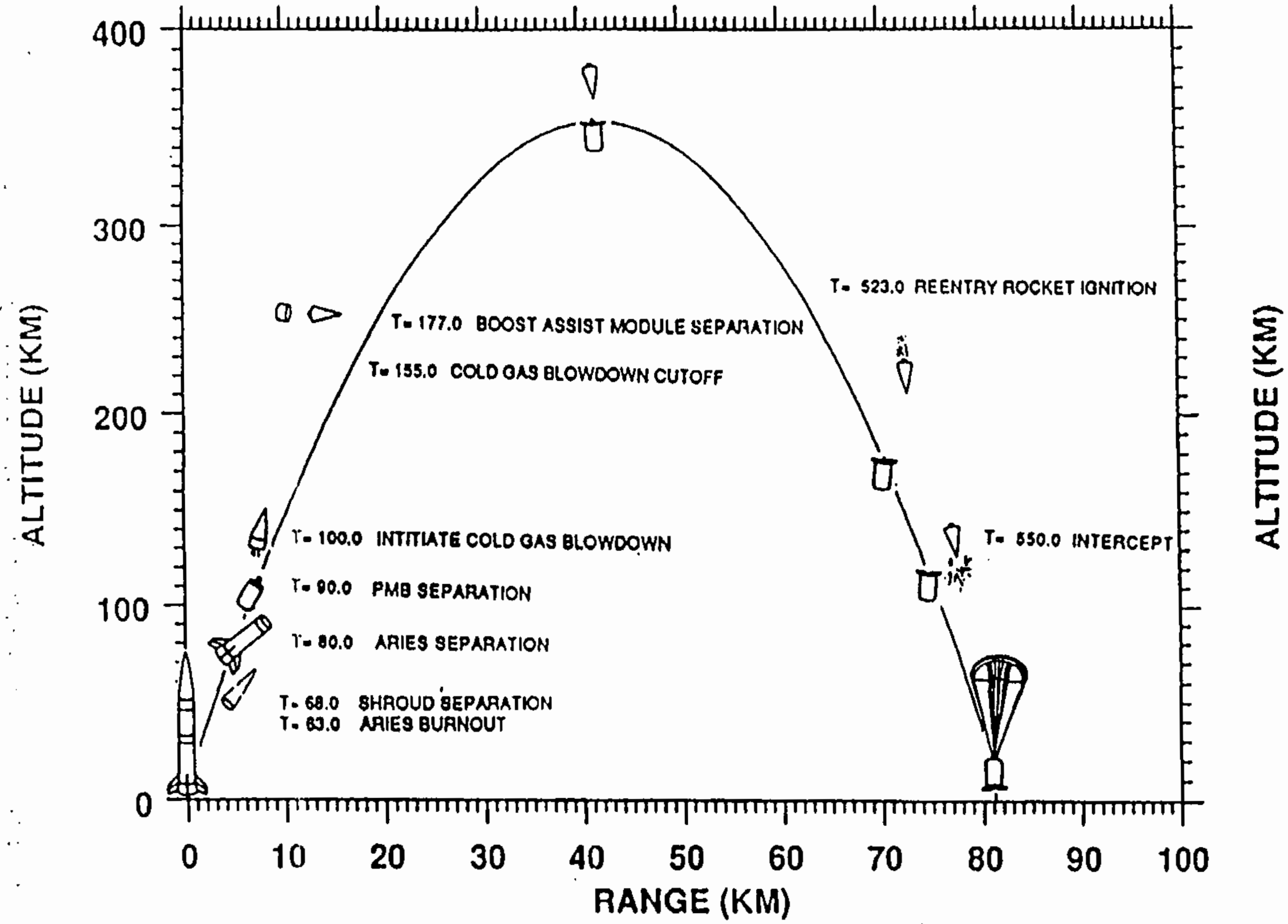
The flight profile for the MOCF is similar to that of the single rocket launch with PMB which is shown in Figure 9. The Free Flyer vehicle consists of a liquid propulsion system, using a maximum of 833 grams of nitrogen tetroxide (N_2O_4), a maximum of 504 grams of hydrazine (N_2H_4) and monomethylhydrazine (MMH), and a visible-light sensor.

The target reaches an apogee of approximately 364 km (226 miles) with apogee for the PMB at 354 km (220 miles). Thereupon, the target stabilizes for reentry and firing of the target's motor. When it reaches a re-entry altitude of approximately 195 km (121 miles), the target reentry rocket is fired. Upon burnout, and at a distance of 12 km (7 miles) between the target and the PMB, the Free Flyer is deployed from the PMB, and attempts to intercept the target. The PMB will be recovered by parachute. All debris from the experiment is expected to fall within the dispersion area illustrated in Figure 7A.

Single Rocket Launch with LEAP projectile and Target - WSMR

Two flight tests will be conducted in this test mode. In each test a single vehicle is used to launch the LEAP projectile, and target; and in each test a PMB/projectile combination and a target are placed in separate sub-orbital trajectories (Figure 9). Flight test objectives are to demonstrate the infrared seeker and guidance and control system capability to divert a Space Test Projectile (STP) to intercept a cold body target. Technological evaluation centers on the performance of the STP's Medium Wave Infrared (MWIR) sensor-seeker, its guidance and control system, and the STP's liquid bi-propellant maneuvering system. The launch vehicle for the single rocket launch flight test mode consists of the following major assemblies:

1) an M56A1 solid-fuel rocket motor with attached interstage section;
2) a PMB;
3) a LEAP projectile;



LEAP ENVIRONMENTAL ASSESSMENT	SINGLE ROCKET LAUNCH MISSION PROFILE

Figure 9

4) a target subassembly within a nose cone;
5) a target boost assist module (TBAM) using either a cold gas blowdown or a Star 13C kick motor; and,
6) a target reentry motor (Orbus-1 rocket motor or Viper V meteorological rocket motor).

Launch vehicle guidance is performed by an inertial navigation system. Both PMB and target are equipped with a cold gas attitude control system. The auxiliary equipment provides an external source of electrical power to the projectile plus cryogenic cooling (LN_2) of projectile sensors until the projectile is ejected from the PMB.

The first flight test of the single launch-vehicle mode involves the Army LEAP. Upon completion of the launch, climb, booster burnout, and target shroud release sequence, the PMB separates from the booster and deploys its target (see Figure 9). Upon separation, the target's axial cold-gas blowdown propulsion system takes it to a higher apogee than the PMB. The PMB tracks the target while maintaining a target oriented alignment.

The target, containing the Viper V rocket motor, will be fired downward to achieve an 800 meters per second (m/s) closing velocity with the LEAP projectile. At a range of about 12 km (7 miles) from the target the LEAP projectile is discharged from the PMB (this occurs after target motor burnout). The LEAP projectile then maneuvers into the target's projected flight path, and impacts the target. Propulsion for the lateral divert maneuver of the STP comes from a burn of a small quantity of liquid oxidizer (nitrogen tetroxide, N_2O_4) and fuel (hydrazine, N_2H_4) a maximum of 833 grams of N_2O_4, and a maximum of 504 grams of N_2H_4 or MMH. Upon LEAP impact with the target, both are destroyed; however, the PMB and its instrumentation are recovered by parachute. All debris from the experiment is projected to fall within the dispersion area illustrated in Figure 7A.

A second flight test in this mode (single launch vehicle) involves an experimental intercept with the same parameters as the first flight except as described below. The launch vehicle will place an Air Force developed LEAP in position to begin intercept maneuvers, and also place the target on a preprogrammed flight path. The PMB and projectile will be launched into sub-orbital trajectories.

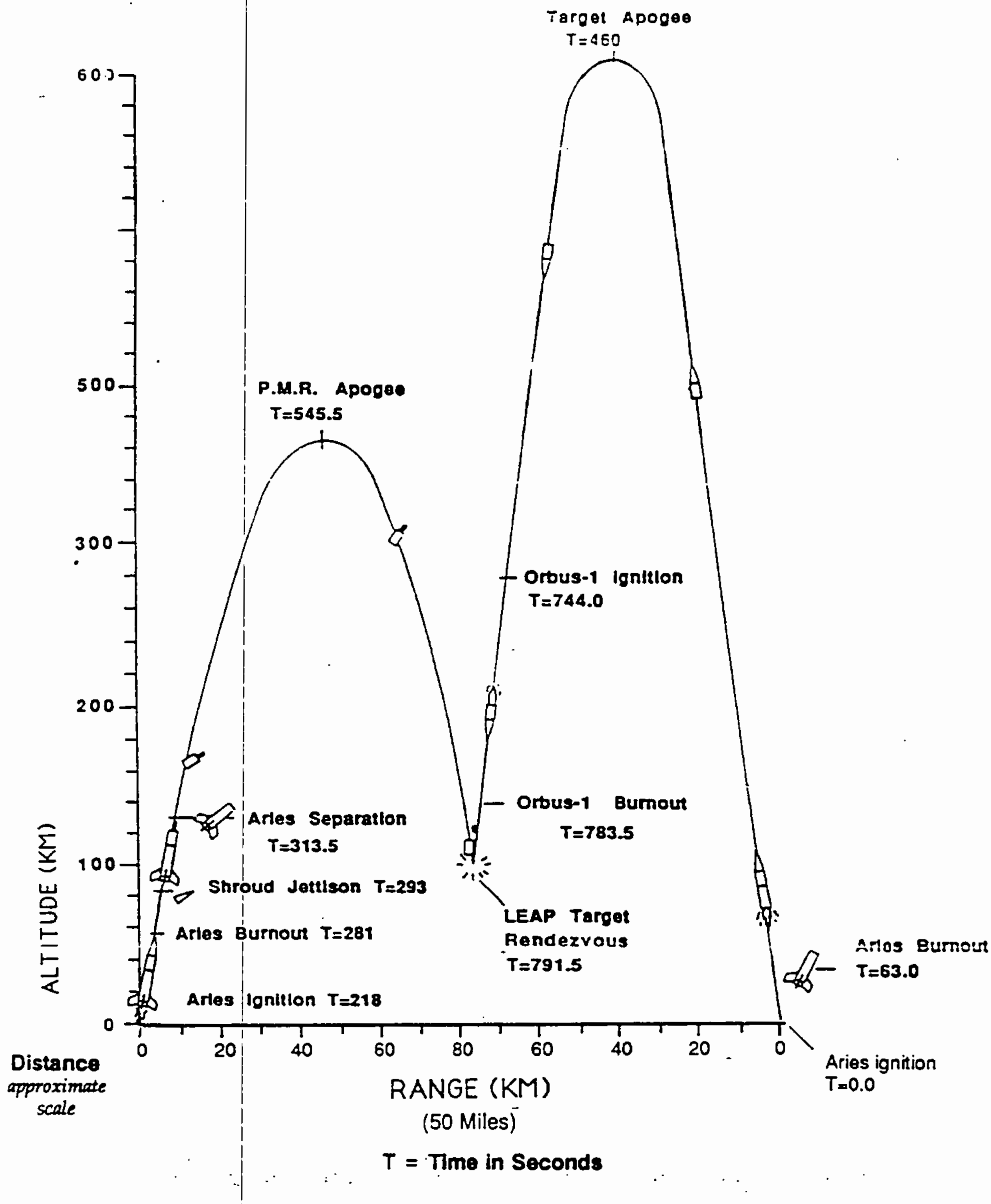
After PMB separation from the booster, the target's Star 13C kick motor will drive the target vehicle to a higher trajectory. When sufficiently downrange, the nose cone shroud is jettisoned and the Orbus-1 target motor is fired to drive the target vehicle to intersect the PMB trajectory. The projectile will be ejected from the PMB and maneuver laterally towards the target's projected flight path to intercept the target (Figure 9). Propulsion for divert maneuvers of the projectile comes from a burn of the small quantity of liquid fuel. All debris from the experiment is expected to fall within the dispersion area illustrated in Figure 7B.

Two Rocket Launch with PMB and Target in Separate Launch Vehicles - WSMR

The objectives of the flight test will be similar to those of the single rocket launch experiment in that it will track, intercept, and impact a target. However, implementation of the mission will be different because two launch vehicles are involved. One vehicle is used to place the LEAP projectile in position to begin intercept maneuvers; the other vehicle will place the target on its trajectory (Figure 6). Both vehicles will be launched from WSMR to provide the target and projectile rendezvous. The LEAP/PMB vehicle will be launched from LC 36 and the Target Vehicle from the Sulf Site launch facility (Figure 2). The two rocket launch profile is illustrated in Figure 10.

For the two rocket launch tests, four major assemblies make up the LEAP/PMB launch vehicle that will be used at WSMR:

1) an M56A1 solid-fuel rocket motor;
2) a PMB;
3) a LEAP projectile; and,
4) a nose cone.



LEAP ENVIRONMENTAL ASSESSMENT	TWO ROCKET LAUNCH MISSION PROFILE - WSMR

Figure 10

Three major assemblies make up the two rocket launch target vehicle that will be used at WSMR:

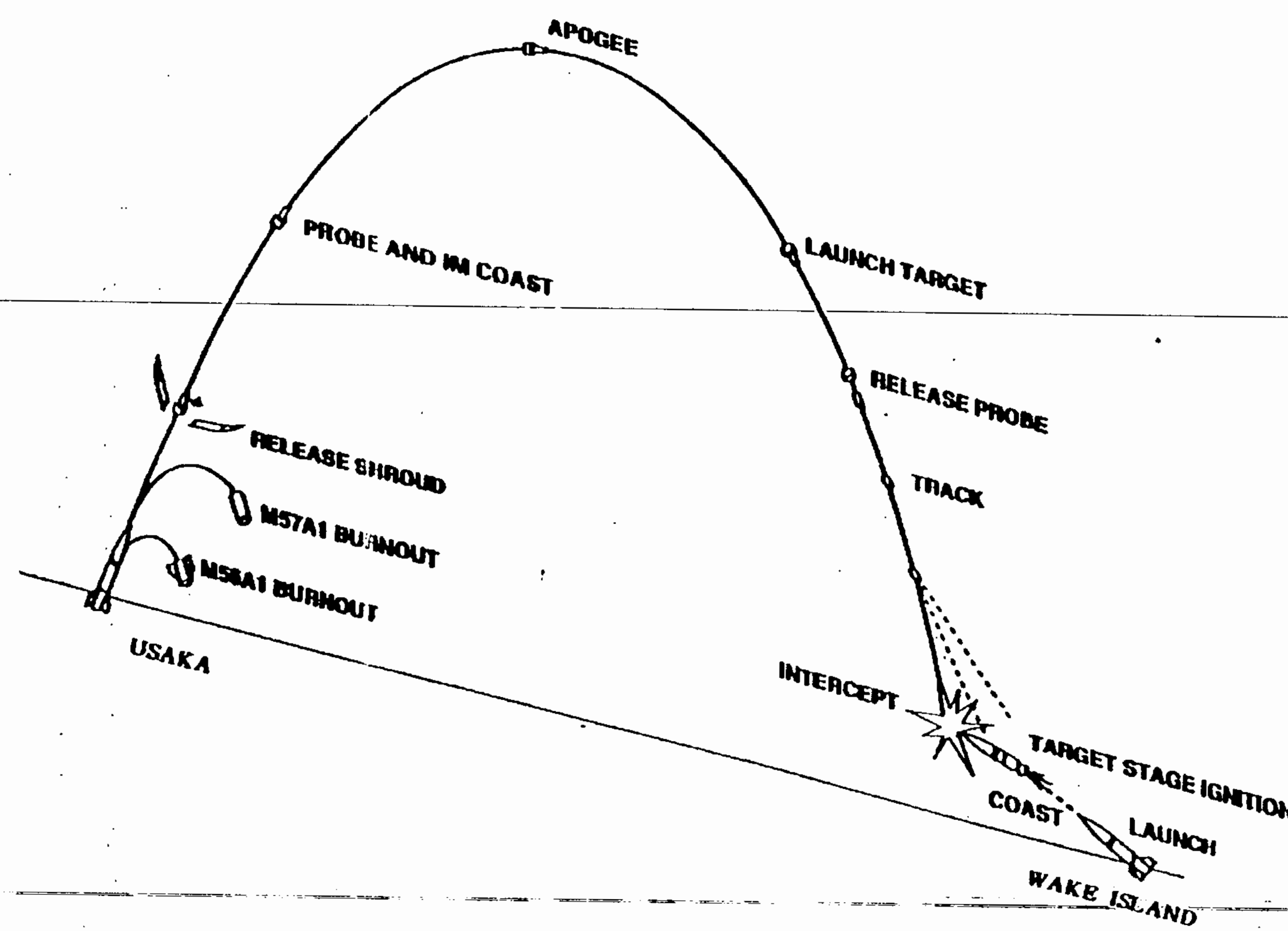
1) an M56A1 solid-fuel rocket motor;
2) a target stage powered by an Orbus-1 motor to accelerate target reentry; and,
3) a conical shaped target containing avionics.

The PMB containing the LEAP projectile will be launched from LC 36 into a sub-orbital trajectory by a single launch vehicle. Booster guidance is by an inertial unit. The PMB will separate from the booster after motor burnout and shroud release. The PMB will continue its trajectory past apogee, falling towards a target position. As the PMB acquires and tracks the target, GN_2 ACS, installed in the PMB, maintains pointing at the target.

Approximately 151 seconds after the target vehicle is launched from the Sulf Site, the Aries booster carrying the LEAP is launched from LC 36. After reaching apogee, the target's Orbus-1 motor will be fired. Approximately 142 seconds later, the STP will maneuver towards the target's projected flight path for target intercept. As in the single rocket launch experiment, propulsion for the lateral divert maneuver of the LEAP projectile comes from a burn of a small quantity of liquid propellants, (a maximum of 833 grams of N_2O_4 and a maximum of 504 grams N_2H_4). Both target and STP will be destroyed at intercept; however, the PMB and instrumentation will be recovered by parachute. Debris from the launches is projected to fall within the dispersion areas illustrated in Figures 7C and 7D.

Two Rocket Launch with PMB and Target in Separate Launch Vehicles - USAKA and Wake Island

Two launch vehicles, each launched from a different test site, are involved in this test profile. The LEAP launch vehicles will be launched from facilities at Meck Island in USAKA. The target vehicles will be launched from Wake Island, which is about 700 miles north of USAKA. Figure 11 shows a typical flight profile for this scenario.



LEAP ENVIRONMENTAL ASSESSMENT

TWO ROCKET LAUNCH MISSION PROFILE USAKA/WAKE

Figure 11

The LEAP launch vehicle to be launched from Meck Island will be an Aries II (see Figure 6). The Aries II consists of major assemblies which include:

1) an M56A1 solid-fuel rocket motor;
2) an M57A1 rocket motor;
3) a PMB;
4) a LEAP projectile; and,
5) a nose cone containing avionics.

The LEAP target vehicles to be launched from Wake Island can be seen in Figure 6. The major assemblies of the rocket include:

1) a Castor IVA rocket motor;
2) a flight termination system (FTS);
3) an Orbus 1 motor;
4) a guidance and control package; and,
5) a nose cone.

The Castor IVA solid propellant rocket motor is an improved performance version of the Castor IV motors used as strap-on boosters for the Delta launch vehicle. An earlier version of the Castor IV was used as the first stage in the Athena-H program which was also launched from Wake Island in the early 1970s.

1.2.4.2 Disassembly and Transportation

WSMR and USAKA Launch Vehicles

For the LEAP flights, five M56A1 motors, two Viper V rocket motors, two Orbus-1 motors, and one Star 13C kick motor (all using solid propellant) will be transported from government contractor facilities to WSMR. Approximately 5 liters of liquid hydrazine (N_2H_4) and 5 liters of monomethylhydrazine (MMH), both hypergolic liquids, will be transported from the National Aeronautics and Space Administration (NASA) White Sands Test Facility (WSTF) in a WSTF government truck to WSMR (a distance of approximately 15 miles) in approved U.S. Department of Transportation (DOT) DOT 3A1800 stainless steel cylinders for the LEAP launches. The cylinders do not require open loop transfer of the fuels at WSMR. Each flight will use a maximum of 504 grams (1.119 lbs) of N_2H_4 or MMH.

N_2O_4 oxidizer (nitrogen tetroxide) will be transferred from the NASA-WSTF to WSMR for these same launches in DOT 3A1800 cylinders also. Of this amount, a maximum of 833 grams (1.836 lbs) will be used. The oxidizer will be shipped separately from the hydrazine in a WSTF government truck with appropriate placarding per DOT regulations as identified in 49CFR178 and Bureau of Explosives Manual 6000. In addition, all other LEAP related components, such as the PMBs, STPs, LAEs, tools, test equipment, etc. will be shipped by truck to WSMR to support the flights (NASA WSTF, June 1991).

For the USAKA rocket launch missions, the rocket motors will be transported by military aircraft from the continental United States to USAKA. After arrival at Kwajalein Island, the motors will be transported by barge to Meck Island where the launches will take place.

For the launches at USAKA, the fuel will originate at Kelly AFB in San Antonio, Texas. The shipping process will be managed by Phillips Laboratory at Edward AFB. MMH, Hydrazine, and N_2O_4 will be shipped in 2.5 gallon stainless steel bottles (trade name HOKE) procured by Phillips Laboratory. The empty containers will be shipped to Kelly AFB in San Antonio, Texas where they will be filled with the appropriate fluid. The full containers will then be shipped by Kelly AFB to Edwards AFB in California under the DOT and BOE regulations previously identified.

Edwards AFB transportation will deliver the full containers to the point of departure for trans-ocean shipping, where USAKA support personnel will take control of the vessels. The fuels will be transferred to a barge or other approved oceangoing vessel, where they will be shipped to USAKA in accordance with BOE Manual 6000.

Once the fluids reach USAKA, a Phillips Laboratory representative will direct movement of the containers from Kwajalein Island to Meck Island. The fuels will be offloaded at the Kwajalein Island dock. They will be immediately placed upon a LCU and sent to Meck Island. There will be no interim storage on Kwajalein Island. Fuel and oxidizers will be transferred to Meck Island on separate vessels. Two LCUs will be used so that there will be no need to have the oxidizer waiting for shipment while the fuel is sent to Meck Island. Handling of the containers will be conducted by USAKA launch personnel. Once the containers have been placed in their respective storage areas, responsibility for the fluids will be assumed by the LEAP project team on the island. Currently, the storage facilities on Meck are approved by the Explosive Safety Board for volumes of 40 gallons for hydrazine/MMH and 20 gallons for Nitrogen Tetroxide.

Removal of the residual propellants to the United States will be the reverse of the above-described operation. Excess fuel and oxidizer will be shipped separately from Meck Island to Kwajalein Island via a LCU where they will be transferred to a barge for shipment to Kelly AFB via Edwards AFB.

Wake Island Launch Vehicles

Castor IVA and Orbus 1 motors will be shipped by commercial truck from Thiokol, Inc. in Huntsville, Alabama to Travis AFB, California where they will be transported by military aircraft to Wake Island. Additionally, all other LEAP components, expendables, tools, test equipment, etc., will be shipped from the continental U.S. to Wake Island by air and barge.

All materials containing solid propellant or flight ordnance will be shipped in accordance with Bureau of Explosives Tariff No. BOE-6000-1, Air Force Manuals 127-100 and 161-30, and other applicable DoD and U.S. Department of Transportation (DOT) regulations.

1.2.4.3 Assembly and Checkout

WSMR and USAKA Launch Vehicles

The launch vehicles, described in Section 1.2.5.1, are assembled and receive a check-out prior to launch. Tests of components and assemblies involve: 1) receiving, inspecting, and verifying the boosters, PMB, and LEAP hardware upon arrival at the launch location; 2) integrating, fueling, and assembling the LEAP hardware into the PMB; 3) evaluating the launch support equipment (equipment installation and checkout, calibration, and maintenance) and prelaunch data reception at a Launch Control Blockhouse; and 4) assembling the PMB, interstage, target, and boosters on the launch pad. These component/assembly tests will be conducted at existing MAB's (Building N-220 at LC 36 and the LC 36 launch pad for WSMR flights and either Building 5080 or 5098 on Meck Island for the USAKA launches). Approximately 10 additional contractor personnel will be required for these component/assembly tests, over a period of 45 days.

The LEAP projectiles are fueled with the hypergolic liquid propellant approximately 16 days before launch by NASA and Phillips personnel who routinely perform such operations and are fully qualified for safe operations. The LEAP projectiles are designed to allow LEAP personnel to work on the launch vehicles while the projectiles are fueled.

Launch pad activities for each flight will include final assembly of the missile, attachment to the launcher and launch of the rocket in support of the LEAP Program. The liquid fuel and oxidizer will be transferred to mobile fuel carts at the storage areas. The fuel carts contain all necessary storage, liquid transfer, and safety systems for transporting the liquid propellant. The fuel carts consist of on board pressurization (helium or nitrogen), a propellant scale, manifold and valve used to regulate flow, and stainless steel propellant transfer tank. The cart works in conjunction with a propellant decontamination and neutralization system that consists of water and sodium hydroxide to dilute the propellants. Liquid fueling will be accomplished in accordance with Occupation Safety and Health Administration (OSHA) guidelines for handling hazardous and toxic materials, and in accordance with Safety Standing Operating Procedures (SSOP) developed for the handling of hydrazine, monomethylhydrazine, and nitrogen tetroxide at host installations and approved by the installation Ground Safety Officer. The Safety Procedures establish responsibility for safety standards and requirements. Video surveillance and voice communication will be maintained with the Launch Operations Control Center (LOCC) throughout the fueling operation. Overall responsibility for launch pad operations resides with the installation ground safety officer, with specific responsibility for liquid propellant handling delegated to Phillips Laboratory under the direction of the host installation. Phillips Laboratory has developed Propellant Transfer Operations Procedures currently in use for the handling of the liquid bipropellants (Procedure Nos: 14697-TOP-460 and 14697-TOP-360) that will be used for the propellant fueling of the LEAP projectiles.

Any spilled fuel will be captured in a drip trap that is an integral part of the fueling cart system. The fuel would then be vacuumed up by the cart, decontaminated, and neutralized. Removal from the installation for proper disposal would occur in accordance with CERCLA and RCRA guidelines.

Wake Island Launch Vehicles

Preflight tests at Wake Island will involve: 1) receiving, inspecting, and verifying the boosters, interstages, and flight support module upon arrival at Wake Island; 2) integrating the launch vehicle stages and payloads; 3) evaluating the launch support equipment (LSE) installation and checkout, calibration, and maintenance, and prelaunch data reception at Wake Island Launch Control Center; and 4) assembling the interstages, flight support module, and other components.

Primary technical staffing to support preflight tests and launch activities at Wake will be provided by temporary assignment of Government and contractor personnel; support staffing will be provided by existing base personnel. While advance personnel will arrive at Wake approximately 105 days before launch, most personnel will arrive about 70 days before launch. Most temporary personnel are expected to depart Wake within 14 days after launch. From 100 to 125 additional personnel will be required to support the LEAP program target launches.

1.2.4.4 Launch and Range Control

WSMR and USAKA Launches

Existing Naval Ordnance Missile Test Station (NOMTS) facilities will be used to support the flight testing for LEAP launches at WSMR. NOMTS, the project sponsor at WSMR will provide: 1) program management for installation activities, 2) flight and ground safety requirements, 3) funding to the installation, 4) facilities, launcher, missile assembly, and instrumentation, 5) range coordination and documentation, and 6) conduct the flight tests.

The host installation provides the airspace, instrumentation, data collection/reduction, mission scheduling, test execution and control, flight termination system approach, and flight termination control. For flights originating at WSMR, the blockhouse at LC 36 will be used for the Launch Operation Control Center. Building 300 will be utilized for range control. Similar flights are routinely conducted from LC 36, and similar operations are regularly performed at LC 37 and Building 300. For flights launched from USAKA, the Meck Island Control Building (Building 5050) will be used for launch control. The Range Operations Control Center on Kwajalein will be utilized for range control.

Meck Island at USAKA will be used to support the Kwajalein Atoll based LEAP launches. Launch and support facilities on Meck Island have been previously constructed for the SDI program and would be used in support of the LEAP Program. These include a newly constructed missile assembly building (MAB), launch station, launch equipment room and payload assembly building, and fueling area. Rehabilitated buildings include the Meck Island Control Building (Bldg. 5050) for launch control and technical support, Launch Equipment Room (Bldg. 5070), Payload Assembly Building (Bldg. 5087), Nitrogen Tetroxide Storage Area (Bldg. 5090) and a number of other support structures used for warehousing, maintenance shops, etc. (USASDC, 1989).

Wake Island Launches

Target launches at Wake Island in support of LEAP will utilize existing launch facilities that were constructed for the Starbird program but are not currently in use. Flight test activities begin at the completion of final checkout at the launch pad, when the launch vehicle is turned over to launch personnel, and include the launch, monitoring and control of the vehicle during flight, range safety, and retrieval of data from the flight.

Launch pad activities for each flight will include the final assembly of the missile and attachment to the launcher and launch of the missile. The launch elevation will be 80 to 89 degrees with a 130 to 150-degree azimuth. A representative baseline trajectory is provided in Figure 11.

Overall responsibility for launch pad safety operations resides with the WSMR ground safety officer. Safety personnel develop ground, flight, and range safety plans and submit them to the appropriate safety offices at WSMR well in advance of the actual activities. This information is reviewed by a panel of safety personnel from interested and affected organizations. Through an iterative process, the panel develops the launch criteria for implementation by the WSMR ground and range safety officers. The safety plans, launch hazard areas, and debris analysis results are consistent with the analysis and mitigation measures identified in this document.

1.2.4.5 Ground and Flight Safety

Booster Reliability

Following is a briefing summary of the backgrounds and reliability of the solid rocket motors which will be utilized in the LEAP program.

1. Castor IVA

The Castor IVAs are used as strap-on boosters for the target launch vehicle from Wake Island. One hundred and sixty-two of the motors have been fired (static and flight) with no failures. This number of successful firings yields a reliability of 98.5% at a 90% confidence level. The Caster IVA has been in production since 1988.

2. STAR 13C

The STAR 13C was used as a vernier motor on the Titan missile system. It is no longer in production and, since the retirement of the motors, has been in storage under the cognizance of USAF/BMO. The test history is 119 static firings and 129 flights without failure for a reliability rating of 99.2% at a confidence level of 90%.

3. M56A1

The reliability of the M56A1 motor is classified. However, in 42 launches of the Aries configuration using the M56A1 there have been no failures of the motor.

4. M57A1

The M57A1 served as the third stage of the Minuteman I missile. It was produced during the 1960s. The remaining motors are in controlled storage under the cognizance of USAF/BMO. The Minuteman I missile has been flown over 100 times (operational testing and Reentry Systems Launch Program (RSLP)) with an overall missile reliability greater than 90% (actual reliability is classified).

5. ORBUS I

The Orbus I is a recently developed (1989) motor intended for use as an upper stage and target motor in a number of booster applications. The test history is as follows: four flightweight motor cases successfully tested, four flightweight nozzle assemblies successfully tested, four flightweight motors test fired, two motors qualification test (temperature, vibration, etc.) fired successfully, two flight motor successes (STARBIRD). Based on the relatively conservative design and the consistency of the test results, United Technologies has assigned a reliability point estimate of 0.994 (99%) to the motor. With the limited number of tests undertaken, the calculated demonstrated reliability is 82% at a confidence level of 80%, this is an extremely good number given that the motor is new.

6. VIPER-V

The VIPER-V motor is the newest in the long series of conservatively designed VIPER sounding rocket motors. Although similar to the earlier qualified versions, a switch to a different qualified propellant and a new liner will necessitate requalification of the motor. Two qualification firings are planned prior to the first LEAP flight. No reliability value can be assigned at the present time. Based on the past history of the VIPER family of motors, the reliability should be well above 90%.

WSMR and USAKA Launches

Flight safety is under the jurisdiction of the host installation and flight testing will not proceed if safety requirements are not met by flight vehicle design and construction. Safety parameters have been met for previous high altitude rocket launches using Aries boosters from the launch pads. For WSMR flights, safety requirements are defined by memorandum from the Operations Control Division, WSMR (NRO, 1990). These requirements cover: 1) the rocket motor system, 2) Target Vehicle, 3) Payload Module Bus, and 4) Space Test Projectile. The LEAP vehicle incorporates equipment, such as a flight termination system, to meet these requirements. Similar requirements are being defined that would apply to follow-on flight tests. Subsequent launches at USAKA require similar coordination with installation safety personnel resulting in a flight safety plan and other support range documentation (DOA, 1989).

For WSMR launches, LEAP safety personnel develop a Missile Flight Safety Operations Plan (MFSOP) in accordance with the WSMR Range Users Handbook 1990, Chapter 12 (Missile Flight Safety) and WSMR Regulation 385-17 (Flight Safety).

The flight safety plan consists of five principal elements (National Range Operations, WSMR Missile Flight Safety Operational Plan - Aries, 20 September 1988 NRO, 1988). The first, Administrative Information, identifies the test/mission, key personnel, control site, mission support, and associated support planning. The second element, Vehicle and Payload System Information identifies the vehicle and payloads to be used in the flight. Flight Termination System, the third element, describes the termination method and verification procedures/restraints. The fourth element, Test Operational Concepts, identifies the flight, test events, (e.g. communication verification), test limits (e.g. launch angle), and operating limits (when the rocket would be destroyed). The fifth element, Range Derived Requirements, identifies requirements for roadblocks and evacuation, tracking sites, command destruct links, and other requirements such as post launch data requirements.

As previously stated, LEAP flights at WSMR will be launched from LC-36. The entire range and western extension (Figure 2) will be evacuated for all LEAP flights. This plan creates an evacuation zone of about 100 miles south to north by 52 miles east to west. This plan assures compliance with the following WSMR requirements:

1. The risk of any part of the experiment hitting a non-participant must be less than 10^{-6}.
2. The risk for impacting mission essential personnel is 1×10^{-5}.
3. The risk for hitting government property on range is 1×10^{-3}.

The target launch for the fourth LEAP launch, which is launched from the Sulf Site, uses the same evacuation area as launches from LC-36. An Aries booster was launched from the Sulf Site for the EXCEDE program using these parameters.

Flight safety planning is an iterative process that is conducted throughout the period prior to the launch. For the LEAP program, this has resulted in modifications to the launch azimuth in order to increase safety parameters, resulting in the debris dispersion areas previously presented. The process has been coordinated with a panel of safety personnel from interested and affected organizations. The final plan is submitted well in advance of actual test activities.

The safety panel ensures that the flight plans meet range safety requirements and calculates the predicted flight path using reasonably foreseeable adverse wind conditions to establish the limits of the vehicle dispersion pattern. The panel uses reasonably foreseeable performance anomalies to predict the flight hazard and dispersion areas. As the designated safety official at the launch site, the range safety officer allows launch of the vehicle only when he is satisfied that all safety parameters have been met.

WSMR Range Operations monitors the trajectory from the ground in all tests. Flight safety is maintained through tracking and up-link command circuits which can terminate flights if necessary.

Flight safety planning at USAKA has been identified in the USAKA EIS. The elements identified and evaluated in the flight safety plans for USAKA include individual and property risk in the proposed flight path, safety support system requirements, trajectory and debris footprint calculations, range clearance requirements, and identification of the flight termination system (USASDC, 1989a).

Explosives Classification Each solid propellant booster contains chemicals that are categorized as explosive ordnance. The net explosive weight (NEW) of each booster is calculated to convert different hazard classes to a single class weight to determine appropriate explosive quantity safety distances. The motors to be used include the M56A1 (10,370 pounds of Class 1.3 solid propellant), M57A1 (3,657 pounds of Class 1.1 solid propellant), and Orbus 1 (912 pounds of Class 1.3 solid propellant). The explosive quantity safety distance for the LEAP launch pad is an area with a radius of 1250 feet (380 meters), based on the liquid and solid propellant converted to Class 1.3 explosive. Hazard zones are established in accordance with DoD Standard 6055.9 (DoD Ammunition and Explosive Safety Standards). Safety distances are established around storage buildings, MABs, and the launch pads. All unauthorized personnel are prevented from entering the safety clearance area. These areas are monitored during prelaunch and launch countdowns to ensure that no unauthorized personnel are within the safety areas. Launch countdown is halted until the area is cleared (SDIO, 1990).

Liquid Fuel and Oxidizer Handling For flights that involve hypergolic liquid propellants, special safety precautions are necessary to ensure that the liquid fuels and oxidizer are kept separate until vehicle launch. In the case of LEAP flights, a small quantity of liquid fuel will be used. This includes a maximum of 504 grams of N_2H_4 or MMH, and a maximum of 833 grams of N_2O_4 to be used in fueling the LEAP projectile. If uncontrolled, the resultant hypergolic mixture would result in a fire. The fuels and oxidizer are toxic to humans and must be handled in closed systems to prevent release into the environment. By using closed systems, propellants are never exposed to the atmosphere; gasses or liquids are removed by vacuuming. Containment facilities will be in place to collect any fuel or oxidizer that might spill during fueling. Liquid fueling will be performed in accordance with Safety Standing Operating Procedures (SSOP) that must be approved by the ground safety officer prior to commencement of activities. For worker safety, OSHA Level B protection will be worn by operations personnel. OSHA Level A suits will be available for use per the direction of the host installation's ground safety officer.

Any spills will be contained, collected, and stored, under the auspices of the Phillips Laboratory. The WSMR installation will coordinate off-site disposal by a licensed hazardous waste handler. Current policy at USAKA requires persons generating hazardous waste to ship it off-island for proper disposal. Special cleanup procedures will be applied to the neutralization of hydrazine during fueling/defueling and any cleanup operations will be the responsibility of Phillips. The hydrazine transfer tank will be evacuated using the closed aspirator system and purged using an inert gas such as nitrogen or helium. Any waste solution will be diluted with water, and placed in containers for contractor disposal in accordance with the RCRA regulations. Unused fuel will be returned to NASA-WSTF for storage for the WSMR flights and Kelly AFB for the USAKA flights. The oxidizer transfer tank will be purged using the aspirator system, and the oxidizer will be neutralized for disposal using sodium hydroxide (Wallace, 1990). NASA-WSTF will be responsible for removal of unused propellants from WSMR. NASA WSTF is a treatment, storage, and disposal facility for bi-propellent hazardous wastes. Phillips Laboratory will be responsible for removal of unused propellants from USAKA.

Procedures have been developed by Phillips Laboratory to govern propellant transfer operations (Phillips, July 1990). The oxidizer (N_2O_4), if inadvertently released to the environment, would form gaseous clouds; therefore, it will be uploaded in a specially designated fuel handling area. Areas around the upload sites will be monitored by sensors to detect the release of the gas, and appropriate emergency plans will be reviewed prior to any fuel handling. These procedures are routinely contained within SSOPs prepared for handling the liquid fuel. The safety procedures provide detailed operating instructions on emergency procedures, safety protection clothing and equipment, and other applicable safety requirements (Department of the Army, White Sands Missile Range Regulation 385-15, 1983). The ground safety officer will use safety plan guidelines, and wind speed and direction to determine if the operation may proceed. The upload operation will proceed only if the concentrations of an accidental release are below the 15-minute, short-term exposure limit value of 5 parts per million (ppm) or the 8-hour time-weighted average exposure limit of 3 ppm (ACGIH, 1989).

Workers will wear OSHA Level B personal protection at all times while handling the oxidizer during fueling operations.

Noise Protection Overall sound pressure levels for rocket launches can exceed 150 decibels (dBA) within 100 feet of the launch pad. To prevent damage to human hearing, personnel will be inside noise-insulated buildings or outside the flight hazard areas. Hearing protection during launches ensures that short-term noise events do not exceed the OSHA criterion of 115 dBA for 15 minutes of exposure (29 CFR 1910.95). Because rocket launches normally last less than a few minutes, no single area will be subjected to noise levels above the stated criteria (SDIO, 1990).

Wake Island Launches

LEAP safety personnel develop ground, flight, and range safety plans and submit them to the appropriate safety offices at WSMR well in advance of the actual activities. This information will be reviewed by a panel of safety personnel from interested and affected organizations (TBE, 1990). Through an iterative process, the panel develops the launch criteria for implementation by the WSMR ground and range safety officers. The safety plans, launch hazard areas, and debris analysis results are consistent with the analysis and mitigation measures identified in this document. The safety planning process follows the process as identified for WSMR launches.

The evacuation area for the Wake Island launches ensures compliance with the three WSMR requirements previously identified. The evacuation area required to meet these requirements does not necessitate evacuation from any islands. A safety keepout zone has been established to prevent aircraft from entering the evacuation area during launch activities from USAKA and Wake Island. The evacuation area runs roughly concurrent with the debris dispersion area illustrated in Figure 8. The zone is approximately 600 miles long and 300 miles wide covering an area between USAKA and Wake Island. Launch personnel remain in secure bunkers during launch activities and nonessential personnel leave Meck Island.

The safety panel ensures that the flight plans meet range safety requirements and calculates the predicted flight path using reasonably foreseeable adverse wind conditions to establish the limits of the vehicle dispersion pattern. The panel also uses reasonably foreseeable performance anomalies to predict the flight hazard and dispersion areas. As the designated safety official at the launch site, the range safety officer will launch the vehicle only when he is satisfied that critical safety parameters have been met.

1.2.5 Recovery and Decommissioning

1.2.5.1 WSMR and USAKA Launches

Recovery operations will only occur at WSMR. The LEAP and remaining debris from the USAKA launches will fall into the ocean eliminating the possibility of debris recovery. WSMR recovery operations will be in accordance with installation requirements (WSMR, 1989).

LEAP launch and support facilities will not be decommissioned as they are utilized for ongoing DoD and civilian launch activities.

1.2.5.2 Wake Island Launches

Following the completion of the LEAP activities at Wake Island, communications, launch control, and other types of equipment that do not support the permanent mission of the Wake Island airfield will be removed. Launch towers and other launch-specific above ground structures constructed for LEAP will be removed to ground level, and the site will be permitted to return to its former condition.

1.2.6 Program Mitigations

The potential for significant impacts to the various environmental media at LEAP test locations is remote. Probability analyses and safety and debris recovery procedures cited in this document demonstrate the unlikelihood of impacts to sensitive environmental resources. Routine operations procedures at WSMR, USAKA and Wake Island have been incorporated into the LEAP Test Program as mitigations in the unlikely event that these resources are affected.

1.2.6.1 WSMR

The following mitigation is designed to protect the Todsen's pennyroyal (Federal Endangered) and its habitat.

1. To minimize damage from brush fires, an airplane will be on stand-by to deliver an aerial-drop of a fire extinguishing slurry to the potential pennyroyal habitat, if a fire is reported. All fire protection activities in the potential suitable habitat will be coordinated with the Chief, Environmental and Natural Resources Division.

2. Upon receipt of information or discovery that debris landed within 400 meters of the potential habitat area, recovery personnel will immediately notify the Chief, Range Support Section. No recovery operation will be undertaken in the potential habitat area without the concurrence of the Chief, Range Support Section, Research Rockets Director NOMTS, and the Chief, Environmental and Natural Resources Division.

3. No vehicles will enter within 400 meters of potential habitat unless the Officer in Charge (OIC) or Noncommissioned Officer in Charge (NCOIC) of the recovery team has personally coordinated the matter with the Environmental Chief or his authorized representative.

4. All recovery operations will be coordinated with the Chief, Environmental and Natural Resources Division, on recovering missile debris within 400 meters of potential habitat area.

5. Prior to any excavation of missile debris at potential habitat area or outside the designated impact area, the OIC or NCOIC of the recovery team will contact the Chief, Range Support Section and Chief, Environmental and Natural Resources Division. No excavation will be conducted without an environmental representative present at the site. After the debris removal, all disturbed areas will be restored to

match the surrounding terrain. Such restoration will include the use of native plant species.

6. When necessary to prevent damage to the environment, helicopter recovery of debris will be utilized with recovery vehicles located at the nearest roadway segment. Such helicopter recovery would also be used in instances when debris recovery is necessary in areas not accessible by vehicle.

Salt Creek and Malpais Spring have been determined to be habitat for the New Mexico state endangered White Sands pupfish. The probability analysis in Section 3.3.1.6 demonstrates that there are an estimated 19 chances in 10,000 of any piece of debris from LEAP flights landing in Salt Creek or Malpais Spring. The potential for impacts to Salt Creek is therefore very remote. However, routine measures have been adopted at WSMR to protect the Salt Creek habitat. These measures have been incorporated into the LEAP Program to protect the habitat in the unlikely event that debris impacts in Salt Creek.

1. Upon receipt of information or discovery that an impact occurred within 400 meters of Salt Creek, recovery personnel will immediately notify the Chief, Range Support Section. No recovery operation will be undertaken in the Salt Creek area without the concurrence of the Chief, Range Support Section, Research Rockets Director NOMTS, and the Chief, Environmental and Natural Resources Division.

2. No vehicles will enter within 400 meters of Salt Creek unless the Officer in Charge (OIC) or Noncommissioned Officer in Charge (NCOIC) of the recovery team has personally coordinated the matter with the Environmental Chief or his authorized representative.

3. All recovery operations will be coordinated with the Chief, Environmental and Natural Resources Division, on recovering missile debris within 400 meters of Salt Creek.

4. Prior to any excavation of missile debris at Salt Creek or outside the designated impact area, the OIC or NCOIC of the recovery team will contact the Chief, Range Support Section and Chief, Environmental and Natural Resources Division. No excavation will be conducted without an environmental representative present at the site. After the debris removal, all disturbed areas will be restored to match the surrounding terrain. Such restoration will include the use of native plant species.

The following mitigation is designed to protect cultural resources at WSMR.

1. Upon receipt of information or discovery that an impact occurred outside the designated impact area, the recovery personnel will conduct a survey for any artifacts in the vicinity of the debris. If any artifacts are discovered, they will not be disturbed and the Chief, Range Support Section and Chief, Environmental and Natural Resources Division will be notified.

2. When necessary to prevent damage to the environment, helicopter recovery of debris will be utilized with recovery vehicles located at the nearest roadway segment. Such helicopter recovery would also be used in instances when debris recovery is necessary in areas not accessible by vehicle.

3. Should a cultural resource be uncovered as a result of debris impact, a decision to excavate or cover the material will be made jointly by the WSMR Environmental Office, NOMTS, and SDIO in accordance with the PMOA described in Section 3.3.1.7.

The following mitigation is designed to protect the desert bighorn sheep (state Endangered) and its habitat.

1. No debris recovery will be undertaken near Strawberry Peak, by helicopter or vehicle, when Desert bighorn sheep are in the area.

2. All recovery operations within Desert bighorn sheep habitat will be coordinated with the Refuge Manager, U.S. Fish and Wildlife Service, San Andres National Wildlife Refuge.

1.2.6.2 USAKA

1. All LEAP Test Program Activities will be conducted within the scope of the USAKA Record of Decision (ROD), December 4, 1989, unless otherwise noted within the document.

2. The LEAP Program office will be responsible for the removal of all hazardous materials and wastes generated by the LEAP Test Program.

1.2.6.3 Wake Island

The following mitigation measure will be implemented to minimize adverse impacts to existing wildlife on Wake Island as a result of the location of radar sites.

1. Selection of alternative sites that are environmentally acceptable, (i.e., not located near nesting habitat). The specific sites will be agreed upon between LEAP program officials and the USFWS in response to wildlife activity in the area immediately prior to placement of the portable radar/telemetry equipment.

1.3 NO ACTION

The no-action alternative for LEAP is to not continue the LEAP Program. Additional flights associated with LEAP would not occur at WSMR, USAKA, and Wake Island installations.

1.4 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

An extensive analysis was conducted to evaluate potential alternatives in support of the LEAP Test Program, including alternatives to the boosters and launch test ranges as described in previous sections. The process included identifying the boosters which met program specifications and identifying those ranges that could support mission requirements (Table 2). All LEAP test flights have been reviewed by the Treaty Compliance Review Group. The group has required that the third, fourth, fifth, and sixth LEAP test flights be flown from either WSMR or USAKA, which are ABM designated ranges. After consideration of the sixteen booster configurations found in Table 3, only the Aries I, Aries II, and the Castor IVA were found to be acceptable. Boosters which were considered but not included in the program are identified in Section 1.4.1. Test ranges which were considered but not included in the program are identified in Section 1.4.2.

1.4.1 Alternative Launch Vehicles

Detailed studies were performed to select the appropriate launch vehicle to support LEAP test flights. Critical factors in the booster selection process included weight, diameter, performance characteristics (including reliability), availability, and compatibility with various test ranges. Boosters considered for the LEAP Test Program are shown in Table 3.

The Black Brant and Aries I boosters were the only two boosters to meet the program requirement of being compatible with launching from WSMR. Both boosters have previously been flown from WSMR. However, the Black Brant booster has a 17 inch diameter, compared to the 48 inch diameter of the Aries. The necessary booster width to accommodate the LEAP payload is designated as 40 inches. The Black Brant, therefore, does not meet program specifications and was dropped from further consideration.

The analysis for booster performance was also applied to LEAP projectile launches from USAKA. For the reasons cited above, the Aries I and Aries II boosters were chosen over other alternatives. A detailed analysis was performed to guide booster selection for the

			Sargeant & M57A1 Talos/M57A1	
3	Boosting Solid (Orbus) Intercept Vc - 1.5 km/s	WSMR← KMR	Aries I BBVc Castor I Sargeant & M57A1 Talos/M57A1	Cost, ABM Treaty Requirements/Availability Consistency, Guidance Accuracy, WSMR Qualified
4	Cold Body Intercept Vc - 3 Km/s TBM-Type Tgt (Orbus)	WSMR← KMR	Aries I BBVc Castor I Sargeant & M57A1 Aries II Castor II Castor IVA Pegasus (1st Stage) Talos/M57A1	Cost, ABM Treaty Requirements/Availability Guidance Accuracy, WSMR Qualified (Aries I), No 50k Rail at WSMR (for Castor IVA)
5	Boosting Solid (Orbus) Intercept Vc ≥ 5 km/s Test Alas	WSMR← KMR	Aries II← MMI Pegasus (1st Stage) Castor IVA Castor IVB	Large Area, 50k Rail Launcher, ABM Treaty Requirements/Aries II: Range, Velocity, Guidance, Castor IVA; Availability, Range Velocity, Reliability
6	Boosting Solid (Orbus) Intercept Vc ≥ 5 km/s Test Alas	WSMR← KMR	Aries II← MMI Pegasus (1st Stage) Castor IVA Castor IVB	Large Area, 50k Rail Launcher, ABM Treaty Requirements/Aries II: Range, Velocity, Guidance, Castor IVA; Availability, Range Velocity, Reliability

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JSAKA is the ideal test range

JSAKA requires that the target
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be launched (ANSER, 1991).
and is summarized in Table 4.
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TABLE 3 - SELECTED BOOSTER DATA FOR LEAP STUDIES

Booster(s)	Government Surplus/ Manufacturer	Reserved[1] Total Surplus	Delivery Delay After Order	Weight (lbs)	Diameter (in)	WSMR KMR Qualified	V_{80}[2] (km/s)	Apogee[2] (km)
Alcor I	Surplus	1/4	N/A	1,000	20.5	No	--	--
Antares II	Surplus	0/2	N/A	2,785	30.3	No	--	--
Aries I (M56A1)	Surplus	40/62	N/A	11,400	48.0	Both	3.0	575
Aries II (M56A1 & M57A 1)	Surplus	1/5	N/A	16,900	48/38	KMR	3.6	975
BE 3	Hercules (Sandia Owned)	2/2	N/A	214	19	No	--	--
Black Brant VC	Bristol Aerospace (SDIO Owned)	1/8	1 yr	2,819	17	WSMR	1.8	180
Castor I	Thiokol (Sandia Owned)	N/A	16 mo.	8,746	31	KMR	2.2	300
Castor II	Thiokol	N/A	1 yr.	9,525	31	KMR	2.7	440
Castor IVA	Thiokol	N/A	18 mo.	25,562	40	KMR	3.8	960
Castor IVB	Thiokol	0/13	N/A	4,108	19/38	No	4.1	1040
Sargeant & M57A1	Surplus	N/A	12-14 mo.	22,138	40.1	KMR	2.1	303
Pegasus (2nd Stage)	Hercules	N/A	12-14 mo.	3,632	39.7	No	2.6	440
Pegasus (2nd & 3rd Stages)	Hercules	N/A	12-14 mo.	4,629	40.1	No	2.3	453
Pegasus (1st Stage)	Hercules	N/A	12-14 mo.	14,113	56	No	4.4	1329
Stars (Polaris A3 & Orbus I)	USA/SDC-Owned	13/60	N/A	36,113	44.4	No	N/A	N/A
Talos & M57A1	Surplus	N/A	N/A	5,937	38(31)	KMR	2.1	296

(1) Boosters Committed to other Programs/Total Government Owned as of 27 Mar 1990

(2) V_{80} and apogee are for a trajectory which would impact about 80 km if fired at about 348° asimuth with a 400 kg payload. No entry is made if this payload cannot be lifted 80 km or achieve a $V_{80} \geq 1.5$ km/sec.

LEAP target launches. The Castor IVA booster was chosen, and as such will serve as the target vehicle booster for Wake Island launches.

1.4.2 Alternative Launch Locations

The evaluation criteria for range selection included treaty considerations, facilities, range safety, range area, cost, scheduling, and capability to satisfy mission requirements. A major factor in the first two LEAP test flights is to gather high resolution, accurate radar and telemetry data that can be used to fully characterize the LEAP target vehicle's performance. After a preliminary review of existing test ranges, the analysis was narrowed to include Poker Flats, Wallops Island, White Sands Missile Range, and U.S. Army Kwajalein Atoll (USAKA). As was previously stated, the Treaty Compliance Group has required the third through sixth flights to be flown from WSMR or USAKA. For reasons of minimizing cost and maximizing program coordination, flights one and two were also limited to those two ranges.

For the first four LEAP test flights, WSMR has the capability to support the mission requirements, which includes accommodating closing velocities of up to 2.0 km/sec. The fourth LEAP flight stresses the range area and geometry to the maximum envelope. The physical boundaries of WSMR do not accommodate the parameters, including higher closing velocities and acquisition ranges, for the fifth and sixth LEAP test flights. In light of the physical parameters, and ABM Treaty requirements, USAKA is the ideal test range available to support the fifth and sixth LEAP test flights.

Launching LEAP intercept vehicles from Meck Island at USAKA requires that the target vehicles be launched from a separate location. A study was performed to identify alternative ranges from which LEAP target vehicles could be launched (ANSER, 1991). The study included an analysis of 11 different launch sites, and is summarized in Table 4. Each of the 11 alternative sites was given a rank score from one to four. Of the eleven alternatives, only Wake Island received a score of one.

TABLE 4 - LEAP RANGE STUDY FOR TARGET LAUNCH VEHICLE

LAUNCH SITE	TARGET VEHICLE EVALUATED	SATISFY MISSION REQUIREMENTS	RANGE FACILITIES CURRENT/PLANNED	COST	COMMENTS	OVERALL EVALUATION
ROI NAMUR	• TALOS/ARIES/ORBUS • STRYPI XII/ORBUS	• MARGINAL	• HAS RAIL LAUNCHER • AND RANGE OPS CENTER	LOW	*• NO GUIDED LAUNCH VEHICLES ALLOWED DUE TO PROXIMITY TO KREMS RADAR	4
MIDWAY	• CASTOR IVA/ORBUS • MINUTEMAN II	• MARGINAL • YES	*• NO LAUNCH CAPABILITY	HIGH	• ENVIRONMENTAL • NO LAUNCH FACILITIES EXIST	3
JOHNSTON ISLAND	• CASTOR IVA/ORBUS	• YES	*• ONLY VEHICLE STORAGE, ASSEMBLY, LAUNCH CONTROL FACILITIES EXIST BUT MOTHBALLED IN POOR CONDITION		• USED IN 1960S FOR THOR MOTORS, ISSUES INCLUDE CHEMICAL AGENTS STORED THERE AND CONTAMINATION OF THOR AREA.	3
OMELEK/ ISLAND	• TALOS/ARIES/ORBUS • STRYPI XII/ORBUS	• MARGINAL	• LAUNCH METEOROLOGICAL ROCKETS. HAVE ONLY A 5K LAUNCHER	•HIGH	• ISLAND SMALL, CURRENTLY USED FOR MET ROCKETS. *• DISPERSION ERRORS AND RANGE SAFETY MAJOR ISSUES	3
ILLEGINNI	• TALOS/ARIES	• MARGINAL	• USED FOR SAFEGUARD PROGRAM *• ALL LAUNCH CAPABILITY HAS BEEN REMOVED	•HIGH	*• ISLAND IS DESIGNATED AS TARGET AREA FOR SAC AND HAS BEEN INSTRUMENTED ACCORDINGLY	3
WAKE ISLAND	• CASTOR/IVA/ORBUS	*• YES	*• LAUNCH PADS AVAILABLE • LAUNCHER COMPLETED, • BUILDINGS AVAILABLE, GSE EXISTS AT SDD	*MEDIUM	*• CAPABILITY TO SUPPORT PEOPLE ON ISLAND • FUEL STORAGE, BUNKERS AVAILABLE • ALL SPFE HARDWARE PLANNING EFFORTS HAVE BASELINED WAKE FOR OVER 2 YRS. OPTIMAL GEOMETRY FOR MISSION	1
VANDENBERG	• MMI	*• NO	• FULLY CAPABLE	MEDIUM	*• REQUIRES ICBM MISSION	3
SHEMYA	• MMI • CASTOR IVA/ STAR37/ORBUS	• YES • MARGINAL	*• NONE AVAILABLE	*HIGH	• REQUIRES LARGE BOOSTERS DUE TO EXTENDED RANGE • NOT PRACTICAL TO INSTALL	3
SUBMARINE LAUNCH	POLARIS/ TRIDENT	YES	SELF CONTAINED ON-BOARD SUBMARINE	*HIGH	SCHEDULE AND COSTS ASSOCIATED WITH NAVY ARE NOT FEASIBLE, NAVY RESPONDS TO OPERATIONAL JCS REQUIREMENTS • NO U.S. POLARIS CAPABILITY (ONLY U.K.)	4
AIR LAUNCHED	PEGASUS	YES	OSC HAS PROPOSAL TO MODIFY L1011 AIRCRAFT	MEDIUM	• LANDING STRIP FOR L1011 IS *• EARLIEST EXPECTED CAPABILITY IS LATE 1933	3 NOTE
WSMR/ GREEN RIVER	CASTOR IVA/ ORBUS	YES	• GREEN RIVER COMPLEX BEEN CLOSED FOR 20 YEARS	MEDIUM	*• RANGE SAFETY ISSUES ARE UNACCEPTABLE, POPULATED AREAS • LAUNCH TOWARDS MEXICO UNACCEPTABLE	4

EVALUATION CODE: 1 = GOOD 2 = ACCEPTABLE 3 = POOR 4 = NOT USABLE *CRITICAL FACTOR EVALUATION

NOTE: THIS OPTION WOULD BE ACCEPTABLE, EXCEPT FOR IOC