Environmental Impact Analysis Process

ENVIRONMENTAL ASSESSMENT
SPACE TEST EXPERIMENTS PLATFORM
MISSION 3

VANDENBERG AIR FORCE BASE, CA
1 SEPTEMBER 1994

DEPARTMENT OF THE AIR FORCE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER (AFMC)
LOS ANGELES, CA

13 Oct 94

MEMORANDUM FOR ALL INTERESTED GOVERNMENT AGENCIES, PUBLIC GROUPS, AND INDIVIDUALS

FROM: HQ SMC/CE
2420 Vela Way, Suite 1467
Los Angeles AFB CA 90245-4659

SUBJECT: Public and Governmental Agency Notification of the Finding of No Significant Impact (FONSI) and the Final Environmental Assessment (EA) for the Space Test Experiments Platform (STEP) Mission 3 (M3), Vandenberg Air Force Base (VAFB), CA

Attached for public and governmental agency notification is a copy of the subject FONSI and EA. The EA evaluated the environmental impacts with regard to the *STEP M3* ground processing and launch at VAFB CA, on-orbit operation, and orbital decay and reentry. The analysis indicates that no significant impact will result from the proposed action, and a FONSI is made. The thirty day review period is not required based on the standards set in Air Force Regulation 19-2, Environmental Impact Analysis Process, paragraph 11(f) (1-4). Request for additional information or document copies should be forwarded to:

HQ SMC/CEV
Mr. Adel A. Hashad, P.E.
2420 Vela Way, Suite 1467
Los Angeles AFB CA 90245-4659
Phone: (310) 363-0934

GILBERT T. PERRY, Lt Col, USAF
Director, Acquistion Civil Engineer

FINDING OF NO SIGNIFIGANT IMPACT (FONSI)
ENVIRONMENTAL ASSESSMENT
SPACE TEST EXPERIMENTS PLATFORM MISSION 3
VANDENBERG AIR FORCE BASE, CALIFORNIA

NAME OF THE ACTION: Space Test Experiments platform (STEP) Mission 3 (M3) Program, Vandenberg Air Force Base (VAFB), and California

AGENCY: United States Air Force (USAF), Headquarters Space and Missile Systems Center (HQ SMC), Environmental Management Division (CEV)

COOPERATING AGENCY: Department of Defense (DOD) Space Test Program (STP)

BACKGROUND: Pursuant to the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing the Act (40 CFR Parts 1500-1508), DOD Directive 6050.1, Air Force Regulation 19-2, which implements these regulations in the Environmental Impact Analysis Process (EIAP), and other applicable federal and local regulations, the USAF has conducted an assessment of the potential environmental consequences of the proposed implementation of the STEP M3 Program and alternatives.

DESCRIPTION OF PROPOSED ACTION: The DOD STP proposes to launch the STEP M3 spacecraft from VAFB, California. The proposed action includes ground processing and launch of the STEP M3 at VAFB, on-orbit operation of the satellite, and orbital decay and reentry.

The STEP M3 program would include the use of three existing facilities on North VAFB for processing and launch: Building 1555 (Vehicle Integration Facility) for mission processing, the Pegasus Hot Pad Loading Area, and the airfield. The Air Force Small Launch Vehicle (AFSLV), known commercially as the Pegasus XL would launch the STEP M3. The AFSLV would be carried aloft by an Orbital Sciences Corporation (OSC) modified Lockheed L-1011 passenger aircraft, which would take off from the existing airfield on North VAFB. An F-16 chase aircraft, which wold takes off from the existing airfield on North VAFB. An F-16 chase aircraft, originating from Edwards Air Force Base, California, could be used for visual observations. The Payload for this fourth STEP mission consists of five DOD experiments, pertaining to long-term exposure to the space environment and space structure technology. These experiments will be flown in an 70^{o}-inclined circular orbit, in order to allow coordination between spacecraft receivers

In addition, ground transmitters. There would be no on-board propulsion system. Existing USAF remote tracking stations around the world would be used to gather data from the satellite. STEP M3 has a planned operational life of 1 year, with a 3-year goal. At the end of its operational lift, the orbit would decay, and the satellite would re-enter the atmosphere.

The standard Pegasus launch Vehicle and associated activities for placing the satellites in orbit have been evaluated in the AFSLV Environmental Assessment (EA) (May 1991) and the Pegasus EA (October 1989). The launch vehicle processing and integration facilities z9Building 1555 and Hot Pad Loading Area) at VAFB were previously evaluated in the OSC Commercial Launch Services Program EA (March 1993) and the STEP Mission 1 EA (January 1994). A FONSI was approved for each of these actions. The EA for the proposed action updates and supplements the evaluation in these previous documents as necessary to complete the environmental analysis.

ALTERNATIVES TO THE PROPOSED ACTION: HQ SMC considered alternatives to the proposed action. There are no other available launch vehicles or combination of systems in the U.S. inventory that can fulfill mission requirements of the STEP M3. Existing Titan, Atlas and Delta launch Vehicles have limited payload opportunities and would place small payloads in suboptimum orbits with larger payloads, adding unacceptable risk of interference with other payloads. Use of other launch sites would not meet the STEP M3 inclination requirements. The action alternative would not allow DOD to fulfill the mission requirements and thereby obtain the data required to accomplish the mission. Nevertheless, the no action alternative was analyzed in this EA as an alternative to the proposed action.

SUMMARY OF ENVIRONMENTAL EFFECTS: The EA evaluated the environmental impacts with regard to the STEP M3 ground processing and launch at VAFB, on orbit operation, and orbital decay and reentry. The following environmental areas were assessed for environmental effects in this EA: air quality, global climate change and stratospheric ozone depletion, waste management, energy, space debris, and safety and risk. Air pollutant emissions are minor in quantify, and do not exceed the base aggregate limit. The emissions of greenhouse and ozone-depleting compounds from the proposed action will not significantly increase the atmospheric concentrations of these compounds from the proposed action will not significantly increase the atmospheric concentrations of these compounds. Minimal amounts of hazardous and non hazardous waste will be generated during satellite processing, which can be accommodated by existing VAFB waste management practices. Energy requirements of the step M3 are insignificant, and can readily be obtained from local supplies. The probability of personal injury or property damage from space debris is so low that the hazard is taken as part of the accepted risk for the program. Safety and risk concerns were identified in planning for the STEP M3, and safety procedures were incorporated into mission procedures. Final risk levels are considered acceptable. Minor issues areas of noise, public services, and visual resources were evaluated in the STEP Mission 1 EA, and were found not to be adversely affected. The proposed action does not differ from the STEP

M1 program in any way that may result in additional, or previously unrecognized, affects in these resources areas. Therefore, they have not been re-evaluated in this EA. Because the proposed action does not include the construction of any new ground facilitates, biological resources, cultural resources, coastal resources, and soils and geology have not been evaluated in this EA. No mitigation measures are required for the proposed action. No permits will be required for the e proposed action.

CONCLUSIONS: THE ANALYSIS SUMMARIZED ABOVE INDICATES NO SIGNUFUGANT IMAPCT RESULT FROM THE PROPOSED ACTION, AND A FINDING OF NO SIGNIFIGANT IMAPCT (FONSI) IS MADE.

POINT OF CONTACT: A copy of the STEP M3 FONSI and EA, 1 September 1994, may be obtained from, or comments on these documents may be submitted to:

HQ SMC/CEV
Mr. Adel A. Hashad, P.E.
Environmental Engineer
2420 Vela Way, Suite 1467
Los Angeles AFB CA 90245-4659
Phone (310) 363-0934

APPROVED:
HQ SMC Environmental Protection Committee

EUGENE L. TATTINI
Brigadier General, USAF
Chairperson, Environmental Protection Committee

FINDING OF NO SIGNIFICANT IMPACT
CONCURRENCE PAGE

Space Test Experiments Platform Mission 3
Vandenberg Air Force Base, California

October 1994

I concur with the Finding of No Significant Impact (FONSI):

Environmental Protection Committee Approval:

ALEXANDER A. ABELA, Colonel, USAF
Chairman, Environmental Protection Committee
Vandenberg AFB, CA

11 Oct 94
Date

Judge Advocate Approval:

W. JAN FABER, Lt Col, USAF
Staff Judge Advocate, 30 SW/JA
Vandenberg AFB, CA

11 Oct 94
Date

Organization Approval:

LOUIS D. VAN MULLEM, JR., Colonel, USAF
Chief, Environmental Management
Vandenberg AFB, CA

7 Oct 94
Date

ENVIRONMENTAL ASSESSMENT
for
SPACE TEST EXPERIMENTS PLATFORM
MISSION 3

VANDENBERG AIR FORCE BASE, CALIFORNIA

Prepared for

HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER/CEV
DIRECTORATE OF ACQUISITION CIVIL ENGINEERING
LOS ANGELES AIR FORCE BASE, CALIFORNIA

and

ARMSTRONG LABORATORY/OEB
BROOKS AIR FORCE BASE, TEXAS

Contract No. F33615-89-D-4003
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1 SEPTEMBER 1994

Prepared by

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SUMMARY

The Department of Defense (DOD) Space Test Program (STP) proposes to launch the Space Test Experiments Platform (STEP) Mission 3 (M3) spacecraft from Vandenberg Air Force Base (VAFB), California. The proposed action includes ground processing and launch of the STEP M3 at VAFB, on-orbit operation of the satellite, and orbital decay and reentry.

Pursuant to the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality regulations implementing the Act (40 CFR Parts 1500-1508), DOD Directive 6050.1, Air Force Regulation 19-2, which implements these regulations in the Environmental Impact Analysis Process (EIAP), and other applicable Federal and local regulations, the USAF has conducted an assessment of the potential environmental consequences of the proposed implementation of the STEP M3 Program and alternatives.

The following environmental areas were assessed for environmental effects in this EA: air quality, global climate change and stratospheric ozone depletion, waste management, energy, space debris, and safety and risk. Air pollutant emissions are minor in quantity, and do not exceed the base aggregate limit. The emissions of greenhouse and ozone-depleting compounds from the proposed action will not significantly increase the atmospheric concentrations of these compounds. Minimal amounts of hazardous and nonhazardous waste will be generated during satellite processing, which can be accommodated by existing VAFB waste management practices. Energy requirements of the STEP M3 are insignificant, and can readily be obtained from local supplies. The probability of personal injury or property damage from space debris is so low that the hazard is taken as part of the accepted risk for the program. Safety and risk concerns were identified in planning for the STEP M3, and safety procedures were incorporated into mission procedures. Final risk levels are considered acceptable. Minor issue areas of noise, public services, utilities, transportation, socioeconomics, hydrology and water quality, natural resources, and visual resources were evaluated in the previous STEP Mission 1 EA, and were found not to be adversely affected. Because the proposed action does not include the construction of any new ground facilities, biological resources, cultural resources, coastal resources, and soils and geology have not been evaluated in this EA. No mitigation measures are required for the proposed action. No permits will be required for the proposed action.

The analysis summarized above indicates no significant impact will result from the proposed action, and a Finding of No Significant Impact (FONSI) is made.

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ACRONYMS AND ABBREVIATIONS

ACE	accelerometer conditioning electronics
ACTEX II	Advanced Controls Technology EXperiment II
ADCE	active damping control electronics
AFR	Air Force Regulation
AFSLV	Air Force Small Launch Vehicle
AIT	Assembly Integration Trailer
AL	Armstrong Laboratory
AMROC	American Rocket Company
AMS	American Meteorological Society
AQAP	Air Quality Attainment Plan
ARAR	Accidental Risk Assessment Report
Bldg	building
BMDO	Ballistic Missile Defense Organization
CAAQS	California Ambient Air Quality Standards
$CaCO_3$	Calcium carbonate
CAP	Collection Accumulation Point
CARB	California Air Resources Board
CCD	Coastal Consistency Determinations
CCR	California Code of Regulations
CDE	command and data handling electronics
CDHS	California Department of Health Services
CEQ	Council on Environmental Quality
CFCs	chlorofluorocarbons
CFR	Code of Federal Regulations
CH_4	methane
$C1_2$	elemental chlorine
$C1^-$	chlorine radical
CMP	Coastal Management Plan
CO	carbon monoxide
CO_2	carbon dioxide
deg	degree(s)
DOD	Department of Defense
DOPAA	Description of the Proposed Action and Alternatives
DSI	Defense Systems, Inc.
EA	Environmental Assessment
ECE	experiment control electronics
EDE	experiment drive electronics
EDMM	Erasable Disk Mass Memory
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ES	Engineering-Science
f/s	feet per second
FED-STD	Federal Standard
FIP	Federal Implementation Plan
FONSI	Finding of No Significant Impact
ft	feet
GPS	Global Positioning System
H_2O	water
h	altitude
HC	hydrocarbons

HCl	hydrogen chloride
HMPP	Hazardous Material Pollution Prevention
HQ SMC	Headquarters Space and Missile Systems Center
IR	infrared
kg	kilogram(s)
km	kilometer(s)
kPa	kilopascal
kV	kilovolt
lbs	pounds
LED	light-emitting diode
LEO	low earth orbit
LV	launch vehicle
m	meters
M	Mach speed
m/s	meters per second
M1	Mission 1
M3	Mission 3
MIL-STD	Military Standard
mR	milli roentgen
N_2	molecular nitrogen
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
ND	no data
NEPA	National Environmental Policy Act
NiCd	nickel cadmium
nm	nautical miles
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O_2	molecular oxygen
O_3	ozone
OMCF	Orbiter Maintenance and Checkout Facility
OSC	Orbital Sciences Corporation
Pb	lead
PM	particulate matter
PM_{10}	particulate matter less than or equal to ten microns
psf	pounds per square foot
PSCs	polar stratospheric clouds
psia	pounds per square inch atmospheric
psig	pounds per square inch gage
PV	photovoltaic
PZT	piezoelectric transducer
q	point of maximum resonance/vibration
RADFET	RADiation Field Effect Transistor
RCRA	Resource Conservation and Recovery Act
RF	radio frequency
RWQCB	Regional Water Quality Control Board
SADA	Solar Array Drive Assembly
SAMMES	Space Active Modular Materials Experiments
SARA	Superfund Amendments and Reauthorization Act of 1986
SAWAFE	Satellite Attack Warning and Assessment Flight Experiment
SB	Senate Bill

SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	System Control Module
sec	seconds
SGLS	Space Ground Link System
SIP	state implementation plan
SMC	Space and Missile Systems Center
SO_2	sulfur dioxide
SO_X	sulfur oxides
SQUOD	Space Qualifiable Optical Disk
SRM	Solid(-propellant) Rocket Motor
SSM	second surface mirror
STEP M1	Space Test Experiments Platform Mission 1
STEP M3	Space Test Experiments Platform Mission 3
STP	Space Test Program
STS	Space Transportation System
SV	Space Vehicle
t	time
TM	Test Module
TORA	Test Operation Risk Assessment
TQCM	Temperature-controlled Quartz Crystal Microbalance
TRI	Toxics Release Inventory
TSDF	Treatment, Storage and Disposal Facility
TVC	Thrust Vector Control
ug/m^3	micrograms per cubic meter
USAF	United States Air Force
USC	United States Code
USDOC	United States Department of Commerce
UV	ultraviolet
V	velocity
VAFB	Vandenberg Air Force Base
VEM	viscoelastic material
VOC	volatile organic compound
WRR	Western Range Regulation
30 SPW/ET	30th Space Wing Environmental Management (VAFB)
Y	conductivity

CHAPTER 1

PURPOSE OF AND NEED FOR THE ACTION

CHAPTER 1

PURPOSE OF AND NEED FOR THE ACTION

1.1 BACKGROUND

The Department of Defense (DOD) Space Test Program (STP) proposes to launch the Space Test Experiments Platform Mission 3 (STEP M3) spacecraft on the Air Force Small Launch Vehicle (AFSLV), also known as the Pegasus XL, from Vandenberg Air Force Base (VAFB), California.

STEP M3 requires completion of Environmental Impact Analysis Process (EIAP). The EIAP is contained in Air Force Regulation (AFR) 19-2, which describes the procedural requirements for implementation of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 42 USC 4321) and the President's Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500 through 1508). The Air Force Form 813 containing the preliminary Description of the Proposed Action and Alternatives (DOPAA) is presented in Appendix C of this document.

The Pegasus launch vehicle and associated activities have been evaluated in the AFSLV Environmental Assessment (EA) (USAF, 1991) and the Pegasus EA (USAF, 1989a and 1990). An EA has also been completed for the launch vehicle processing and integration facilities at VAFB (Building 1555 and Hot Pad Loading Area), and the Pegasus XL launch vehicle (OSC, 1993). The Pegasus XL, known as the AFSLV, will be used to support the proposed action. An EA of the STEP Mission 1, which used the same processing and integration facilities and similar launch procedures as the proposed action, has been prepared (USAF, 1994). A Finding of No Significant Impact (FONSI) was approved for each of these actions.

As stated in the Air Force Form 813 for this action, the EA need only cover the space vehicle launch site processing, launch, on-orbit operation, and orbital decay and reentry. This EA updates and supplements the information in these previous documents, as necessary, to complete the environmental analysis for the proposed action. A supplementary analysis of several issues is included in this EA to meet the level of analysis required under Air Force and DOD standards, and to reach a conclusion on potential environmental effects of the proposed action.

1.2 PURPOSE OF THE PROPOSED ACTION

The overall goal of the STEP program is to support DOD in demonstrating new space technology and obtaining vitally needed scientific data about space and the earth's environment by creating low-cost, lightweight, standardized satellites for science payloads.

The purpose of STEP M3 is to continue to provide inexpensive access to space by procuring a class C-equivalent space vehicle per DOD Handbook 343 (Design, Construction, and Testing Requirements for a One-of-a-Kind Space Experiment), based on an adaptable spacecraft bus to support five STP experiments. The payload for this mission of STEP consists of five DOD experiments, each testing different space materials technologies. Existing U.S. Air Force (USAF) remote tracking stations around the world will be used to gather data from the satellite.

1.3 NEED FOR THE PROPOSED ACTION

The proposed action is needed to meet space materials requirements for ongoing and planned space missions. STEP M3 will fly five experiments, each of which are designed to research different facets of long-term exposure to the space environment and space structure technology. The aspects analyzed by the experiments include: stabilization of space structure vibration and deformation; low-cost, low-power, high capacity, and lightweight magnetic mass memory units for spacecraft; candidate materials for future space systems; demonstration of "smart skin" technology; and rewritable high capacity optical disk mass memory storage for spacecraft.

The five experiments will demonstrate and test new space materials technologies. Once analyzed, the data collected from the experiments will determine the adequacy of these materials and technologies for future space missions, and promote advances in space materials technology. In addition, the proposed action will continue to support the overall goals of the STEP program.

1.4 PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

The purpose of this EA is to make the decision maker(s) aware of the environmental consequences of the proposed action and alternatives, including the no action alternative. The EA contains the environmental documentation used by the decision maker(s) for selection and approval of the proposed action or an alternative.

1.5 ISSUES

The most significant issues of the proposed action are air quality, effects on global climate change and stratospheric ozone depletion, waste management, energy, space debris, and safety and risk. These major issues have been subject to careful evaluation in this EA. Other issues which may pertain to the proposed action but are considered minor, are noise, public services, utilities, transportation, socioeconomics (population, housing and employment), hydrology and water quality, natural resources, and visual resources. These minor issues were discussed and analyzed in the EA for the STEP Mission 1 (M1) Program (USAF, 1994), and were not found to be adversely impacted. The proposed action does not differ from the STEP M1 program in any way which may result in additional, or previously unrecognized, impacts in these resource areas. Therefore, they have not been re-evaluated in this EA. Because the proposed action does not include the construction of any new ground facilities, biological resources, cultural resources, coastal resources, and soils and geology have not been evaluated in this EA. These subjects were evaluated as appropriate in previous environmental documentation for new or modified facilities to be used for this program (OSC, 1993).

1.6 SCOPE OF THIS ENVIRONMENTAL REVIEW

This EA has been prepared to satisfy the environmental review requirements set forth in NEPA, and in accordance with the President's Council on Environmental Quality regulations implementing the Act (40 CFR Parts 1500-1508) and Air Force Regulation (AFR) 19-2 (EIAP, August 10, 1982). The objective of this EA is to form a basis for determining the significance of environmental impacts which would result from implementation of the proposed action and alternatives.

Following this review, the Air Force will approve the determination of whether or not the proposed action will have a significant effect on the human environment, and whether or not an Environmental Impact Statement (EIS) is required. If the environmental analysis indicates that the proposed action will not result in a significant effect on the environment, or that potentially significant impacts can be mitigated to a level of insignificance, then a FONSI will be prepared, reviewed and approved by the Air Force.

This EA will focus on the potential impacts in the major issue areas of air quality, global climate change and stratospheric ozone depletion, waste management, energy, space debris, and safety and risk. Potential impacts in these areas could result from ground processing and launch of the STEP M3 satellite at VAFB using the AFSLV mounted on an L-1011 carrier aircraft, on-orbit operation, and orbital decay and reentry. Ground processing activities include cleaning and testing of the satellite and its experiments at VAFB.

CHAPTER 2

DESCRIPTION OF PROPOSED ACTION

AND ALTERNATIVES

CHAPTER 2

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The Department of Defense (DOD) Space Test Program (STP) proposes to launch the Space Test Experiments Platform Mission 3 (STEP M3) spacecraft on the Air Force Small Launch Vehicle (AFSLV), also known as the Pegasus XL, from Vandenberg Air Force Base (VAFB), California. The proposed action is the ground processing and launch of the STEP M3 spacecraft at VAFB, on-orbit operation of the satellite, and orbital decay and reentry of the satellite.

2.2 PROJECT LOCATION

Vandenberg Air Force Base occupies 98,147 acres along the south-central coast of California and is located approximately 140 miles northwest of Los Angeles (see Figure 2-1). West Ocean Avenue bisects the Base into North VAFB and South VAFB (see Figure 2-2). The STEP M3 program would utilize facilities on North VAFB.

Launches from the Pacific coast location of VAFB are within the Western Range, which permits space launch azimuths (horizontal direction from a zero degree (^{o}) at geographic north) with polar and other high inclination (angle between zero at horizontal and 90^{o} at vertical) orbits (see Figure 2-3). Polar orbits provide coverage of the entire planet perpendicular to the equator. These orbits may be required for scientific study, weather and earth resources surveillance, communications relay, navigational systems, and defense purposes. Another type of high inclination mission is the sun-synchronous mission, where the satellite orbit maintains its initial orientation relative to the sun. Because of overflight safety restrictions, polar launches must be made from the West Coast. Lower inclination equatorial launches are made from Kennedy Space Center off the coast of Florida, within the Eastern Range or from Wallops Island off the coast of Virginia (see Figure 2-3).

2.3 DESCRIPTION OF THE PROPOSED ACTION

The STEP M3 will be launched on the AFSLV, known commercially as the Pegasus XL. The AFSLV launch vehicle has been designed to benefit from equipment heritage and economies of scale. Developed by Orbital Sciences Corporation (OSC), the Pegasus XL meets more stringent U.S. Air Force (USAF) reliability requirements and has a greater payload-to-orbit capability than the standard commercial Pegasus vehicle. The Pegasus XL is six feet longer than the standard Pegasus, and contains an additional 8,400 pounds of propellant (OSC, 1993).

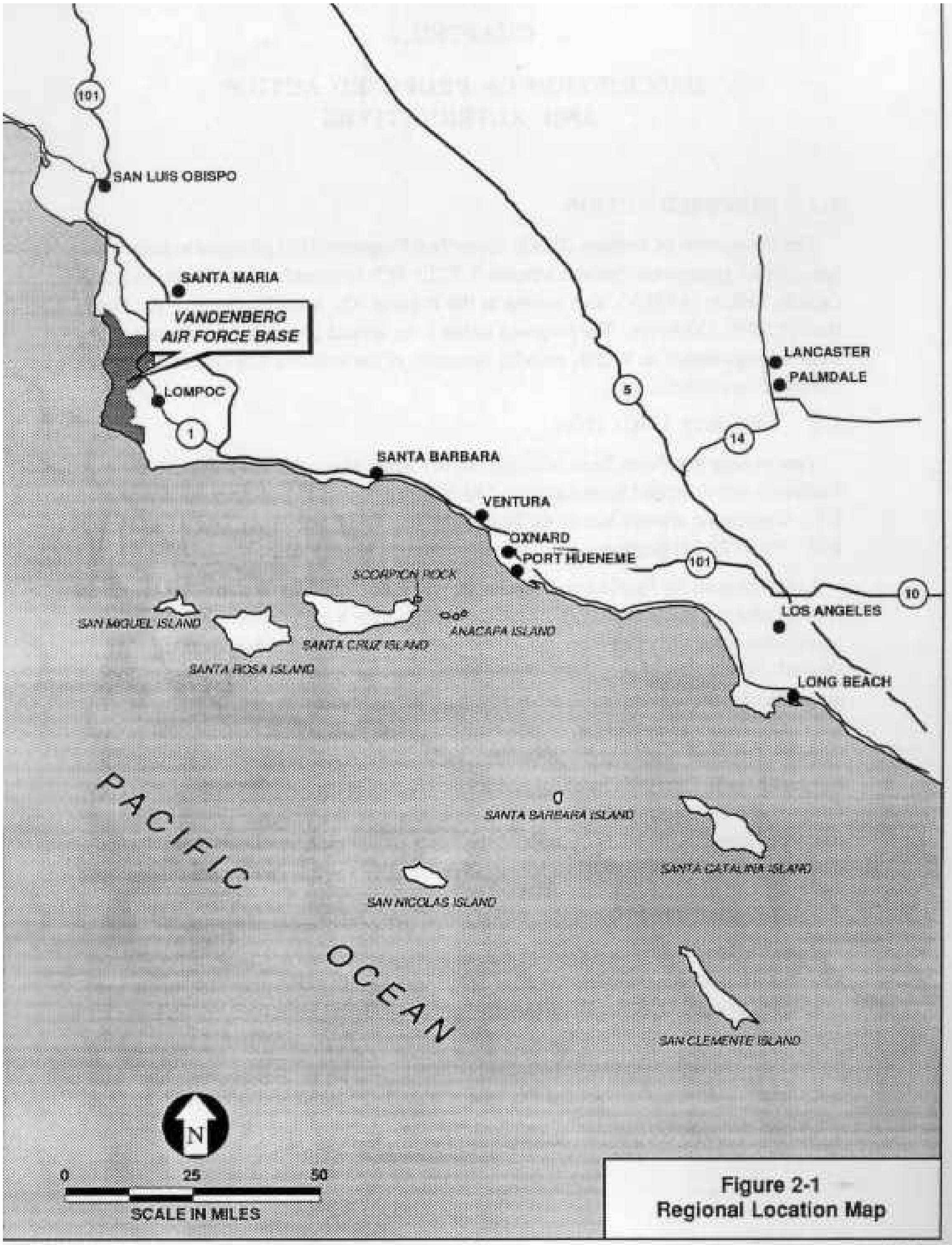


Figure 2-1
Regional Location Map

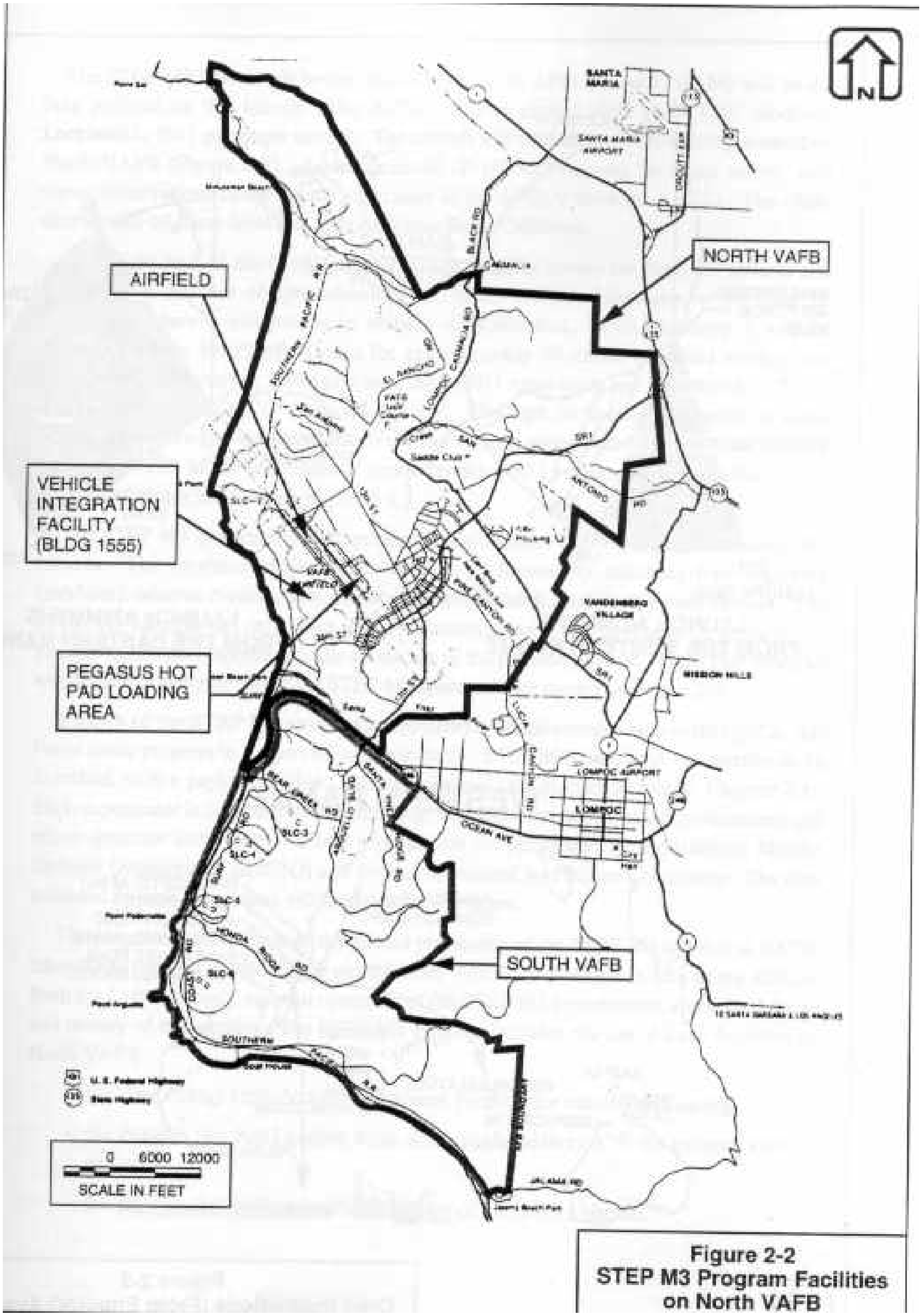
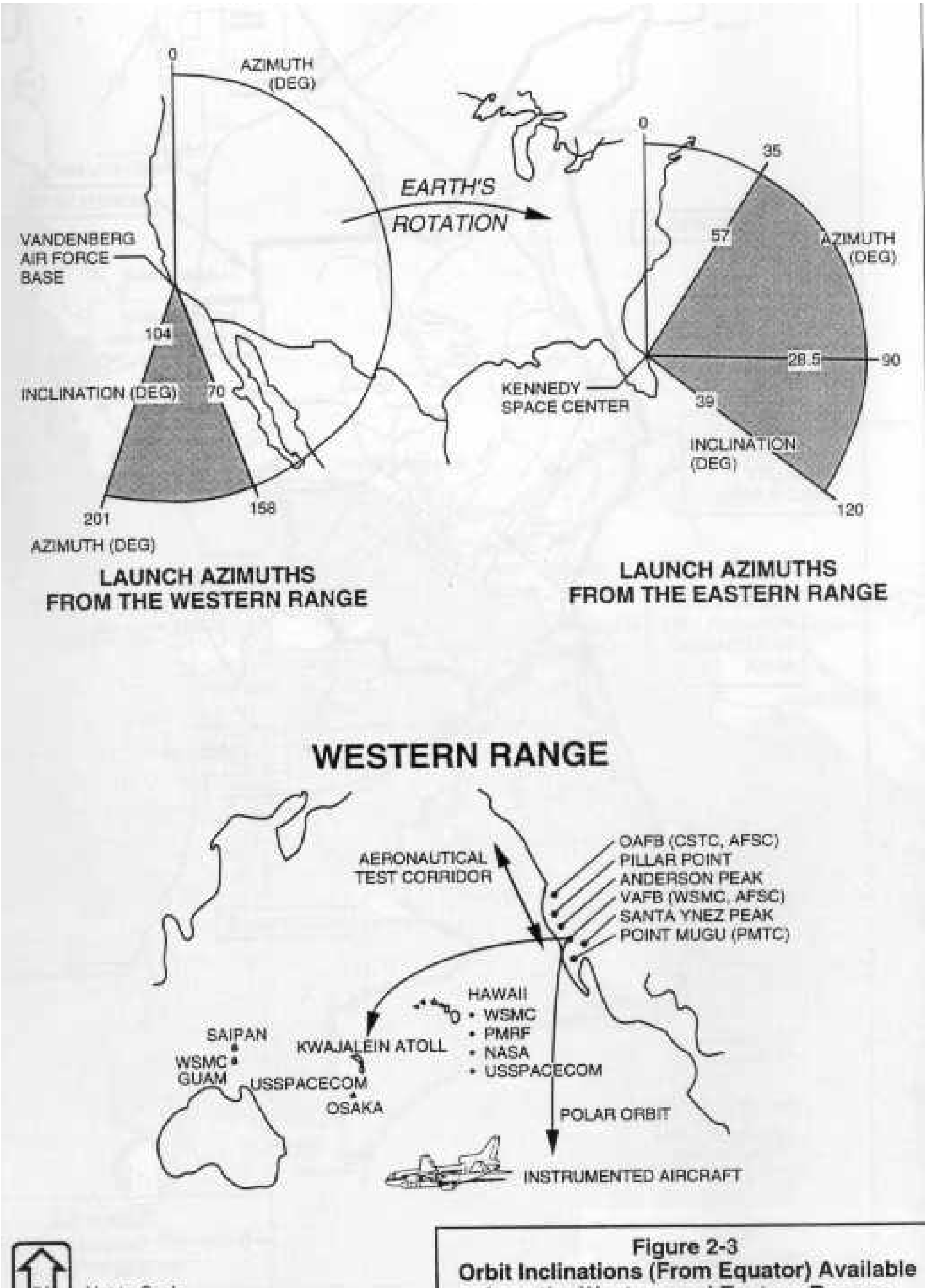


Figure 2-2
STEP M3 Program Facilities on North VAFB



Source: Modified from GRW, 1989

Figure 2-3
Orbit Inclinations (From Equator) Available from the Western and Eastern Ranges

The STEP M3 launch will be the second flight of the AFSLV, and STEP M3 will be the only payload on this launch. The AFSLV will be carried aloft by an OSC-modified Lockheed L-1011 passenger aircraft. The aircraft will take off from the existing airfield on North VAFB (Figure 2-2). A chase aircraft (F-16) will be used for flight safety, with visual observations of the launch separation of the AFSLV from the L-1011. The chase aircraft will originate from Edwards Air Force Base, California.

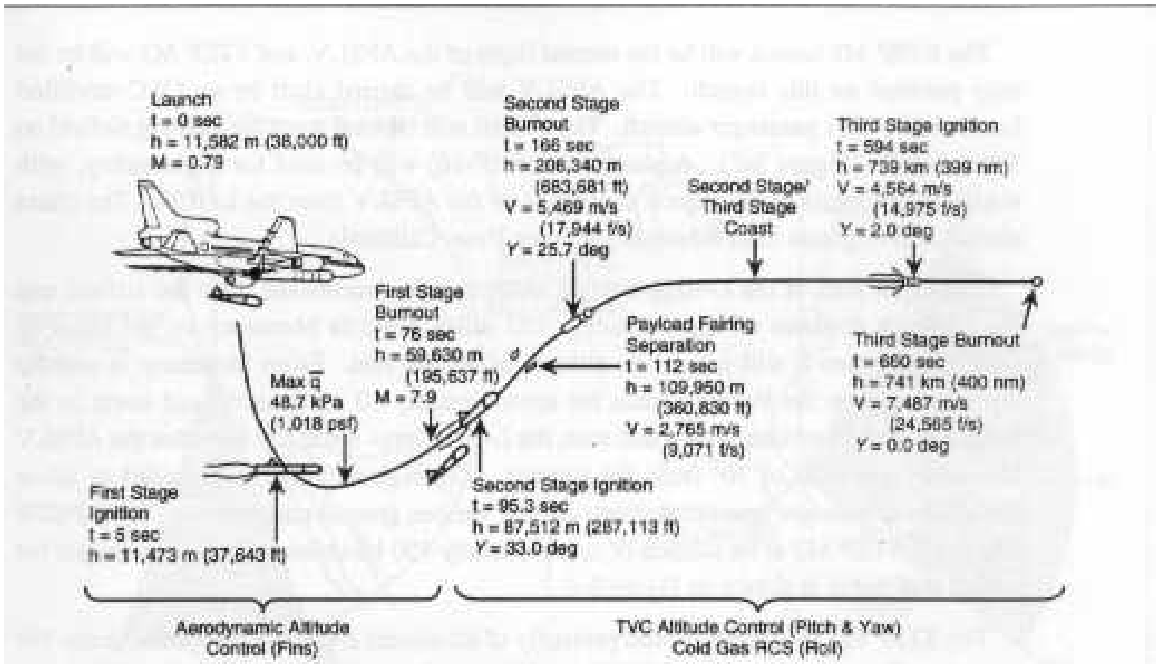
The flight path of the L-1011 aircraft heads initially northward from the airfield and VAFB for a distance of approximately 125 miles towards Monterey on the coast of California, where it will pass at an altitude of 39,000 feet. From Monterey, it will fly directly out over the Pacific Ocean for approximately 10 miles, and head north to the latitude of San Francisco. From that area, the L-1011 turns south and launches the AFSLV into a circular orbit of 70^{o} from the equator. The high inclination is needed to allow coordination between spacecraft receivers and various ground transmitters. The AFSLV will place STEP M3 at an altitude of approximately 450 kilometers (km). A schedule for orbital attainment is shown on Figure 2-4.

The STEP M3 spacecraft is built primarily of aluminum and weighs approximately 594 pounds. The structure of the STEP satellites is formed by attaching four segments (modules): adaptor module, core module, payload module, and deployment module. The STEP M3 satellite has only three modules (adaptor, core, and payload). A deployment plate with exposed experiments sits on the top of the payload module. The STEP modules and different configuration of the STEP M3 spacecraft are shown on Figure 2-5.

Launch of the STEP M3 spacecraft represents a continuation of the existing U.S. Air Force space program in support of scientific study. STEP M3 consists of one satellite to be launched, with a payload of five DOD experiments (see discussion below, Chapter 2.4). Each experiment is designed to research long-term exposure to the space environment and space structure technology. Three experiments are sponsored by the Ballistic Missile Defense Organization (BMDO) and two are sponsored by Phillips Laboratory. The data collected by each experiment will complement the others.

The proposed action involves the ground processing of the STEP M3 satellite at VAFB, takeoff and landing of the L-1011 aircraft from VAFB, air platform launch of the AFSLV from the L1011 aircraft, on-orbit operation of the STEP M3 experiments, and orbital decay and reentry of the satellite. The STEP M3 program includes the use of three facilities on North VAFB:

- Building (Bldg) 1555 (Vehicle Integration Facility) for mission processing,
- the Pegasus Hot Pad Loading Area, adjacent to Taxiway A of the existing airfield, and
- the existing airfield for takeoff and landing of the L-1011 aircraft.



Time (Sec)	Event Description	Event Start	Event Completion	Duration
0	Launch	Launch From Aircraft	LV Separation	Instantaneous
450	LV Separation	Separation Command	SV Separation	Instantaneous
576	Solar Array Deployment 1st Motion	Four Pyros Fire (Panels Rotate Outward)	Hinges Lock	8 seconds
588	Solar Array Deployment 2nd Motion	Two Pyros Fire (Four Panels Fold Outward and Back)	Hinges Lock	15 seconds
628	Solar Array Deployment 3rd Motion	Two Pyros Fire (Two Panels Fold Outward and Back)	Hinges Lock	12 seconds
654	SGLS Antenna Deployment	Line Cutters Fire	Spring Uncoils	
657	ACTEX 11 Frame	Deployment First Stage	Hinges Lock	
747	ACTEX 11 Frame	SADA Axis Rotation	Hinges Lock	
837	ACTEX 11 Frame	Deployed Array Rotation	Rotation Complete	

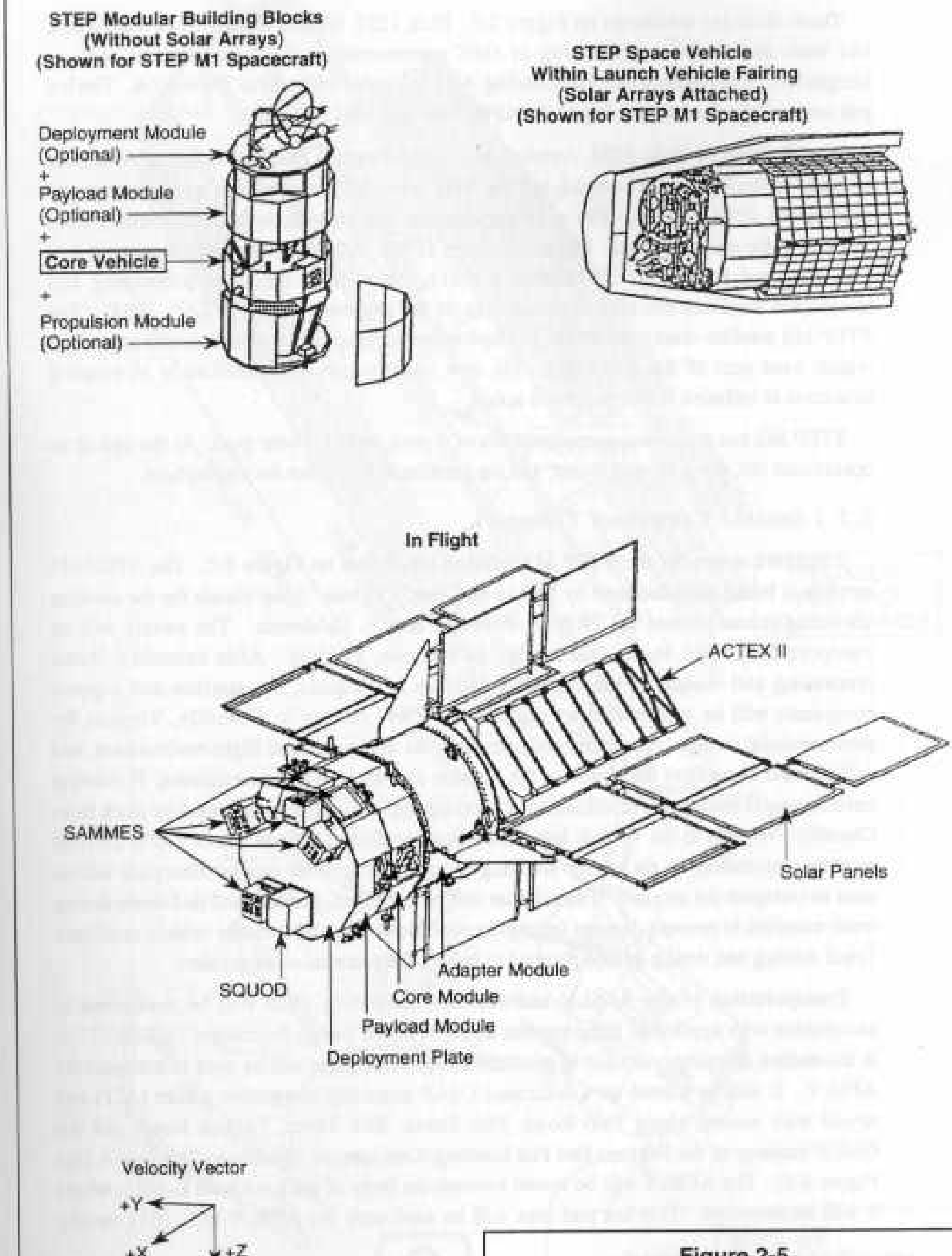


Figure 2-5
STEP Modules and
Configuration for the STEP M3 Spacecraft

These facilities are shown on Figure 2-6. Bldg 1555, located at the end of Talo Road, has been modified for processing of OSC commercial launch systems and payload integration. The Pegasus Hot Pad Loading Area is located adjacent to Taxiway A. The hot pad area will be used for mating of the AFSLV to the L-1011 aircraft.

Modification to Bldg 1555, construction of the Pegasus Hot Pad Loading Area, and upgrade of the Pegasus XL launch vehicle were previously evaluated in an environmental assessment (OSC, 1993). The standard Pegasus launch vehicle has previously been evaluated for environmental impacts (USAF, 1989). An environmental assessment was also prepared for the STEP Mission 1 (M1), which used the same processing and integration facilities and similar procedures as the proposed action (USAF, 1994). The STEP M3 satellite does not contain any hydrazine for propulsion or radioactive materials, which were part of the STEP M1. No new construction or modification of existing structures is included in this proposed action.

STEP M3 has a planned operational life of 1 year, with a 3-year goal. At the end of its operational life, the orbit will decay, and the satellite will re-enter the atmosphere.

2.3.1 Satellite Component Transport

Transport stages for the STEP M3 satellite are shown on Figure 2-7. The STEP M3 satellite is being manufactured by DSI in McLean, Virginia. Solar panels for the satellite are being manufactured by TRW in Redondo Beach, California. The panels will be transported by truck to the DSI facility in McLean, Virginia. After assembly, initial processing and testing of the complete satellite in Virginia, the satellite and support equipment will be transported by truck to the TRW facility in Chantilly, Virginia for environmental testing. Environmental tests simulate the launch and flight environment, and will be used to confirm the ability of the satellite to withstand these conditions. Following environmental testing, the satellite and support equipment will be transported by truck from Chantilly, Virginia to the Vehicle Integration Facility (Bldg 1555) on North VAFB for final satellite preparation. A six section shipping container of pressure molded fiberglass will be used to transport the satellite. The satellite will be packaged, padded, and tied down during truck transfers to prevent damage (except in conditions of a major motor vehicle accident). Truck routing and timing will be planned to reduce the potential of an accident.

Transportation of the AFSLV and satellite from Bldg 1555 will be conducted in accordance with applicable requirements under Western Range Regulation (WRR) 127-1. A six-section shipping container of pressure-molded fiberglass will be used to transport the AFSLV. It will be placed on a dedicated USAF assembly integration trailer (AIT) and towed with escorts along Talo Road, 35th Street, 29th Street, Tangair Road, and the OMCF taxiway to the Pegasus Hot Pad Loading Area located adjacent to Taxiway A (see Figure 2-5). The AFSLV will be towed beneath the body of the Lockheed L-1011, where it will be mounted. This hot pad area will be used only for AFSLV to L-1011 mating

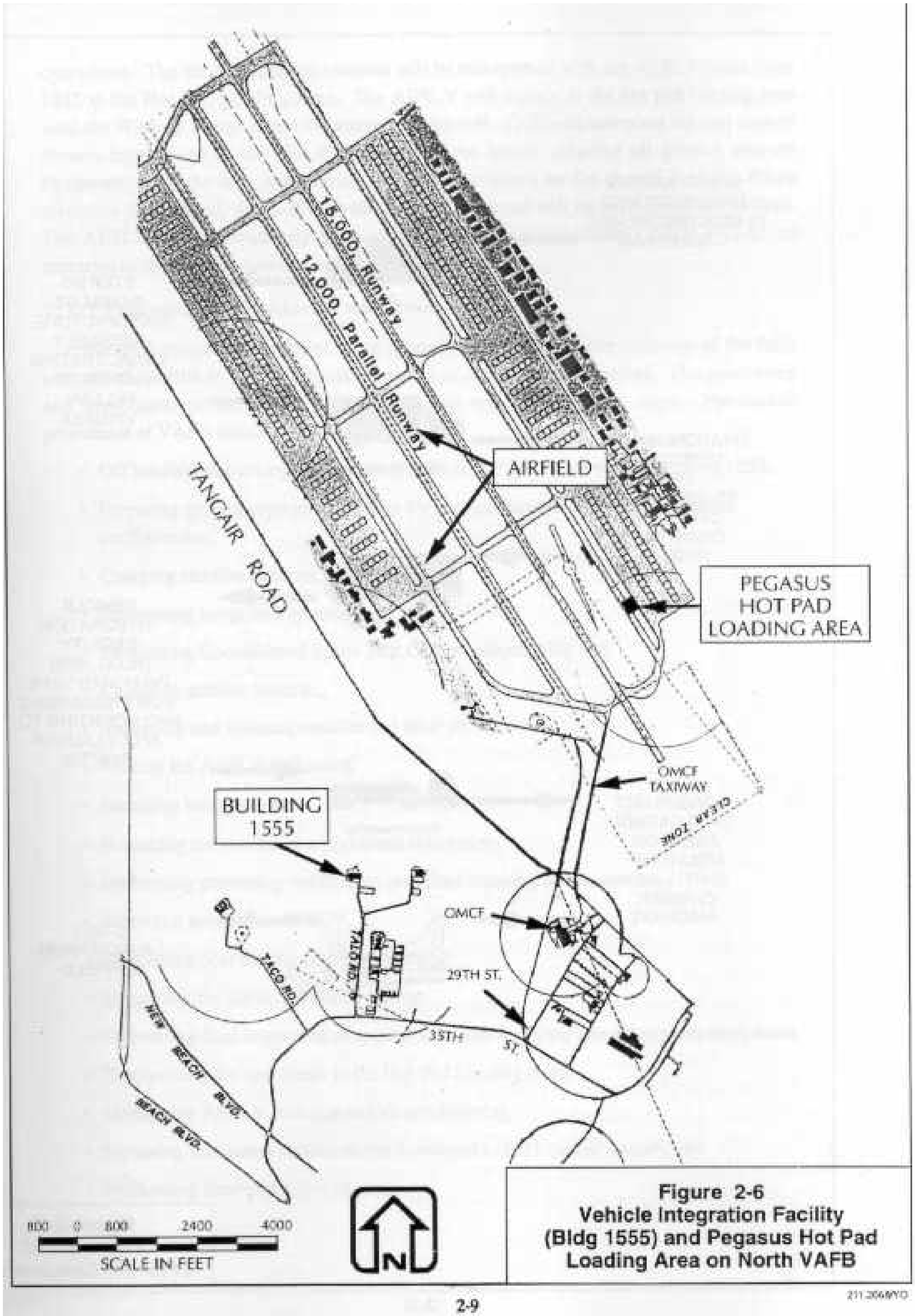


Figure 2-6
Vehicle Integration Facility (Bldg 1555) and Pegasus Hot Pad Loading Area on North VAFB

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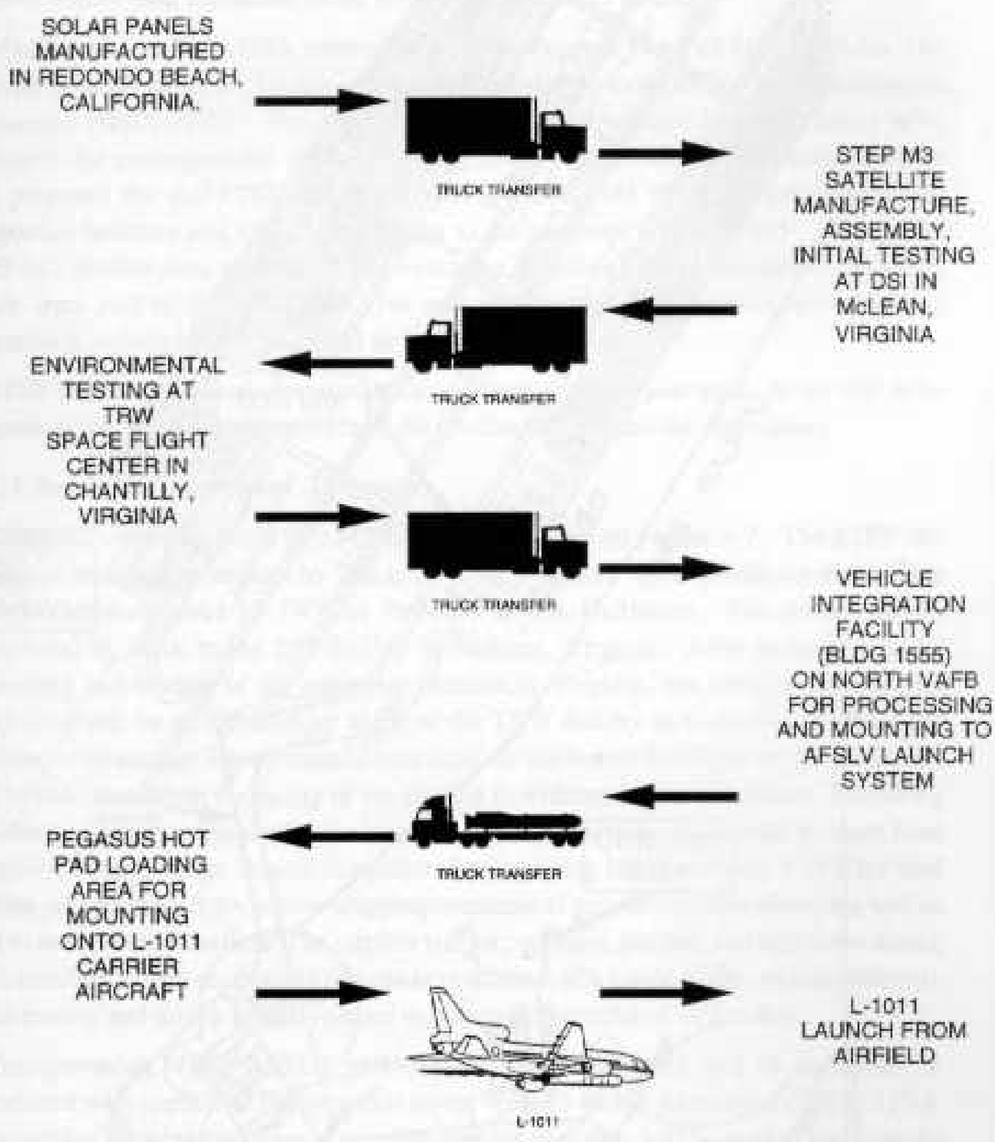

Figure 2-7
Transport of STEP M3 Components

operations. The air conditioning systems will be transported with the AFSLV from Bldg 1555 to the Hot Pad Loading Area. The AFSLV will remain at the hot pad loading area until the Western Range clears the aircraft for takeoff. OSC will complete the last chance system inspections at the Hot Pad Loading Area before clearing all ground support equipment from the area and starting the L-1011 engines on the day of launch. When clearance is obtained, the L-1011 with AFSLV attached will takeoff from the airfield. The AFSLV will subsequently be launched from this air platform. There will be no rehearsal of the launch sequence before the actual launch.

2.3.2 Processing Procedures

Pre-launch processing includes those procedures conducted after delivery of the fully assembled satellite at VAFB up until initiation of countdown operations. The processing and pre-launch period for STEP M3 will last approximately 30 days. Pre-launch procedures at VAFB include:

- Off loading, unpacking, and inspecting the STEP M3 space vehicle at Bldg 1555,
- Preparing ground support equipment for use and assembling satellite to flight configuration,
- Charging satellite batteries,
- Performing integrated systems test,
- Performing Consolidated Space Test Center compatibility test,
- Changing satellite batteries,
- Inspecting and cleaning satellite and solar panels,
- Arming the AFSLV ordinance,
- Installing solar panels,
- Rotatating the satellite to a horizontal orientation,
- Performing premating verification test, final cleaning and inspection,
- Mounting satellite on AFSLV,
- Performing post mating verification test,
- Integrating the AFSLV payload fairing,
- Performing final inspection of experiments and verifying ground support equipment,
- Transporting the spacecraft to the Hot Pad Loading Area,
- Monitoring AFSLV batteries and air conditioning,
- Mounting the launch vehicle on the Lockheed L-1011 carrier aircraft, and
- Performing final prelaunch checks.

Bay 2 of Bldg 1555 will be dedicated to the STEP M3 throughout the processing period (Figure 2-8). The satellite has a better than Class 10,000 environment (the air shall not contain more than 10,000 particles of 0.5 microns and larger per cubic foot) requirement (per FED-STD 209D). Portable cleanroom tents will be erected as needed within Bay 2. It is possible that one other payload will be at the building during that period. Bldg 1555 has an existing approved explosive siting for 600 pounds of Class/Div. 1.1 explosives, or more than 150,000 pounds of Class/Div. 1.3 explosives. The proposed action does not have any explosive safety requirements. Explosive safety requirements of the Pegasus XL boosters were previously evaluated (OSC, 1993). No modification to the explosive safety rating of Bldg 1555 is required for implementation of the proposed action. Bldg 1555 has facility lighting and grounding protection in accordance with Air Force Regulation (AFR) 127-100. Other safety requirements incorporated into the facility include continuous humidity/temperature control and monitoring, perimeter and access control, and a facility warning system.

2.3.3 Personnel Requirements

The proposed action will require no more than a total of 20 temporary operational personnel. They will be present at VAFB only during the launch processing and launch phases.

Launch processing consists of all activities necessary to prepare the satellite and space vehicle for launch. Launch operation personnel will include temporary vehicle drivers for the one vehicle transporting the pre-assembled satellite and components to VAFB. No new permanent personnel will be required at VAFB. A maximum of 20 contractor launch operations personnel from OSC, DSI, TRW, and other companies will work in one 8-hour shift or two 12-hour shifts (maximum) per day at VAFB. This number includes crane operators, a payload specialist, and range and safety personnel. All STEP M3 operations personnel involved in the integration and launch activities will be permanent OSC, TRW or DSI personnel. Additional persons, including government and contractor personnel, may also be present.

2.4 MISSION

The overall goal of the STEP program is to support DOD in demonstrating new space technology and obtaining vitally needed scientific data about space and the earth's environment by creating low-cost, lightweight, standardized satellites for science payloads. To accomplish this goal, STP is procuring a Class C-equivalent space vehicle based on an adaptable spacecraft bus to support numerous STP experiments. Class C space vehicles are those which are medium or higher risk efforts that are economically reflyable or repeatable. The characteristics for Class C space vehicles usually involve some combination of the following features: medium to high national prestige, short life, low to medium complexity, small size, single string design (i.e., no backup systems for individual components), hard failure modes (i.e., component failure results in system shutdown),

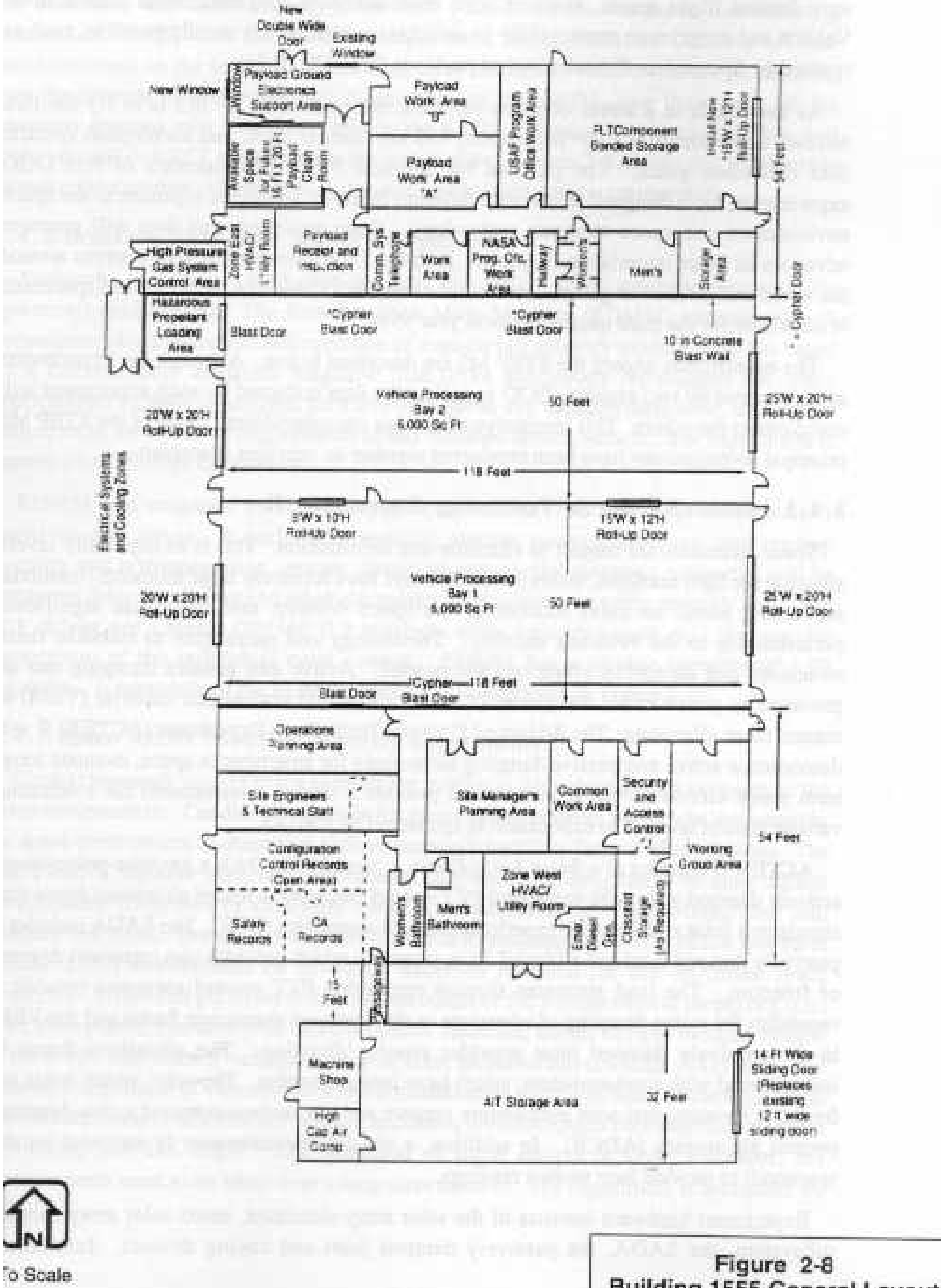

Figure 2-8
Building 1555 General Layout

very limited flight spares, medium cost, short schedule, and noncritical launch time. Vehicle and experiment retrievability or on-orbit maintenance is usually possible, such as typified by Spacelab or Orbiter attached payloads (USDOC, 1986).

As the fourth in a series of space vehicles, the goal of STEP M3 is to fly the five mission experiments at a 70^{o} inclination, 450 km circular orbit, and accomplish specific data collection goals. The payload for Mission 3 of STEP consists of five DOD experiments, each designed to research different facets of long-term exposure to the space environment and space structure technology. Once analyzed, this data will promote advances in space materials technology. Existing USAF remote tracking stations around the world will be used to gather data from the satellite. Launch of the STEP M3 spacecraft is scheduled for the third quarter of fiscal year 1994.

The experiments aboard the STEP M3 are described below. Although the experiments are sponsored by two separate DOD agencies, the data collected by each experiment will complement the others. This interactive effect was not coincidental; many of the STEP M3 principal investigations have been conducted together on previous spacecraft.

2.4.1 Advanced Controls Technology Experiment II

Space structures are subject to vibration and deformation. This is an especially severe situation for light satellites, where the solar arrays have relatively large moments (rotational movement about an axis) relative to the space vehicle, and can cause significant perturbations to the vehicle's stability. Technology and techniques to stabilize these structures and damp out vibrations are needed. Active and passive damping can be provided by piezoelectric transducer (PZT) elements and viscoelastic material (VEM) to control these vibrations. The Advanced Controls Technology Experiment (ACTEX) II will demonstrate active and passive damping technology for structures in space, evaluate long-term space effects on the structure, and provide a testing environment for evaluating various control laws. The experiment is sponsored by BMDO.

ACTEX II consists of a Solar Array Drive Assembly (SADA), a graphite-polycyanate actively damped yoke with embedded PZT control elements, a folded aluminum frame that simulates a solar array and the experiment control electronics (ECE). The SADA includes a passively damped joint and a biaxial drive assembly which provides two rotational degrees of freedom. The lead zirconate titanate embedded PZT control elements provide a capability for active damping of vibrations in the deployed aluminium frame and the VEM in the passively damped joint provides passive damping. The aluminum frame is instrumented with accelerometers, which have integral heaters. The yoke, which holds the frame, is instrumented with temperature sensors and has surface mounted active damping control electronics (ADCE). In addition, a triaxial accelerometer is mounted on the spacecraft to provide base motion readings.

Experiment hardware consists of the solar array simulator, smart solar array support subsystem, the SADA, the passively damped joint and caging devices. Instrument electronics include the power switching electronics, the experiment drive electronics (EDE), the command and data handling electronics (CDE), the accelerometer conditioning electronics (ACE) and the ADCE. Experiment instrumentation consists of four accelerometers on the solar array simulator, three orthogonal accelerometers on the host, two thermistors on the yoke, two thermistors on the SADA, one thermistor on the passively damped joint, potentiometers on the SADA and passive joint cage device, and eight channels of PZT sensors from the active yoke. Figure 2-9 shows the relationship between the experiment hardware, electronics and instrumentation components.

2.4.2 Erasable Disk Mass Memory Experiment

Low-cost, low-power, high capacity, and lightweight mass memory is needed for spacecraft applications. The Erasable Disk Mass Memory (EDMM) experiment will demonstrate the deployment and operation of a spacecraft memory module, which is based on a commercially available magnetic disk drive technology repackaged for space applications. EDMM is designed for a five-year life in any standard earth orbit, and will be able to meet the vibration requirements of any standard launch vehicle. The experiment is sponsored by Phillips Laboratory.

EDMM is a magnetic mass memory unit assembled from standard, commercially available disk drives. It includes a housing, electric power converters, anti-latchup circuitry and instrumentation sensors. Standard commercial magnetic memories will be integrated with the sensors and other electronics to provide a complete memory unit. The disk drives are Conner CP3540 0.5 gigabyte units, mounted such that the angular momentum of the individual units cancels. EDMM has a storage capacity of 1.08 gigabytes. A schematic of the EDMM experiment is displayed on Figure 2-10.

2.4.3 Space Active Modular Material Experiments

Critical materials used in space systems are subject to degradation upon exposure to the space environment. Candidate materials for future space systems need to be evaluated in the space environment to determine performance and durability for extended missions. The Space Active Modular Materials ExperimentS (SAMMES) is designed to measure critical performance properties of candidate materials, monitored by sensors integrated into modular test units. The objective of SAMMES is to evaluate the effects of the low earth orbital (LEO) environment on advanced materials intended for use on future space structures. SAMMES performs *in situ* measurement of the thermo-optical properties (i.e., solar absorptance, emissivity) of thermal control materials, atomic oxygen induced erosion of materials, and current-voltage curves of solar photovoltaic devices. SAMMES also measures deposition of contaminants and contamination effects of solar absorbance, total dose accumulation from charged particle radiation, atomic oxygen flux and fluency, solar insolation, and sun angle. The accretion of these effects is slow; therefore, the measurements need to be taken over a long-term mission. The experiment is sponsored by BMDO.

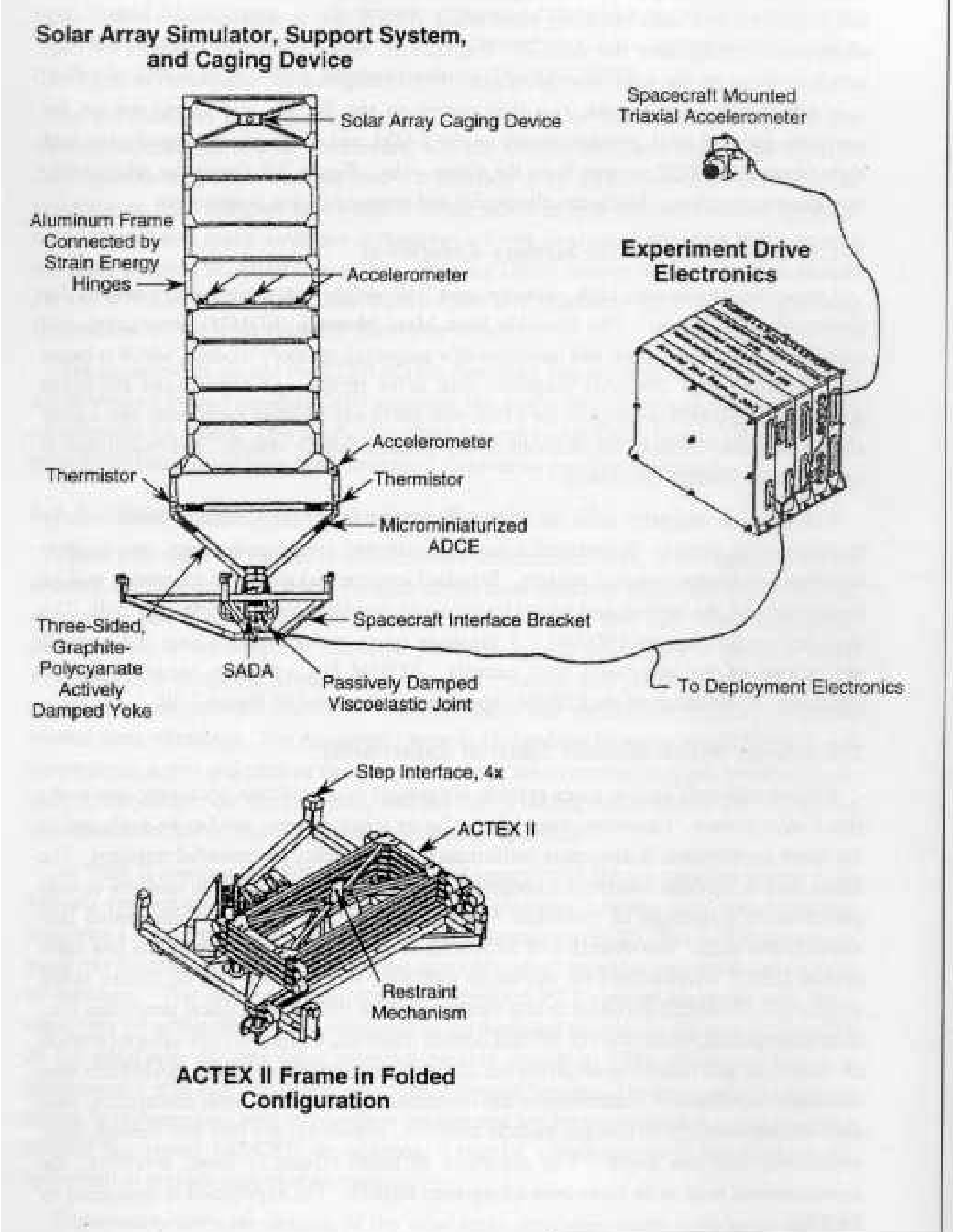

Figure 2-9
ACTEX II Experiment Hardware

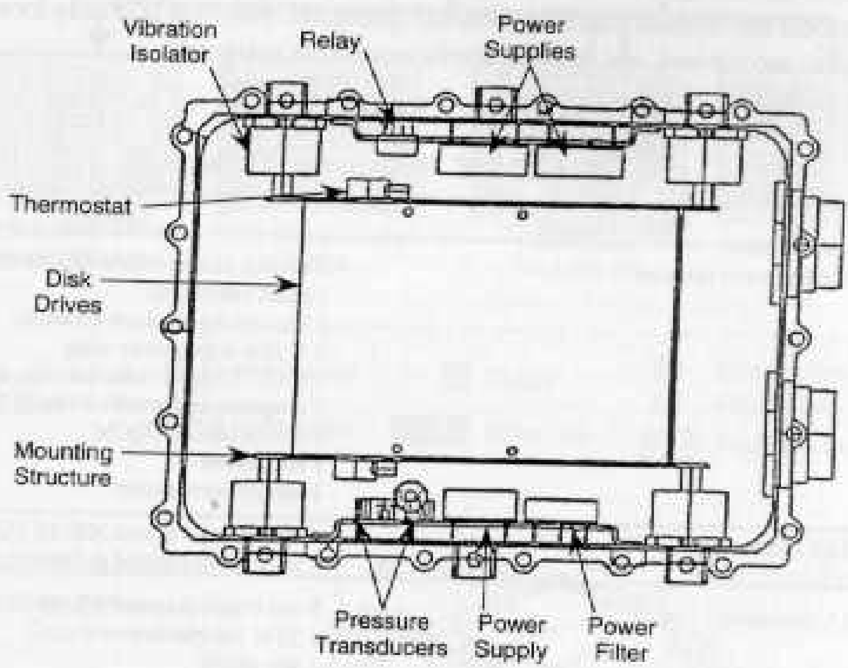

Figure 2-10
EDMM Instrument Schematic

SAMMES consists of a System Control Module (SCM) connected electrically to five Test Modules (TM). The TMs are an LEO environmental monitor module, a "Ram" (direction in face of flight) calorimeter module, a "Wake" (direction at the rear of flight) calorimeter module, a Temperature-controlled Quartz Crystal Microbalance (TQCM)/actinometer module, and a solar photovoltaic module (Figure 2-11). The TMs and their sensors are summarized in Table 2-1. The externally mounted TMs have only mechanical and thermal interfaces with the spacecraft, while the internally located SCM has electrical, mechanical, and thermal interfaces with the spacecraft.

Table 2-1

SAMMES Instrument Modules

Test Module	Sensors
LEO Environment Monitor	2 second surface mirror (SSM) calorimeters 1 black calorimeter 2 Kapton/Ag actionmeter units 2 C film actionmeter units 1 RADFET total radiation dose monitor 1 temperature controlled Mk-16 TQCM 1 coated Mk-16 TQCM 1 sun sensor 1 sun position sensor
TQCM/Actionometer	4 test material coated MK-16 TQCMs 7 test material coated actinometer units
RAM Calorimeter	8 test material coated Mk-16 TQCMs 1 SSM calorimeter 1 sun sensor
WAKE Calorimeter	7 test material coated calorimeters 1 SSM calorimeter 1 black calorimeter 1 sun sensor
Solar Photovoltaic	5 remote solar PV test cells/strings 1 SSM calorimeter 1 RADFET total radiation dose monitor 1 sun sensor 1 sun position sensor

The SCM/TM microcontrollers operate the SAMMES experiment with minimal ground or spacecraft command requirements. The TM microprocessor executes SAMMES command sequences which autonomously perform sensor data acquisition, sensor temperature control, establish operational modes, and affect power management. The host microprocessor accepts and processes commands from the STEP spacecraft, formats SAMMES data for transportation to the host and transmits SAMMES data upon request.

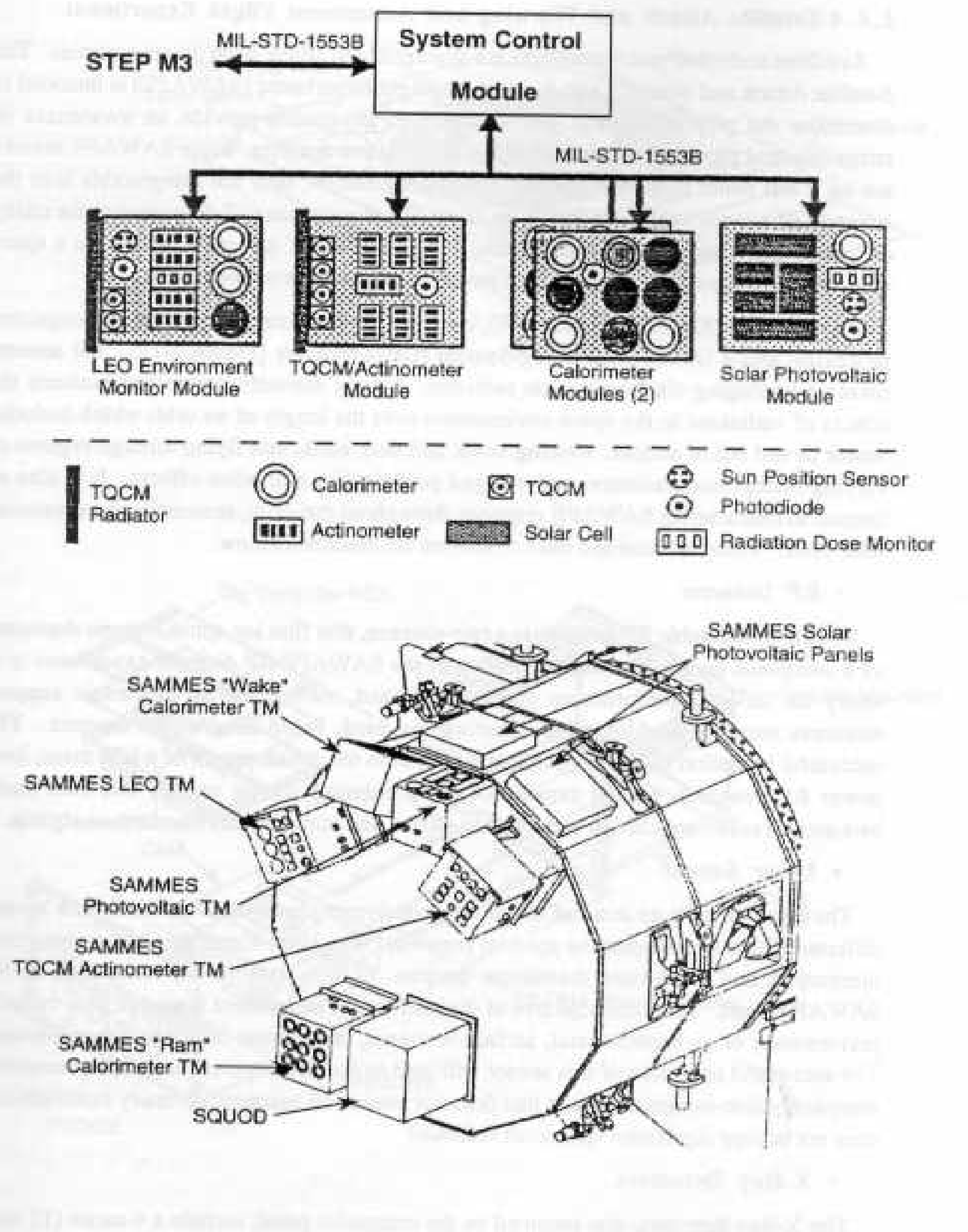

Figure 2-11
SAMMES Instrument Modules and Location

2.4.4 Satellite Attack and Warning and Assessment Flight Experiment

Satellites and other space structures are susceptible to attack from diverse sources. The Satellite Attack and Warning and Assessment Flight Experiment (SAWAFE) is intended to determine the physical means and intensity of an attack, provide an awareness of tampering, and provide collateral information for failure analysis. Since SAWAFE sensors are on a flat panel substrate that is mechanically robust, they are integratable into the structure of a space vehicle as part of its skin. The experiment will demonstrate the utility of "smart skin" technology, to determine if it is capable of detecting attacks on a space vehicle, and to provide an evaluation of environmental effects on the system.

SAWAFE has Radio Frequency (RF), laser, and X-Ray detectors, an attack recognition processor, and a Global Positioning System (GPS) receiver (Figure 2-12). All sensors measure impinging electromagnetic radiation. It is of scientific interest to evaluate the effects of variations in the space environment over the length of an orbit which includes sensor in and out of eclipse, viewing sunlit and dark earth, and flying through regions of varying background radiation and charged particle flux and other effects. It is also of interest to characterize SAWAFE response throughout the daily, seasonal and interannual solar cycle. These systems and their objectives are described below.

- **RF Detector**

The band-selectable RF detector is a two-element, thin film log spiral antenna deposited on a composite panel. The main objective of the SAWAFE RF detector experiment is to verify the on-orbit performance of a miniaturized, state-of-the-art electronic support measures receiver working with a surface-mounted, broad-band width antenna. The successful operation of this experiment will lead to the development of a low mass, low-power RF detection system capable of differentiating among natural and man-made background noise, acquisition and tracking radars, and jamming and interference signals.

- **Laser Sensor**

The laser sensor is an array of thin film pyropolymer photovoltaic devices, each having different filters to delineate the spectral response. The laser instrument has pyroelectric, thermopile and solid-state thermistor devices. These devices are embedded in the SAWAFE panel. The main objective of the laser sensor experiment is to verify the on-orbit performance of an experimental, surface-mounted, laser threat-detection sensor system. The successful operation of this sensor will lead to the development and deployment of a completely skin-integrated sensor that does not intrude on spacecraft primary functions and does not occupy significant spacecraft volume.

- **X-Ray Detectors**

The X-Ray detectors, also mounted on the composite panel, include a 4-meter (13 feet) length of optical fiber that scintillates under X-Ray exposure and a 100-meter (33 feet) length of optical fiber that darkens under X-Ray exposure. Each optical fiber is provided with a light-emitting diode (LED) source at one end and a detector at the other. The X-Ray

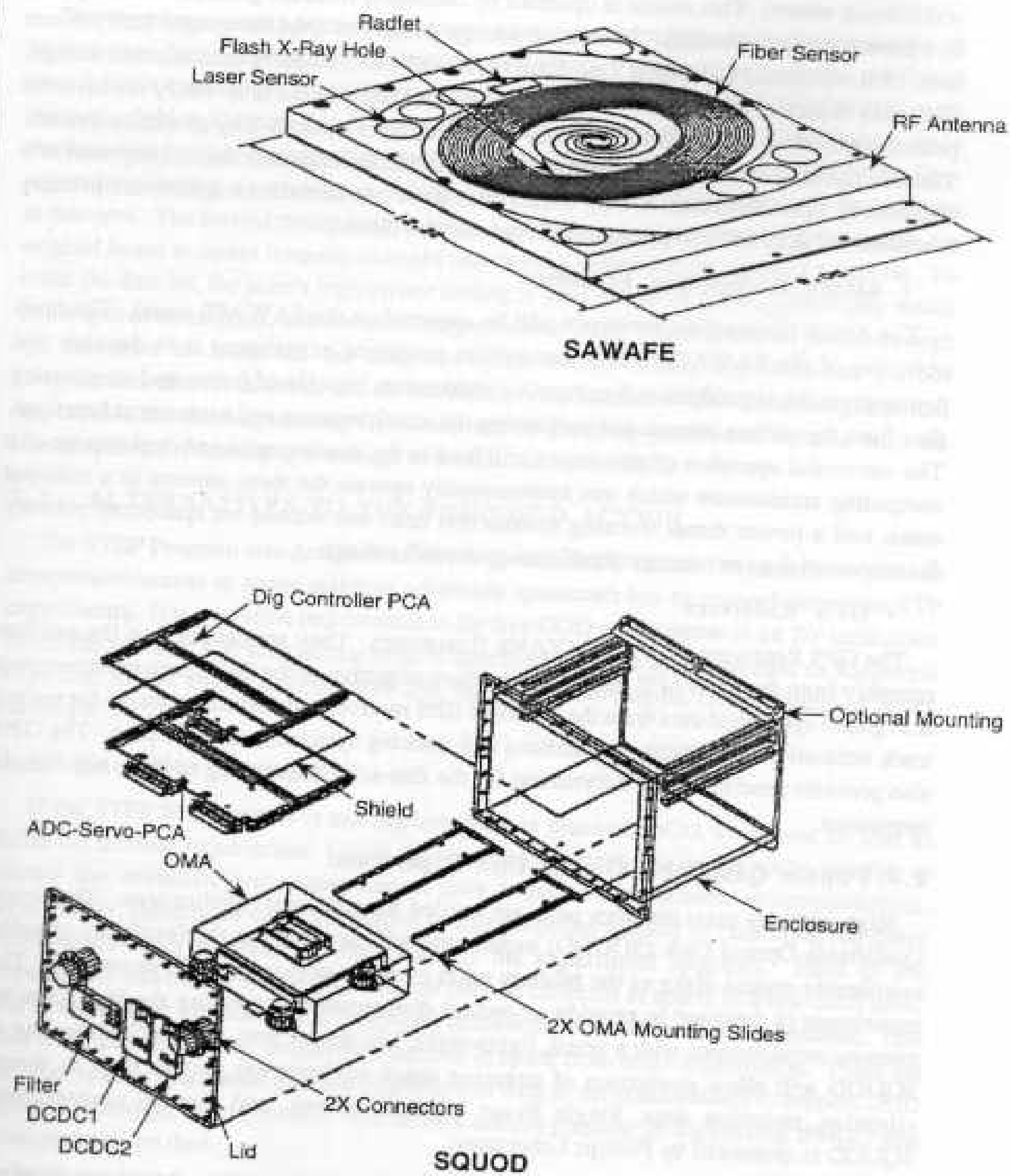

Figure 2-12
SAWAFE Panel Sensor Layout and SQUOD Experiment

detectors are accompanied by a 150 kV flash X-Ray source for calibration of the scintillation sensor. This source is operated by command from the ground, or in response to a predetermined schedule. It emits an energy density of 1 milliroentgen (mR) at one foot. A RADiation Field Effect Transistor (RADFET) will measure total mission dosage. The main objective of the SAWAFE X-Ray detector experiment is to verify the on-orbit performance of an experimental, surface-mounted, fiber optic X-Ray detection system. The successful operation of this sensor will lead to the development and deployment of a completely skin-integrated X-Ray sensor that does not intrude on spacecraft primary functions and does not occupy significant spacecraft volume.

- **Attack Recognition Processor**

The Attack Recognition Processor will be mounted on the SAWAFE panel. The main objective of the SAWAFE attack recognition processor experiment is to develop and demonstrate the algorithms and computing architecture capable of fusing and interpreting data from the various sensors and performing the attack warning and assessment functions. The successful operation of this sensor will lead to the development and deployment of a computing architecture which can autonomously operate the three sensors in a minimal mass, and a power threat warning system that does not intrude on spacecraft primary functions and does not occupy significant spacecraft volume.

- **GPS Receivers**

The GPS Receivers are Trimble TANS II receivers. They are mounted on the satellite remotely from the SAWAFE panel. The primary objective of the GPS receiver experiment is to gather ephemeral data from the on-board GPS receiver and make it available for testing track estimation algorithms, acquisitions and tracking systems, and other uses. The GPS also provides precise timing information for the fine-scale sequencing of some experiment operations.

2.4.5 Space Qualifiable Optical Disk Experiment

High-capacity mass memory units are needed for spacecraft applications. The Space Qualifiable Optical Disk (SQUOD) experiment will demonstrate the feasibility of using rewriteable optical disks as the primary mass memory storage on LEO spacecraft. The experiment is designed to provide an optical disk capable of meeting the high capacity memory requirements with a small, lightweight, low-power unit. Space flight testing of SQUOD will allow evaluation of stressing space environment factors such as shock, vibration, radiation dose, Single Event Upset Recovery, and thermal management. SQUOD is sponsored by Phillips Laboratory.

SQUOD is comprised of a magneto-optic disk configuration, based on standard commercial hardware, integrated with a drive, sensors, and other electronics to create a complete memory unit (Figure 2-12). Various data patterns will be read in from the controller to exercise memory. The output and input will be bit-compared to evaluate the error rate. Durability will be assessed from operation of the experiment through the mission life.

The experiment uses a laser diode source to activate the magneto-optic storage media. A high-power laser setting, exploiting the temperature dependency of the medium's coercivity, is used to heat a small spot on the medium sufficiently to allow a relatively small magnetic field to induce a flip in the medium's state of magnetization. The magneto-optic medium also has a high-value Kerr coefficient, so that a probe beam, provided by the low-power laser setting, experiences a polarization rotation when passing through the medium at that spot. The rotated return beam is passed through an analyzer for comparison with the original beam to detect intensity changes and thereby determine the value of a data bit. To erase the data bit, the laser's high-power setting is used to restore the magneto-optic media at the spot to its original, non-reversed magnetization state. The laser beam passes through the substrate to focus on the magneto-optic media. Thus, any substrate surface irregularities are out of focus and do not affect beam intensity. The electromagnetic coil responsible for the magnetizing field need not be precisely positioned because only the heated spot has coercivity low enough to be affected by the field.

2.5 ALTERNATIVES TO THE PROPOSED ACTION

The STEP Program was designed to meet a specific DOD mission requirement: provide inexpensive access to space using an adaptable spacecraft bus to support numerous STP experiments. It is a mission requirement to fly five DOD experiments in an 70^{o} inclination (from the equator) 450 km circular orbit at specified altitudes to collect data on long-term exposure to the space environment and obtain measurements from testing of space materials.

2.5.1 No Action Alternative

If the STEP M3 program is not implemented as planned, DOD would not be able to fulfill the mission requirement. Under the no action alternative, it would not be possible to obtain the scientific and experimental data required for mission accomplishment. Specifically, there is no other alternative to this proposed method of collecting the space environment data promised to the DOD by the experiment sponsors. Each of the experiments will obtain unique data that can only be collected in space, in a low-earth orbit, and at the specific altitudes and atmospheric conditions required for each experiment. This data is not currently being obtained on earth or in space from other experiments. There are no other space experiments planned to gather this data in the areas needed to support DOD space technology. These models will serve a unique purpose by supporting BMDO and other users of the data.

If the STEP M3 program is not implemented, DOD would also not be able to continue launch opportunities for satellite spacecraft users. This could result in the inability to launch this size category of satellites into polar orbit and, as such, may further result in the inability to advance current scientific knowledge.

2.5.2 Alternatives Eliminated from Consideration

There are no other available launch vehicles or combinations of systems in the U.S. inventory that can fulfill mission requirements of the STEP M3. Use of the limited payload opportunities on existing Titan, Atlas and Delta launch vehicles would place additional requirements on schedules, planning, and availability, and may result in the inability to carry out the STEP M3 mission. Use of these launches would place small payloads in suboptimum orbits with larger payloads, adding unacceptable risk of interference with other payloads. Other vehicle or program concepts submitted as AFSLV are not alternatives because they have not been developed and are not available.

Use of remote sensors or high-flying devices (i.e., telescopes or balloons) or space simulation environments would not accomplish the mission objectives. It is not possible to complete the proposed experiments and gather the required data if not in an actual space environment. No ground-based space simulation environment can accurately simulate long-term exposure to a space environment.

A variety of launch sites were initially considered. Previous Pegasus missions have been flown from the National Aeronautics and Space Administration (NASA) Dryden Flight Test Facility at Edwards Air Force Base. Each of these missions used a NASA B-52 aircraft as the launch platform. There are no remaining Pegasus missions. Use of the Dryden Flight Test Facility is not possible for STEP M3 because NASA has decided to no longer support other commercial endeavors after the last Pegasus mission is flown. The Dryden facility will no longer support OSC Pegasus activities.

Use of a B-52 aircraft for the STEP M3 launch is not possible because the longer and heavier Pegasus XL was not designed or manufactured to be carried by the B-52. OSC has made the decision to depart from use of the NASA aircraft in favor of a completely commercial L-1011 carrier aircraft.

Although the AFSLV may be launched from Wallops Island or the Eastern Range at some later date, the specific mission of the STEP M3 requires an inclination for the orbit that is higher (70^{o} from the equator) than would be possible from the Eastern Range (39^{o} to 57^{o}) or from Wallops Island off the coast of Virginia. Therefore, these sites are not being considered as alternatives to STEP M3 launch at this time. For these reasons, the only site considered is VAFB. This site has been approved for this program by the Air Force, and a launch site contract between the USAF at VAFB and STEP has been obtained.

The Air Force has considered each of the above alternatives to the proposed action. It was determined that mission requirements could not be met under these alternatives. Therefore, these other alternatives were eliminated from further consideration and will not be evaluated in this EA.

2.6 MITIGATION MEASURES

The Proposed action will not result in significant adverse impacts on the affected environmental resource areaas analyzed. No mitigation measures are required for the proposed action.

CHAPTER 3

AFFECTED ENVIRONMENT

CHAPTER 3

AFFECTED ENVIRONMENT

This chapter of the Environmental Assessment (EA) describes the existing environmental conditions that would be affected by the proposed action. The study area for each environmental resource is limited to the immediate area of Building (Bldg) 1555 on North Vandenberg Air Force Base (VAFB), the airfield, and the atmosphere in which the satellite is placed. For some environmental resources, a regional study area was used, as appropriate.

The affected environment pertinent to the major issues of air quality, effects on global climate change and stratospheric ozone depletion, waste management, energy, space debris and safety and risk have been subject to comprehensive discussion in this chapter. Other minor issues which may pertain to the proposed action include noise, public services, utilities, transportation, socioeconomics (population, housing and employment), hydrology and water quality, natural resources, and visual resources. These minor issues were discussed and analyzed in the EA for the Space Test Experiments Platform (STEP) Mission 1 (M1) Program (USAF, 1994), and were not found to be adversely impacted. The proposed action does not differ from the STEP M3 program in any way which may result in additional, or previously unrecognized, impacts in these issue areas. Therefore, they have not been re-evaluated in this EA. Because the proposed action does not include the construction of any new ground facilities, the topics of biological resources, cultural resources, coastal resources, and soils and geology have not been evaluated in this EA. These subjects were evaluated as appropriate in previous environmental documentation for new or modified facilities to be used for this program (OSC, 1993).

3.1 AIR QUALITY

3.1.1 Climate

The climate of the South Central Coast Air Basin can be categorized as a Mediterranean type. The weather is warm and dry from May to October, and wet and cool from November to April (CARB, 1975). Mean daily temperatures range from the low fifties in January to the low sixties in September. The average annual temperatures are around 55^{o}F. Much of the rainfall occurs during the winter months with February being the wettest month (about 2.9 inches). Small amounts of rainfall may occur during the summer months. The average rainfall in the area is approximately 14 inches.

Historical data collected near the project site reveals an annual predominant and secondary predominant wind pattern in the area. Predominant winds from the northwest sector account for almost 44 percent of the recorded wind directions, while the secondary predominant winds from the east-southeast sector account for nearly 15.3 percent of the recorded wind direction. The annual average winds from the northwest sector and east-southeast sector are 9.5 miles per hour and 6.2 miles per hour, respectively. The annual average wind speed is 6.8 miles per hour (CARB, 1984).

3.1.2 Local Air Quality

Five air quality monitoring stations located near or within VAFB are used to describe the existing air quality in the area. These monitoring stations are: VAFB - Watt Road; VAFB- Point Arguello; VAFB - Space Transportation System (STS) Power Plant on Power Street; Jalama Beach; and, Lompoc - 128 South H Street (see Figure 3-1). The VAFB Watt Road monitoring station, located on North VAFB, is the nearest to the project site. The criteria air pollutants measured at the monitoring stations include ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter less than or equal to ten microns in aerodynamic diameter (PM_{10}) (SBCAPCD, 1993).

Data collected at the monitoring stations reveals that the SO_2, NO_2 and CO ambient concentration levels do not exceed state and federal air quality standards. However, violations of the PM_{10} or O_3 air standards were recorded at four of the monitoring stations. The Jalama Beach monitoring station recorded two violations of the PM_{10} 24-hour state standard. The VAFB - STS Power Street monitoring station, VAFB - Point Arguello monitoring station, VAFB Watt Road monitoring station and Lompoc - 128 South H Street monitoring station recorded seven days, two days, and one day, respectively, which exceeded the O_3 1-hour state standard. The Vandenberg - STS Power Street monitoring station recorded one day that exceeded the O_3 1-hour federal air quality standard. A summary of the air quality data recorded at the five stations and air standards is shown on Table 3-1.

3.2 GLOBAL CLIMATE CHANGE AND STRATOSPHERIC OZONE DEPLETION

The possibility of global climate change and stratospheric ozone depletion due to the increased introduction of certain gases into the atmosphere through human activity is a widely publicized, global issue with potential major long-term implications to global climate and ecosystems. Over the last 100 years, the temperatures in the northern and southern hemispheres have increased by about 0.5^{o}C (AMS, 1991). A recent comparison of the hemispheric temperature histories performed by Idso (1990) found striking trends associated with the increased industrialization that occurred after 1950. Beginning in the mid-1950s, northern hemisphere temperatures stopped rising at the rate that characterized the twentieth century, while those in the southern hemisphere continue to rise, though at a slightly lower rate than characterized the first half of this century. Recent studies by Karl et al. (1993) have also shown a rise of the global land mass minimum temperatures at a rate

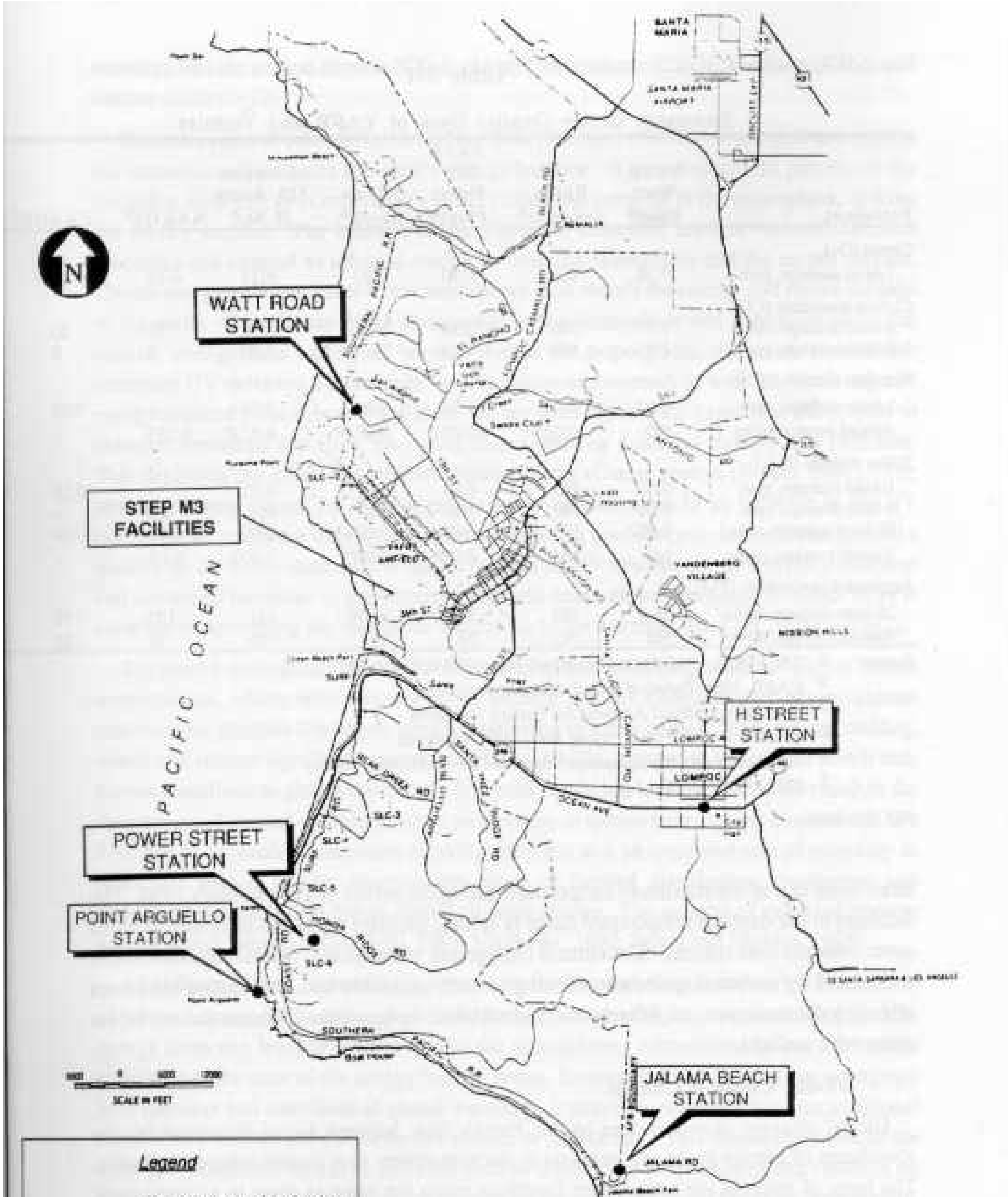

Figure 3-1
Air Monitoring Stations in the VAFB Area

Table 3-1

Summary of Air Quality Data at VAFB and Vicinity

Pollutant	**VAFB Watt Road**[a]	**VAFB Point Arguello**[b]	**VAFB STS Power Plant**[b]	**Jalama Beach**[b]	**Lompoc 128 South H St.**[b]	**NAAQS**[c]	**CAAQS**[d]
Ozone (O_3)							
1-hour average, ppm	0.10	0.11	0.13	0.07	0.11	0.12	0.09
Carbon monoxide (CO)							
1-hour average, ppm	1.2	ND	2.10	ND	4.00	35	20
8-hour average, ppm	1.0	ND	1.14	ND	2.00	9	9
Nitrogen dioxide (NO_2)							
1-hour average, ppm	0.02	0.04	0.03	0.02	0.06	--	0.25
Annual average, ppm	ND	0.002[e]	0.001	0.002[e]	0.012[e]	0.053	--
Sulfur dioxide (SO_2)							
1-hour average, ppm	0.01	ND	0.01	0.01	0.02	--	0.25
3-hour average, ppm	0.01	ND	ND	ND	ND	0.5	--
24-hour average, ppm	0.002	ND	0.05	0.00	0.00	0.14	0.04
Annual average, ppm	ND	ND	0.000	0.000[e]	0.000	0.03	--
Suspended particulates (PM_{10})							
24-hour average, ug/m^3	36.6	ND	37.70 [f]	93.70 [f]	ND	150	50
Annual average, ug/m^3	ND	ND	ND	ND	ND	50	30

Source: [a] SBCAPCD, 1993 (Period of record: May 1992 to March 1993)
[b] CARB, 1991 (Period of record; calendar year 1991)
[c] NAAQS = National Ambient Air Quality Standards
[d] CAAQS = California Ambient Air Quality Standards
[e] Insufficient data for representativeness to EPA and CARB criteria
[f] SBCAPCD, 1991

ND - No Data

three times that of the maximum temperature during the period of 1951 through 1990. The decrease in the daytime temperature range is at least partially related to increases in cloud cover over the land masses. The climate change and stratospheric ozone-depletion issues are related by common gases contributing to both problems and interrelated processes affecting the transport, transformation and ultimate by-products of the reactions of the gases with sunlight.

- **Global Climate Change**

Global climate change refers to the Earth's heat balance being disrupted by the abundance of certain gases and aerosols in the atmosphere that absorb infrared radiation. The layer of gases in the atmosphere functions much the same as glass in a greenhouse; both prevent the escape of heat. Water, in its various forms, is by far the most important greenhouse gas. Other naturally occurring or man-made gases that contribute to global warming include carbon dioxide (CO_2), chlorofluorocarbons (CFCs), methane (CH_4), and nitrous oxide (N_2O).

The absorption of solar radiation and the absorption and emission of infrared radiation in the atmosphere dominates the earth's energy balance. Approximately 30 percent of the incoming solar energy is reflected by either clouds and particles in the atmosphere, or from the earth's surface. The balance of the energy is absorbed, used in various chemical processes and emitted as infrared energy by both the atmosphere and the earth's surface. Clouds and greenhouse gases in the atmosphere then absorb the energy and return the heat to the earth. Greenhouse gases accumulate in the atmosphere and contribute to global climate change in a variety of ways. Within the troposphere, the gases can absorb incoming UV radiation and use it in various chemical processes as well as absorb infrared energy radiated from the earth's surface. In the stratosphere, the gases may participate in chemical reactions depleting the ozone, thus removing a natural sink for UV radiation. This depletion can cause a significant forcing of the climate system (WMO, 1991). The physical effects caused by this stratospheric ozone loss result in an increase in the UV radiation that enters the troposphere, with the resulting conversion to infrared energy, and a cooling of the lower stratosphere due to the loss of UV absorption. It is widely accepted that continued increases in greenhouse gases will cause global warming, although there is uncertainty concerning the magnitude and timing of the warming trend (SCAQMD, 1992).

Suggested ecological effects of increased global warming include: higher ocean temperatures, which will severely affect climate and the abundance of phytoplankton (microscopic plantlife floating or weakly swimming in water bodies); polar ice-cap melting, which will release significant quantities of CO_2 and CH_4 trapped in the ice and which may further contribute to global warming; a potential rise in sea level, which could result in the destruction of coastal wetland habitat; an increase in temperature, which could result in a decrease in accessible freshwater drinking supplies; and an increased rate of mortality in plant and animal species (particularly those of limited distribution, movement and reproductive capabilities) due to related climatic change. The severity of expected impacts will vary with latitude (SCAQMD, 1989; Matthews, 1990; Peters and Darling, 1985).

As indicated above, water (H_2O) vapor is by far the most abundant absorber and emitter of infrared energy in the atmosphere. The various forms of H_20 transport most of the heat energy from one level to another within the atmosphere. Atmospheric water vapor also reflects or emits most of the energy back to space. Increased atmospheric water vapor may both alleviate and contribute to global warming. It alleviates warming because additional cloud cover would increase the earth's albedo, or reflectivity. This means that more of the solar (UV) radiation would be reflected back to space. The abundance of this resource on earth, as well as the results from experiments on the effects of cloud cover on temperature, leads some to the conclusion that the cooling effect will dominate the warming effect. This increased cloud cover also contributes to global warming by more efficiently absorbing the IR radiation which passes through the atmosphere and is radiated by the earth. Currently under debate is the question of whether the global temperature feedback from H_20 is positive (overall temperature increase) or negative (overall temperature decrease) (Sun and Lindzen, 1991; Lindzen, 1990; Ellsaeasser, 1990; Idso, 1989). In all large numerical models of global warming, a warming of the surface of the earth causes an increase in water vapor at all levels in the atmosphere (Manabe and Wetherald, 1980).

The less abundant greenhouse gases (CO_2, CH_4, CFCs, N_2O and tropospheric O_3) are estimated to be present in higher concentrations now than at any other time over the past 160,000 years. This is largely due to the direct and indirect influence of human activity. The levels of these gases are still rising (Matthews, 1990; Kennett, 1982).

As calculated by general circulation models, CO_2 is the second most abundant heat-absorbing gas and accounts for about 55 percent of the contribution to the warming effect (SCAQMD, 1992). The relationship between CO_2 concentrations, biological organisms and global temperature change is dynamic and interdependent. As a result, it is not clearly understood and, therefore, difficult to model. Fossil fuel use and forest clear-cutting increase the amount of CO_2 in the atmosphere because they overwhelm the biological respiration processes that remove CO_2 from the atmosphere. Atmospheric CO_2 decreases through conversion by photosynthetic plants and phytoplankton to carbohydrates. Forest clear-cutting, particularly in tropical rain forests, significantly affects the global efficiency of photosynthetic plants, by reducing the number of plants available to remove CO_2 from the atmosphere. CO_2 is also removed from the atmosphere through dissolution into the ocean, where it is converted to calcium carbonate ($CaCO_3$) by living organisms such as bivalves and corals. It has not been determined what the buffer capacity of the world's oceans is for CO_2, and the subsequent effect that this dissolution will have upon ocean water pH, water temperature, and global currents. CO_2 can persist in the atmosphere up to 100 years (Matthews, 1990; SCAQMD, 1989; Harte, 1988).

CFCs absorb 16,000 times more heat than atmospheric CO_2 per unit mass and account for approximately 24 percent of the calculated human-induced effects on global warming. CFCs have been used since the 1930s as refrigerants and coolants. CFCs are broken down in the atmosphere by UV radiation, thereby releasing elemental chlorine (Cl_2) or the chlorine radical (Cl^-). The net result of these reactions is the depletion of stratospheric O_3. The Cl_2 and Cl^- released from the CFCs can catalyze over 100,000 of these reactions, which, in turn, result in greater potential stratospheric O_3 depletion. The consequential result is an increase in the amount of UV radiation that penetrates the atmosphere, which has the potential to increase the incidence of skin cancer. In addition, this UV radiation could ultimately contribute to surface warming because it will be absorbed in the troposphere and at the surface instead of in the stratosphere. Some CFCs can persist in the atmosphere for nearly 400 years (Matthews, 1990; SCAQMD, 1989; Bowman, 1988).

CH_4 absorbs over 20 times more heat than CO_2 per unit mass and accounts for 15 percent (SCAQMD, 1992) of the contribution to global warming. Atmospheric CH_4 increases as a result of various biological processes associated with digestion in cattle, flooded areas, landfills and other areas where life exists in the absence of oxygen. CH_4 persists in the atmosphere for about ten years (Matthews, 1990; SCAQMD, 1989; Margulis and Lovelock, 1974). N_2O absorbs 200 times more heat than CO_2 per unit mass and accounts for approximately six percent of the calculated effects on global warming. Atmospheric N_2O increases as a result of continued use of fossil fuels and "slash and burn" forestry techniques. N_2O persists in the atmosphere up to 180 years (Matthews, 1990; SCAQMD, 1989).

Tropospheric O_3, a caustic and common component of surface air pollution, is increasing in concentration. This is due largely to industrial and automotive pollutants, and the greater amount of UV radiation which is reaching the earth's surface. Ultraviolet radiation participates in reactions to both form and destroy ozone, with heat produced in both instances. At higher altitudes, the O_3 formation cycle would have the benefit of preventing UV penetration of the atmosphere. However, at lower altitudes, significantly higher levels of UV radiation and associated reactions could further contribute to surface warming.

Output from global climate models show that, over the next 50 years, greenhouse gas accumulations may result in surface temperature increases between 0.1 and 3° Celsius, depending on parameterizations in the models. The initiation of aggressive limits on greenhouse gas releases, or a continuation of current trends, may lead to smaller or larger changes, respectively, than those forecast by the models.

In addition to the emissions of greenhouse gases, man-made smoke and sulfate aerosol emissions have occurred during roughly the same period (Duffy, 1993). These aerosols cool the climate directly by reflecting solar radiation and indirectly by forming cloud condensation nuclei. The nuclei are the small particles needed for the formation of clouds. Increasing the amount of nuclei will increase the formation of clouds, thereby increasing the earth's reflectivity. Thus, any significant warming that may have been introduced by the greenhouse gases may have been offset by the aerosol cooling effect.

Each of the factors described above may have varying contributions to global climate change depending on the altitude, latitude and interdependence on each other. Hansen and Lacis (1990) have also argued that because of the long atmospheric residence time of CO_2, a substantial warming pulse has been hidden by the cooling effects of sulfates and that pulse will emerge soon after SO_2 emissions are reduced. Idso (1991) suggests that as the CO_2 content of the atmosphere rises, so will the impetus for forest expansion to assimilate the CO_2, as long as the various processes that produce CO_2 do not produce an abundance of detrimental pollutant byproducts. It is clear there is still much to be understood about the interactions of all of those contributing factors in the atmosphere and the eventual impact on global climate change.

- **Stratospheric Ozone Depletion**

Various compounds, including CFCs, halons, carbon tetrachloride, methyl chloroform, fluorine, chlorine, bromine, iodine or astatine containing compounds have been accumulating in the troposphere, and are transported into the stratosphere through vertical atmospheric motion. Within the troposphere, the compounds are relatively inert, and the primary concerns are for concentrations that would be considered toxic. In the stratosphere, these compounds participate in complex chemical reactions to destroy ozone, a compound that absorbs most of the UV radiation from the sun. Destruction of the ozone layer thus increases the penetration of UV radiation to the earth's surface, a known risk factor that would increase the incidence of skin cancers, cataracts and immune deficiencies. The increased UV radiation may potentially contribute to crop and fish damage and further degrade air quality by increasing the UV radiation available in the troposphere for photochemically generated pollutants.

Ozone in the stratosphere is formed by the photolysis of molecular oxygen (O_2). The chlorine chemistry that destroys the O_3 uses reactive chlorine, freed by photochemical reaction with UV radiation, from CFCs or other compounds as a catalyst for the disassociation of an oxygen atom from O_3. The chlorine atom is then released by further reactions and free to catalyze additional O_3 destruction. A single chlorine atom may destroy as many as 100,000 ozone molecules before it is inactivated or eventually returned to the troposphere, where precipitation or other processes removes it from the atmosphere (Stolarski, 1988).

Recent research (Newman et al., 1993) has shown a primary mechanism for causing large changes in the Arctic stratospheric chemistry has been mixed processes within polar stratospheric clouds (PSCs). The PSCs consist of various nitric acid hydrates, sulfuric acid aerosols, and water ice particles. During early and mid-winter when temperatures drop to below 195° Kelvin, the conditions are established for ozone removal as sunlight returns at the end of winter. In the northern hemisphere vortex (the Arctic region where ozone depletion occurs), the period of significant loss is relatively short because of the warmer, less stable Arctic vortex dissipating by late winter. When the PSCs are formed, the chemical reactions that take place dramatically shift the balance between inactive and active forms of chlorine and increase the efficiency of chlorine in catalytic ozone removal.

Observing the seasonal onset of the chemical ozone loss is not as easily performed in the northern hemisphere as it is in the southern hemisphere because it is masked by increases that are a result of air transport (Proffitt et al., 1993). Furthermore, loss of stratospheric ozone in the mid-latitudes is not completely understood, but it appears that the decreases are due to chemistry occurring at mid-latitudes and transport of ozone-poor air from the polar areas to the mid-latitudes.

In 1990, the National Aeronautics and Space Administration (NASA) provided a report to Congress (NASA, 1990) updating the present state of knowledge of the upper atmosphere. The relevant major findings of the report are summarized below:

- The weight of scientific evidence strongly indicates that chlorinated (largely man-made) and brominated chemicals are primarily responsible for the observed substantial decreases of stratospheric ozone over Antarctica in the springtime.

- While the magnitude of the ozone loss over the Arctic is comparably less than that over the Antarctic, the same potentially ozone-destroying processes have been identified in the Arctic stratosphere. The degree of any future ozone-depletion will likely depend on the particular meteorology of each Arctic winter and future atmospheric levels of chlorine and bromine.

- The analysis of the total-column ozone data from ground-based Dobson instruments shows measurable downward trends from 1969 to 1988 of three to five percent (i.e., 1.8 to 2.7 percent per decade) in the Northern Hemisphere (30 to 64°N latitudes) in the winter months that cannot be attributed to known natural processes.

In early 1992, NASA identified a large concentration of ozone-depleting chemicals in the stratosphere (Parkin and Soong, 1992). The finding led to the prediction that, for the first time, a large region of depleted ozone would develop over a populated area by the end of 1992. That predicted region, over Canada and the northeastern U.S., prompted the U.S. government to accelerate the schedule of phase-out of ozone-depleting substances. Preliminary evaluation of the data collected has shown that the anticipated ozone hole did not appear (Grant, 1993). However, the loss of ozone may have been offset by transported ozone from other latitudes.

3.3 WASTE MANAGEMENT

Waste management is the responsibility of each individual and organization at VAFB. Nonhazardous solid waste is disposed at the Base landfill (see discussion under Chapter 3.5.2, Solid Waste). Hazardous waste management at VAFB is regulated under the Code of Federal Regulations (CFR), Title 40, Parts 260 through 270, and the California Code of Regulations (CCR) Title 22. All projects must comply with the base Hazardous Waste Management Plan (85-50-5/89).

3.3.1 Toxic and Hazardous Waste

Hazardous wastes not recycled or reused are placed in interim storage for up to 90 days at the designated Collection Accumulation Points (CAP) on base, managed by Jacobs Services Company. Jacobs Services Company completes paperwork for tracking before transporting the wastes to the permitted Treatment, Storage and Disposal Facility on VAFB (Bldg 3300). From this location, an Environmental Protection Agency (EPA)-permitted hauler (Security Environmental Services, EPA # CAD980887475) collects it for off-site disposal. The Defense Reutilization and Marketing Office, a government agency that operates the permitted storage facility at the base, contacts the hauler whenever hazardous waste must be removed off base.

Flammable materials storage lockers are located inside Bldg 1555. Solvents utilized for cleaning during satellite processing will be stored in these lockers. A large walk-in bunker, located outside Bldg 1555, will be used for storage of ordnance.

Toxic and hazardous materials that are part of the satellite, or will be utilized during satellite processing, have been identified in previous documents (OSC, 1993; DSI, 1994). These materials are briefly listed below.

NiCd Batteries. Five 28 volt 80 amp-hour nickel cadmium (NiCd) battery packs are contained on the satellite. Each battery pack is protected from catastrophic shorting by a 30 amp fuse.

Ammonia. One heat pipe within the satellite contains 48.6 cubic inches of ammonia gas pressurized at 124 pounds per square inch atmospheric (psia) at 20° Celsius (nominal), or 600 psia at 80° Celsius (maximum operating).

Compressed Gas. A dry nitrogen gas purge will be used periodically in Bldg 1555 to control satellite cleanliness. Up to eight bottles of compressed gas at approximately 2,000 pounds per square inch gage (psig) will be stored in Bldg 1555 for use during processing activities.

Solvents. Solvents such as isopropyl alcohol are used for cleaning sensors and solar cells (TRW, 1993). A maximum of one gallon of solvents would be used for satellite processing (DSI, 1994). Records of solvent use for the proposed action will be kept.

3.3.2 Pollution Prevention

Pollution prevention policies and procedures have been issued by the federal government through the Pollution Prevention Act of 1990, the National Environmental Policy Act (Pollution Prevention), Department of Defense Directive 4210.15, and Council on Environmental Quality memoranda. These laws and regulations require agencies to investigate and act on pollution prevention and waste minimization opportunities at their facilities. The objectives of pollution prevention programs are to: (1) prevent or reduce waste at the source; (2) recycle or reuse waste that cannot be prevented or reduced; (3) treat waste that cannot be prevented or recycled; and (4) dispose of waste only as a last resort.

Section 313 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 requires facility owners or operators to file an annual toxic chemical release inventory (TRI). This applies to listed toxic chemicals, and in addition, includes a toxic chemical source reduction and recycling report for the preceding calendar year. The report is to include the following information:

- The quantity of the chemical entering any waste stream prior to recycling, treatment, or disposal during the calendar year and the percentage change from the previous year;
- The amount of chemical which is recycled, the recycling process used, and the percentage change from the previous year;
- The source reduction practices used;
- An estimation of the expected production and recycling of the toxic chemicals in the two years following the reporting year;
- A ratio of production in the reporting year to the previous year;
- The techniques used to identify source reduction opportunities;
- The amount of toxic chemical released into the environment from a catastrophic or other one-time event; and
- The amount of the chemical which was treated and the percentage change from the previous year.

Executive Order Number 12856 mandates all federal facilities to comply with this TRI reporting requirement, with reports due on or before July 1, 1995.

A strategy for a national approach to incorporate pollution prevention into Environmental Protection Agency (EPA) programs was issued in the Federal Register on February 26, 1991 (CFR, 1991). As part of the EPA comprehensive national pollution prevention strategy, an Industrial Toxics Project was developed to target specific chemicals from the manufacturing sector and to develop focused prevention strategies for these chemicals. The 17 EPA Industrial Toxics are benzene, cadium, carbon tetrachloride, chloroform, chromium, cyanide, dichloromethane, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, nickel, tetrachloroethylene, toluene, trichloroethane, trichloroethylene, and xylene. These chemicals were identified because they have been determined to pose significant risks to human health and the environment. A program was developed to set voluntary goals of reducing total environmental releases of these chemicals by 33 percent by the end of 1992 and 50 percent by the end of 1995.

The EPA 17 Industrial Toxics program was designed to reduce releases of the targeted chemicals from the 1988 Toxics Release Inventory (TRI) levels reported under Section 313 of the Emergency Planning and Community Right-to-Know-Act.

The Air Force Pollution Prevention Program Action Memorandum, issued by the Secretary of the Air Force and the Air Force Chief of Staff on January 7, 1993, establishes goals of the Air Force Pollution Prevention Program. The primary goal is to "prevent future pollution by reducing hazardous material use and releases of pollutants into the environment to as near zero as feasible." In addition, Executive Order 12856 (Federal Compliance with Right-to Know Laws and Pollution Prevention Requirements) requires federal agencies to develop pollution prevention strategies to achieve voluntary goals of reducing emissions of toxic chemicals or toxic pollutants by 50 percent by the year 2000.

The Air Force Pollution Prevention Program Action Plan sets out the overall strategic goal for Air Force pollution prevention and lists specific objectives and targeted subobjectives in six major areas of Air Force activities. These are:

1. All phases of new weapons systems
2. Existing weapons systems
3. Installation and Government Owned Contractor Operated facilities
4. Existing pollution prevention technologies identification and distribution
5. Pollution prevention technologies research and development
6. Investment strategy

Objective 3 includes the goal of reducing purchases of EPA 17 Industrial Toxics by 50 percent (from the 1992 baseline year) by the end of 1996.

The goal of Department of Defense Directive 4210.15, Hazardous Material Pollution Prevention (HMPP) is to eliminate or reduce the use of hazardous materials in processes and products, instead of relying on management of hazardous wastes. Where the use of hazardous materials cannot be avoided, personnel are to apply management practices that avoid harm to human health and the environment.

Pollution prevention is the responsibility of each individual user (i.e., tenant, contractor, etc.) and organization on VAFB who engages in any activity that uses, stores or disposes of any substance which could result in emissions of pollutants to the environment. Opportunities for pollution prevention are continually identified during the course of program planning. These opportunities are evaluated and implemented to minimize costs and prevent potential harm to the environment.

3.4 ENERGY

Energy requirements for the STEP M3 launch are mainly for support and launch operations, as identified in Chapter 3.1. These operations will require diesel and jet fuel (JP-4) for the aircraft. Energy requirements are presented in Table 3-2.

Table 3-2

STEP M3 Energy-Related Requirements

	Energy Consumption per launch (gallons)	
Equipment	**Diesel**	**JP-4**
Forklift	3.3	--
Truck	3.6	--
Hydraulic Lift	3.3	--
L-1011	--	7,475
F-16	--	2,028

3.5 SPACE DEBRIS

Space debris is generated by manned and unmanned space programs. While meteoroids are a source of naturally occurring orbital debris, they are not considered to be a serious hazard due to their essentially consistent population, transient nature through the near-earth environment, larger volume of occupied space and generally predictable population for spacecraft design (Baker, 1989). Since the launch of Sputnik over 30 years ago, there have been in excess of 7,500 mission-related objects deposited in outer space. Present estimates show the population at 7,000 to 8,000 objects of size 10 centimeter (cm) or larger, 35,000 to 150,000 objects in the 1-10 cm range, and 3-40 million under 1 cm (TRW, 1994). The number of objects per unit volume (object density) varies with altitude, with a peak object density at about 800-1,000 kilometers (km). The debris population is increasing as a result of newly launched objects, explosions, collisions, and breakup of boosters and spacecraft. The number of intact objects is increasing by about five percent annually, and the number of fragments is increasing at about two percent annually. The fragment growth is expected to be about four percent after the year 2010. The space debris poses the greatest hazard to human activities in manned and unmanned programs in outer space. Collisions with space debris could cause varying degrees of damage. Slow degradation of spacecraft capability could occur, due to pitting or fracturing of optical surfaces, solar cell cover glasses or special thermal coatings. In addition, launching upper stages with solid-propellant rocket motors could place clouds of small to large particles that could erode spacecraft surfaces passing through the cloud at high velocities.

While the concerns of space debris and their effects are now being designed into spacecraft, there is valid concern over the safety and related issues with space debris reentering the earth's atmosphere and potentially impacting the earth. Historical data shows that some satellite pieces can survive the harsh environment of reentry into the earth's atmosphere. Well-known examples include the Russian Kosmos 954, which scattered pieces in northern Canada in 1978, and the National Aeronautics and Space Administration (NASA) Skylab satellite, which fell in Australia in 1979. The reentry issue is of importance since legal precedence on international liability for the consequences of damage and cleanup has been set with the January 1978 burn up and disintegration of the Soviet Kosmos 954 satellite (Baker, 1989). The Kosmos 954 was an ocean surveillance satellite containing a nuclear power source fueled by about 50 kg of uranium that burned up in the atmosphere and disintegrated in the Great Slave Lake region of northern Canada. Of the refuse recovered, all but two pieces were radioactive, some of them lethally so. The reentry of vehicles has been studied by the Air Force (USAF, 1993), and a number of factors that affect satellite breakup were identified. These factors included:

- Surface material of the satellite;
- Vehicle attitude during reentry;
- Vehicle size and shape;
- Reentry flight path angle;
- Reentry velocity; and
- Vehicle construction characteristics.

Through tests that were performed in the Vehicle Atmospheric Survivability Tests and the Vehicle Atmospheric Survivability Project, additional information was gained on the breakup and trackability of satellites. The results of the tests on these satellites showed initial minor fragmentation starting about 45 to 49 nautical miles altitude (83 to 90 km), with the final major breakup occurring at around 42 nautical miles (78 km).

3.6 SAFETY AND RISK

Safety reviews are required for any program on Vandenberg Air Force Base (VAFB). Reviews apply to the satellite, its experiment payload, support equipment, and facilities. The safety review procedure provides the means of substantiating compliance with program safety requirements, and encompasses all system safety analyses and testing as required by Department of Defense (DOD).

The STEP M3 System Safety Program is being conducted in accordance with the Space Test Experiments Platform System Safety Program Plan (TRW, 1990). This plan has been prepared to evaluate system safety requirements, hazard analyses, and system safety data of the program. It provides a description of the system safety management system, including responsibilities, milestones, and means of implementing system safety criteria. Other applicable safety compliance documents include:

- MIL-STD-1574A, System Safety Program for Space and Missile Systems;
- AFFTCR 127-3, Safety Planning for Air Force Flight Test Center Tests;
- WRR 127-1, Western Range Safety Requirements;
- MIL-STD-1522A, Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems;

- MIL-STD-1576, Electro Explosive Subsystem Safety Requirements and Test Methods for Space Systems;
- CSTC Regulation 127-1, Space Test Safety;
- MIL-STD-454L, Standard General Requirements for Electronic Equipment;
- DOD-E-83578A, Explosive Ordnance for Space Vehicles, General Specifications;
- SSD-TD-0005(B), Pegasus Design Safety Requirements;
- SSD-TD-0018(A), Pegasus Safety Requirements for Ground Operations; and
- SSD-TD-0067, Pegasus Air Force Small Launch Vehicle (AFSLV) Safety Program Plan;

The STEP M3 satellite, experiments, and associated ground support equipment have been reviewed in an Accident Risk Assessment Report (ARAR), to ensure compliance with safety standards (DSI, 1994). A Test Operations Risk Assessment (TORA) is included in the ARAR. System safety inputs and reviews of operational procedures are ongoing, as the documentation for plans and procedures is approved.

3.6.1 Hazardous Subsystems

Subsystems associated with the satellite, its experiments, and related ground support equipment were analyzed in the ARAR and TORA to identify potential design and operational hazards. These primary hazards may result in accidents that affect personnel, the satellite, and/or other property. Potentially hazardous subsystems include structural, ordnance, pressurized/propulsion, radiation-producing, and electrical. The subsystems and associated hazards are summarized below.

The satellite structure consists of modules bolted together to form the vehicle. Primary hazards identified include structural failure under hoisting or launch loads, and inadvertent deployment of antennas, simulator frame, or solar panels.

The ordnance subsystem consists of pyrotechnically activated line cutters and pin pullers, which are used to initiate deployment of solar panels, and Space Ground Link System antennas. In addition to the pyrotechnic devices, the ordnance subsystem includes two pyrotechnic control units, a launch vehicle interface unit, firing circuitry, and Arm/Safe plugs. These components route firing current from the battery to the pyrotechnic devices, and provide the required isolation and inhibits to accidental firing of pyrotechnics during ground operations. Testing of the ordnance will be conducted during processing at VAFB. Primary hazards identified with the ordnance subsystem include collision and/or burn injury due to inadvertent firing of ordnance.

Pressurized subsystems of the satellite include the heat pipe portion of the thermal control subsystem. One ammonia-filled heat pipe is located internally, attached to the bottom surface of the core late in the adapter module, to assist in temperature stabilization. The heat pipe contains no moving parts, and is not readily accessible when installed. Primary hazards identified include contamination, fire and/or explosion due to mechanical failure or leakage allowing release of anhydrous ammonia gas.

Radiation-producing components of the satellite include an electrically powered X-Ray source in the Satellite Attack and Warning and Assessment Flight Experiment (SAWAFE). This source, which is capable of a maximum power output of 1 milliroentgen (mR) at one foot, is used periodically as a controlled simulator for the experiment's X-Ray sensors. Additionally, the telemetry transmitter located within the core module of the satellite can radiate at power levels up to 5 watts, with a nominal frequency of 1.8 gigahertz. Transmitter output is routed by the antenna leads to two dummy loads which are mounted on the satellite for ground operations and removed immediately before flight. In flight configuration, transmissions radiate from either one or both Space Ground Link System transmitter antennas. While the satellite and its experiments are in a dormant (non-radiating) mode before, and during launch, radiation exposure from these components is a potential hazard if ground testing is conducted improperly. The potential for radio frequency interference with other spacecraft during operation is non-existent.

The electrical power subsystem of the satellite consists of five 28-volt nickel cadmium (NiCd) rechargeable battery packs, which provide power to the electrical and electronic components. Electrical ground support equipment is also used for operation, testing and diagnostic work on the satellite. Potential hazards include burns from short circuits of the battery pack(s), burns or corrosion from leaking potassium hydroxide battery electrolyte, and electric shock from improper operation or hookup of ground support equipment.

3.6.2 Risk Scenarios

Safety concerns regarding the proposed action can generally be divided into three categories: injury to personnel, damage to the space vehicle, and damage to other structures or subsidiary facilities. These hazards may be related to hazardous materials used in the satellite, experiments, and ground support equipment, or may be inherent to the satellite materials, design and operation. Accidents which may result in injury or damages are summarized in Tables 3-3 through 3-5.

Table 3-3

Potential Injuries to Personnel

Potential Injury	Cause(s) of Accident
Collision with accidentally released antennas or panels	Activation of release devices due to electromagnetic interference, personnel error, or short circuits
Burn from release of hot gases	Structural failure of electro-explosive device housing to contain gases when accidentally activated
Burn to finger(s) or hand if ordnance is being handled when inadvertently fired	Activation of pyrotechnic firing circuitry due to static electricity or personnel error
Burn or blast from an explosion of system pressurized component	Mechanical failure or leakage of a thermal control pressurized component allowing release of anhydrous ammonia gas
Illness from exposure to Radio Frequency (ionizing) radiation during ground testing	Activation of X-Ray source in SAWAFE without personnel shield
Long-term illness due to excessive Radio Frequency (non-ionizing) radiation from the Space Ground Link System	Improper operation of ground support equipment during satellite functional testing
Burn from uncontrolled short circuit of 28-volt battery pack	Intrusion of conductive foreign object, such as a screwdriver, into active satellite electronics
Chemical burn or eye damage from leaking of potassium hydroxide battery electrolyte	Very high overcharge rate over extended time Defective battery case or internal construction
Electric shock	Improper operation or hookup of ground support equipment

Source: DSI, 1994

Table 3-4

Potential Damage to the STEP M3 Satellite and AFSLV

Potential Damage	Cause(s) of Accident
Collision impact after unexpected release from hoisting sling or collapse during launch operations	Structural failure of one or more components under hoisting or launch loads
Collision damage to solar cells from accidentally released panels	Activation of pyrotechnic release devices due to electromagnetic interference or personnel error
Collision damage to AFSLV third stage due to accidentally deployed ACTEX frame	Possible short circuits
Fire and/or explosion from release of hot gases (in a flammable environment only)	Structural failure of electro-explosive device housing to contain gases when accidentally activated
Damage or destruction from an explosion system of pressurized component	Mechanical failure or leakage of a thermal control pressurized component allowing release of anhydrous ammonia gas
Electrical harness fire from uncontrolled short circuit of 28-volt battery pack	Intrusion of conductive foreign object, such as a screwdriver, into active satellite electronics
Corrosion to satellite hardware from leaking of potassium hydroxide battery electrolyte	Very high overcharge rate over extended time Defective battery case or internal construction

Source: DSI, 1994

Table 3-5

Potential Damage to Property and Structures

Potential Damage	Cause(s) of Accident
Collision of accidentally released antennas or panels with test equipment	Activation of release devices due to electromagnetic interference, personnel error, or short circuits
Fire and/or explosion from release of hot gases (in a flammable environment only)	Structural failure of electro-explosive device housing to contain gases when accidentally activated
Contamination, fire and/or explosion system	Mechanical failure or leakage of a thermal control pressurized component allowing release of anhydrous ammonia gas

Source: DSI, 1994

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

This chapter presents a discussion of the potential environmental consequences that could result from implementation of the proposed launch of the Space Test Experiments Platform Mission 3 (STEP M3) spacecraft on the Air Force Small Lauch Vehicle (AFSLV), known commercially as the Pegasus XL, from Vandenberg Air Force Base (VAFB). The no action alternative is also analyzed in this chapter. The evaluation focuses on the environmental issues which have the potential to be adversely impacted. The significance of potential adverse impacts is discussed for each environmental subject.

4.1 NO ACTION ALTERNATIVE

Under the no action alternative, existing facilities planned for use by this program would not be used. The environmental resource areas discussed in Section 3 would not be affected, and no adverse impacts would occur. Because of the minimal and less than significant impact of the proposed action (discussed below under subchapter 4.2), their avoidance by the no action alternative does not present a substantial environmental advantage. The primary disadvantage of the no action alternative would be the inability to collect the needed scientific data.

4.2 PROPOSED ACTION

4.2.1 Air Quality

This chapter describes air pollutant emissions attributable to support and launch operations for the STEP M3.

- **Ground Support Operations**

The STEP M3 satellite will be delivered to VAFB by truck. Upon delivery to Building (Bldg) 1555, the Vehicle Integration Facility, it will be unloaded to the processing area using a forklift and proceed through inspection and validation tests.

The satellite will be integrated with the Pegasus XL launch system at Bldg 1555. The integrated payload/launch vehicle assembly will then be moved by truck on a trailer to the Pegasus Hot Pad Loading Area. There, it will be unloaded using a crane or a hydraulic lift, and carefully moved for attachment to a Lockheed L-1011 for an air launch.

The attachment of the STEP M3 assembly to the aircraft will be conducted over a three-day period at the hot pad area. Power for the attachment operations and air conditioning at the hot pad area has been installed. No generators will be required for the proposed action.

Operations described above result in emissions to the atmosphere. Emissions from payload and payload/launch vehicle movement consist of combustion products from transport trucks. There are also minimal amounts of isopropyl or denatured alcohol from wipedowns. Emissions from these operations for a single STEP M3 launch are presented in Table 4-1.

Table 4-1

STEP M3 Ground Support Operations Emissions

	Emissions, lbs/launch				
Activity	**CO**	**HC**	**NO_X**	**SO_X**	**PM**
1. Forklift unloading	0.18	0.05	0.44	--	0.03
2. Alcohol wipedown	--	6.57	--	--	--
3. Assembly truck transfer	0.30	0.08	0.65	--	0.15
4. Hydraulic lift for attachment	6.50	0.15	1.55	0.10	0.08
TOTAL EMISSIONS	**6.98**	**6.85**	**2.64**	**0.10**	**0.26**

Source: Engineering-Science

CO - carbon monoxide
HC - hydrocarbons
NO_X - nitrogen oxides
SO_X - sulfur oxides
PM - particulate matter

1 - Based on 1-hour operation of a diesel-fueled 50-horsepower forklift
2 - Based on maximum use of 1 gallon of isopropyl alcohol
3 - Based on a maximum 20-mile roundtrip
4 - Refer to OSC, 1993

- **Launch Operations**

Emissions from launch operations that affect surface air quality are attributable only to the landing and takeoff of the L-1011 from which the Pegasus XL launch vehicle and the STEP M3 payload will be launched. Emissions for the Pegasus XL were previously quantified and addressed in USAF (1994) for the STEP Mission 1. However, that analysis was based on two flights, a rehearsal and a launch. There will be no rehearsal for the proposed STEP M3 launch. The launch operations associated with the proposed action are presented in Table 4-2.

Emissions from the ground-based and launch-based operations associated with the STEP M3 project, as presented in Tables 4-1 and 4-2, are minor. Aircraft launch operations are exempt from permit requirements. A comparison of the launch emissions from the proposed action with other launch operations at VAFB is not possible, since cumulative launch emissions have not been quantified for the base. Ground support emissions are expected to receive a de minimus exemption, since they are not expected to exceed VAFB's aggregate limit (see discussion in Appendix B). Since this exemption has not yet been approved, it is not possible at this time to quantify the proportion of the emissions from the proposed action in terms of the allowable VAFB permit limit. The overall STEP M3 emissions are minor in quantity and generated during a very short period of time at a location that is isolated from the general public, with virtually no impact on local air quality.

Table 4-2

STEP M3 Launch Operation Emissions

	Emissions, lbs/launch				
Activity	**CO**	**HC**	**NO_x**	**SO_x**	**PM**
L-1011 Landing/Takeoff Cycle[1]	354	249	63	7	NA[2]
F-16 Landing/Takeoff Cycle[3]	27	1	15	1	0.2
Total Emissions	381	250	78	8	0.2[2]

Source: Engineering-Science

[1] Based on EPA AP-42 emission factors and one landing/takeoff cycle each

[2] No PM emission factors are available for the L-1011

[3] EPA AP-42

4.2.2 Global Climate Change and Stratospheric Ozone Depletion

Four types of emission scenarios exist for the launch of the STEP M3 satellite. The first is the emissions from surface operations that will contribute greenhouse gases and ozone-depleting compounds into the atmosphere. Given enough time, emissions from these sources will eventually migrate into the stratosphere. The second scenario, similar to the first, is emissions from a launch within the troposphere that may migrate into the stratosphere. The third scenario is a direct injection of emissions by a launch vehicle passing through the stratosphere. Finally, the fourth is the potential deposition of materials from the satellite into the stratosphere with reentry and breakup of the satellite.

Quantities of the exhaust products of the solid-propellant rocket motors (SRMs) used in the Pegasus XL are not directly known but can be estimated using the nature and ratio of exhaust products from similar vehicles that use the same launch propellants, oxidizers and other chemical components that have been widely studied. The information presented here was obtained by comparing data from the Pegasus launch vehicle (USAF, 1989; OSC, 1993) to the most currently available information on the Pegasus XL (OSC, 1993).

The Pegasus XL will use three stages of SRMs to boost the payload into 450 km circular orbit. As a conservative estimate of the emissions, all combustion and ground-related operation emissions are assumed to eventually migrate into the stratosphere. Thus, the impact on global climate change and stratospheric ozone depletion will include emissions from ground processing activities, emissions from launch vehicle transport using the L-1011 aircraft, rocket motor emissions, and satellite reentry into the atmosphere.

- **Emissions of Greenhouse Gases and Ozone Depleting Compounds**

To calculate the quantity of greenhouse and ozone-depleting compounds emitted into the atmosphere during the STEP M3 launch, the tropopause (boundary between the troposphere and stratosphere) was assumed to be approximately 15 kilometers (km) (49,000 feet), and the upper stratospheric boundary was assumed to be 50 km (164,000 feet). These altitudes are consistent with calculations made by Prather et al., (1990) and NASA (1990). From the mission profile presented in Figure 2-4, the tropopause would be reached shortly after launch during the first stage burn. This burn will carry the launch vehicle from 11.5 km (7 miles) to about 60 km (37 miles), and above the stratosphere. This first stage SRM accounts for over 75 percent of the total solid propellant carried by the Pegasus XL. While it is recognized that HC1 released in the lower to mid-troposphere will likely be washed out as acid rain, the initial release of HC1 starts just below the tropopause and has therefore been included in the calculations for potential ozone depletion in the stratosphere. For the purposes of this analysis, it is assumed that all emissions from the SRMs may potentially migrate to the stratosphere, either from below or above. This analysis has also included the second and third stage SRM emissions. Even though the upper stages burn to an altitude of about 740 km (460 miles), with time the emissions will eventually fall back into the stratosphere and impact the ozone concentrations.

The following analyses are based on the launch of the STEP M3 satellite from the airborne platform. The total estimated emissions for the two compounds that have the greatest impact on global climate change and ozone depletion, carbon monoxide (CO) plus carbon dioxide (CO_2) and hydrogen chloride (HCl), respectively, are shown along with other constituents in Table 4-3. The CO is significant because it is anticipated that CO will rapidly oxidize to CO_2 due to initial high temperatures and the abundance of oxygen.

Table 4-3

Emissions of Greenhouse and Ozone-Depleting Compounds During the Launch of the STEP M3 Satellite

Combustion Product	L-1011 Emissions (tons)	F-16 Emissions (tons)	SRM Exhaust (tons)	Total Launch (tons)
CH_4[a]	--	--	--	--
CO_2 + CO[b]	--	--	5.10	5.10
HCl	--	--	3.92	3.92
H_20	--[d]	--[d]	1.86	1.86
N_2[c]	--	--	1.74	1.74
NO_x	0.5[e]	0.2[f]	1.77	2.47

a Exhaust emissions are assumed to be minimal

b The emitted CO from the SRM will be rapidly converted to CO_2 due to the high initial temperature and abundance of oxygen. CO from the L-1011 is assumed to remain as CO and is not included.

c For worst case assumption, N_2 here has all assumed to be a precursor to N_2O

d Water vapor emissions for the L-1011 and F-16 were not available. These are assumed to be insignificant.

e The NO_x was calculated using EPA AP-42 emission factors using an assumed 163.4 minute flight time composed of 32.8 minute taxi, 0.7 minute takeoff, 40 minute climb, 35 minute cruise, 40 minute approach and 14.9 minute final taxi

f The NO_x was calculated using EPA AP-42 emission factors for the landing takeoff cycle plus the 40 minute climb, 35 minute cruise and 40 minute approach.

The total propellant weight of all stages of the Pegasus XL SRM in the launch is 19,761 kilograms (OSC, 1993). Emissions were obtained by scaling the emission rates for the Pegasus (USAF, 1989) by the increased solid propellant weight of the Pegasus XL.

Emissions from ground support activities that are directly attributable to the launch of the STEP M3 satellite and would contribute to the greenhouse effect and deplete the ozone layer are considered insignificant relative to the actual launch emissions. Surface emissions of these gases may include internal combustion sources that produce water vapor, CO_2, methane (CH_4) or nitrogen compounds, as well as operations that could release chlorofluorocarbons (CFCs). These operations include the use of air conditioning and fire protection systems and solvents that would potentially contain ozone-depleting compounds, CH_4, and substances that would lead to the formation of nitrous oxide (N_2O). These substances are known as N_2O precursors. The major assembly and related activities will be performed off-site and are detailed in the Pegasus Environmental Assessment (EA) (USAF, 1989).

Upon satellite reentry, the only major material expected to survive will be the titanium passive joint of the ACTEX II experiment (Aerospace, 1993). Recent work evaluating the heterogeneous and homogeneous reactions that can deplete stratospheric ozone has shown a very small impact on concentrations (TRW, 1994). Heterogeneous reactions take place on the surfaces of particles while the homogeneous reactions involve the generation of gases by deorbiting debris that react with, and destroy, the ozone. The evaluation methodology looked at the direct orbital decay of large and small particles as well as stripping small particles from surfaces of the larger space objects by aerodynamic drag forces generated during the deorbit/reentry process. To determine the depletion of ozone, the population density of the deorbiting debris was evaluated, and the flux into the stratosphere calculated. Assuming reasonable debris population increases as a result of future space launches, the resultant ozone depletion by heterogeneous and homogeneous mechanisms were estimated.

- **Comparison of STEP M3 to Global Emissions**

The average global stratospheric ozone-depletion rates for the types of chemicals that would be emitted by a Pegasus XL and associated L-1011 flight were calculated as a percent effects per ton of emission. For each ton of chlorine emitted, a 2.5×10^{-5} percent reduction of stratospheric ozone would occur (Brasseur and Solomon, 1986). For each ton of nitrogen oxides emitted, a 1.00×10^{-6} percent reduction of ozone would occur (Brasseur and Solomon, 1986). The calculated depletion of stratospheric ozone is included in Table 4-4.

Table 4-4

Calculated Depletion of Stratospheric Ozone Resulting from Launch of the STEP M3 Satellite

Combustion Product	Total Launch Emissions (tons)	Global Emissions (tons/yr)	Fraction of Global (Percent)	Reduction in Stratospheric Ozone (Percent)
CH_4[a]	--	1.1×10^4 tons[b]	--	--
CO_2 + CO[c]	5.10	5.5×10^9[b]	9.3×10^{-8}	--
HCl	3.92	3×10^5	1.3×10^{-3}	9.8×10^{-5}
H_20	1.86	1.4×10^{14} tons[b]	1.3×10^{-12}	--
N_2[d]	1.74	2.8×10^3[e]	6.2×10^{-2}	1.74×10^{-6}
NO_x	2.47	--	--	2.47×10^{-6}

a Exhaust emissions are assumed to be minimal

b Source: USAF, 1991, atmospheric background

c The emitted CO from the SRM will be rapidly converted to CO_2 due to the high initial temperature and abundance of oxygen. CO from the L-1011 is assumed to remain as CO and is not included.

d For worst case assumption, N_2 here has all assumed to be a precursor to N_2O

e Global emissions of N_2O

The exhaust products released in the upper troposphere, stratosphere, and above from the Pegasus XL SRMs will cause ozone depletion as a result of the release of hydrogen chloride (HCl). HCl is produced in the combustion of solid propellants during launch. It is assumed that all of the chlorine in the oxidizer is released as, or rapidly transformed into, HCl. It is estimated that the launch will result in approximately four tons of HCl to be emitted into the atmosphere during the launch. This HCl is all assumed to either be directly injected, or eventually migrate into the stratosphere and deplete the stratospheric ozone concentrations by about 9.8×10^{-5} percent.

N_2O is not a specific exhaust product of the SRM. Potential precursors are present, some of which may catalyze ozone depletion. Assuming, conservatively, that all of these emissions become N_2O, the emissions associated with the launch, including N_2 and NO_x will contribute approximately 4.2×10^{-6} percent to the total ozone depletion.

The contribution of all anthropogenic deorbiting space debris to the depletion of the ozone layer was estimated in TRW (1994). On a global scale, the combined effect of heterogeneous and homogeneous mechanisms in depletion of ozone is estimated to deplete the ozone concentration in the stratosphere by one percent over the next 10,000 to 100,000 years. Thus, the depletion of stratospheric ozone by deorbiting debris, and specifically the STEP M3 satellite, can be considered insignificant.

Water vapor will be an exhaust emission product of the L-1011 and the SRM. Water vapor has both a warming and a cooling effect on global temperatures. Thus, it is uncertain, at this time, what the net effect this will have on global climate change. By most estimates, however, the STEP M3 contribution of this gas should be considered negligible.

Tropospheric ozone formation may result from the launch of the Pegasus XL and associated L-1011 exhaust product emissions. However, relative amounts cannot quantitatively be estimated with the information available and the uncertainty of the photochemical modeling tools.

- **Impact Summary**

The emissions of greenhouse and ozone-depleting compounds from the STEP M3 launch will have an impact on the tropospheric and stratospheric concentrations of these compounds. The significance of the impact on global climate change is unknown because of the current state of knowledge on the interaction and effects of the different gases on whether the total effect will be for global warming or cooling. The significance of the effect of space launches on ozone-depleting compounds is more quantifiable. With the phase-out of ozone-depleting compounds under the Montreal Protocol and Clean Air Act Amendments of 1990, and the recent push for an accelerated phase-out schedule (Parkin and Soong, 1992), the fraction of ozone-depleting compounds attributable to space launches will increase dramatically (Aerospace, 1993). However, even though the fraction contributed by the space launches will increase, the launch impact on the total ozone burden will remain small. This is because even if a total ban on ozone-depleting chemicals were to be implemented immediately, the effects of past chemical emissions would linger for the next 20 years (Parkin and Soong, 1992).

Changes in the levels of stratospheric ozone, which result in an increased incidence of ultraviolet (UV) light radiation at the surface of the earth, have given rise to concerns about a wide variety of health and environmental impacts, including increases in incidences of human cancers and cataracts, suppression of human immune systems, to name a few (EPA, 1988; NASA, 1978). Estimating changes in these areas of concern from stratospheric ozone-depletion is difficult due to uncertainties in estimating baseline ozone-depletion and translating these depletions to the increased incidence of UV radiation at the surface of the earth, and a lack of understanding of the various human and environmental dose/response mechanisms. For non-cancer related impacts, uncertainties are such that the impacts from the proposed action cannot be numerically estimated.

A major effort over the last several decades has been to understand the results of human epidemiologic studies that have investigated the relationship between various forms of skin cancer and increased UV radiation. The EPA has used the results of these studies to support its rulemaking on the protection of stratospheric ozone, concluding that it may be reasonably anticipated that an increase in UV radiation caused by a decrease in the ozone column would result in increased incidences of skin cancer. In addition to the conclusions reached by EPA, other analyses have been published which acknowledge the adverse relationship between reduced stratospheric ozone and increased cancer incidences (Shea, 1988; Van Der Leun, 1986).

The total tropospheric and stratospheric emissions of ozone-depleting compounds resulting from the STEP M3 launch will reduce the stratospheric ozone by about 1.0×10^{-4} (0.0001 percent). Significant adverse impacts to stratospheric ozone are not anticipated.

4.2.3 Waste Management

Waste management will be handled according to existing waste management procedures on VAFB (see discussion below and in Appendix B).

- **Toxic and Hazardous Waste**

Minor amounts of hazardous waste would be generated by STEP M3 processing at VAFB. Approximately one 55-gallon drum of waste, including epoxy and rags contaminated with solvents used for cleaning, is generated during processing of a satellite. This waste will be handled and disposed as hazardous waste. The drum of hazardous waste generated during processing of the STEP M3 satellite would represent approximately 0.4 percent of the average volume of hazardous waste generated on VAFB during the same period (approximately 250-300 drums per month). The volume of hazardous waste anticipated to be generated by the proposed action can be accommodated by the existing hazardous waste handling and disposal system on VAFB.

Protective clothing used during satellite processing will be washable and reusable, rather than disposable. Cleaning of the protective clothing, if needed, during and following processing activities will be done by contractor personnel at Bldg 1555. Wash rinseate will be routed with existing wastewater from Bldg 1555 to the wastewater treatment facility. If the wash rinseate is suspected to contain toxic or hazardous residues, it will be disposed as hazardous waste. If the clothing needs to be disposed, it will be placed with the other waste generated during satellite processing, and properly disposed as hazardous waste.

There is a potential for spills from all buildings and where hazardous materials are used. Spilled material will be placed in containers and transported to the designated Collection Accumulation Point by processing personnel. Bldg 1555 is equipped with an emergency above ground storage tank, located outside of the building, to collect any large spills of hazardous waste. Any hazardous waste in the above ground storage tank would be removed by contractor personnel and properly disposed as hazardous waste.

Protective measures minimizing or eliminating the impacts of hazardous materials used on the satellite and in its processing have been considered and incorporated into design and procedures (DSI, 1994). These are briefly described below.

NiCd. The nickel cadmium batteries will have been installed on the satellite before its arrival at VAFB. The batteries can be removed and replaced, if required, on the satellite during processing operations. The battery packs are fully ventilated aluminum cases, and each individual cell is self-venting at a pressure range between 150 and 300 psig. Each of the battery packs is equipped with a 30-amp fuse to provide automatic protection against a catastrophic short circuit in the satellite. Additionally, each pack is provided with a "battery disconnect" connector located on the outer shell of the core module, which can be easily removed to electrically disable the battery pack. Engineers and technicians assigned to work on the satellite during processing are familiar with the battery connectors, their removal, and their functional ability to render the battery pack safe. The potential for explosion is extremely remote. No significant adverse impacts from the battery packs are expected.

Ammonia (Gas). Only a small amount of ammonia gas is contained in the heat pipe within the satellite, which is inaccessible to personnel during processing operations. Under conditions of a burst-type leak, which releases all the gas simultaneously, minimal concentrations would exist in the satellite (DSI, 1994). Once in the open area of Bldg 1555, ammonia gases would be removed from the area by the air handling system.

Compressed Gas. Normal area ventilation and the two person rule (at least two persons present in the work area at any time) prevent the possibility of adverse effects from total air displacement (by leaking nitrogen or helium).

Solvents. Isopropyl alcohol is the preferred solvent for cleaning, unless another is specifically required. It is not considered hazardous, unless consumed by drinking. The hazardous or poisonous nature of the solvents will be indicated on their storage containers. The solvents will be stored, handled, utilized and disposed in accordance with requirements standard procedures, and no significant impacts are anticipated.

- **Pollution Prevention**

Pollution prevention opportunities have been identified and pursued. The types of solvents used for cleaning operations have been consolidated, and the least hazardous solvent that will perform the desired function will be selected. Procedures for processing of the STEP M3 satellite at VAFB have been developed to minimize the amount of pollution and waste to be generated.

Solvents that may potentially be used during the processing include isopropanol (isopropyl alcohol), toluene, methyl ethyl ketone, acetone, 1,1,1 trichloroethane, a blend of ethanol and 1,1,1 trichloroethane, and Triton X-100 (or similar surfactant). Three of these chemicals (toluene, methyl ethyl ketone, and tricholoethane) are identified as EPA 17 Industrial Toxics. The total quantity of solvents used (combined total) will be less than one gallon. No significant adverse impacts on pollution prevention are anticipated.

4.2.4 Energy

The energy requirements of the STEP M3 project are considered minimal. They are readily available from local supplies, and will not affect the availability of energy for national security and other users.

4.2.5 Space Debris

The design of the STEP M3 is to maintain a useful orbit of the satellite for at least one year with a goal of three years, after which the satellite will reenter the atmosphere. This design is consistent with the U.S. Space Command (USS PALECOM) Regulation 57-2, which implements the policy of minimizing the impact of space debris on military operations (USAF, 1993c). According to this regulation, "design and operation of DOD space tests, experiments, and systems will strive to minimize or reduce accumulation of space debris consistent with mission requirements." The design of STEP M3 helps to remove the satellite from space after the mission is complete but also introduces the potential for problems associated with the reentry.

The breakup of the STEP M3 satellite is assumed to occur when sufficient thermal energy has been transferred to melt the spacecraft. This thermal energy is derived from the frictional heating that occurs at high speed when the satellite reenters the earth's atmosphere and encounters drag due to increased atmospheric density. Once the outer shell of the satellite has reached its melting temperature and broken up, interior components will be exposed to the flow and rapidly begin to heat up and disintegrate as melting temperatures of the interior components are achieved.

The breakup and reentry characteristics of the STEP M3 vehicle were investigated to assess the survival potential of the satellite, or any of its components (Aerospace, 1993). The aluminum primary structure was assumed to be stable during the initial stage of reentry. The initial breakup of the structure is predicted to occur at approximately 44.7 nautical miles, with the largest piece surviving reentry and impacting the earth being the titanium passive joint of the Advanced Controls Technology EXperiment (ACTEX) II. The 122 other small titanium subcomponents may also be expected to survive reentry. Historical data has shown that low ballistic coefficient pieces such as skin fragments, circuit boards, etc., can also survive the reentry environment and contact the earth's surface, but at much reduced speeds. The ACTEX II substructure, along with the low density debris, is expected to be spread along approximately 375 nautical miles of the reentry ground track. Although not quantified in the reentry analysis, the probability of personal injury or property damage is so low that the hazard is taken as part of the accepted potential risk for the program. Significant adverse impacts from space debris are not expected, and the U.S. Air Force, Space and Missile System Center has accepted the STEP M3 program risks.

4.2.6 Safety and Risk

Material, design and operational hazards identified in the ARAR have the potential to result in accidents which injure personnel, damage the satellite, and/or damage property and structures. Risks associated with these hazards are addressed in this chapter. Risk assessment involves categorizing hazards according to their severity and probability of occurrence. These are described below.

- **Severity**

The severity of a hazard or risk is classified by the extent of injury or damage from an accident. Table 4-5 details the categories used to describe hazard severity.

Table 4-5

Hazard Severity Categories

Category	Classification	Description
I	Catastrophic	May cause death or system loss
II	Critical	May cause severe injury, severe occupational illness, or major system loss
III	Marginal	May cause minor injury, minor occupational illness, or minor system damage
IV	Negligible	Will not result in injury, occupational illness, or system damage

Source: DSI, 1994

- **Probability**

Hazard probability is expressed qualitatively. It is defined as the likelihood that a hazard will occur. The six levels of probabilities are listed in Table 4-6.

Table 4-6

Hazard Probability Categories

Potential Occurrence	Level	Description
Frequent	A	Likely to recur, and may be continuously experienced.
Reasonably Probable	B	Likely to occur several times.
Occasional	C	Likely to occur sometime.
Remote	D	Unlikely to occur, but possible.
Extremely Remote	E	Probability of occurrence cannot be eliminated to zero. It can be assumed that this hazard will not be experienced.
Impossible	F	Physically impossible to occur.

Source: Modified from DSI, 1994

- **Assessment of Risks for Primary Hazards**

Severity and probability of the primary hazards of STEP M3 were assessed in the ARAR (DSI, 1994). Although the consequences of some accident scenarios are critical or catastrophic, the probability of each accident occurring is typically remote. Based upon the initial hazard assessments, safety actions for elimination and control of the primary hazards were recommended (DSI, 1994). The safety actions have either been completed or will be implemented during processing procedures. Considering implementation of the recommended safety actions, final risk probabilities were determined. Table 4-7 summarizes the probability, severity, and final risk for the identified hazards.

Table 4-7

Risk Assessment for STEP M3 Primary Hazards

Hazard Description	Probability	Severity	Residual Risk Probability
Structural failure of satellite components	Remote	Catastrophic	Extremely Remote
Inadvertent deployment of antennas, frame or panels	Remote	Marginal	Remote
Inadvertent release of hot gasses	Extremely Remote	Critical	Extremely Remote
Inadvertent firing of ordnance	Extremely Remote	Critical	Extremely Remote
Contamination, injury, fire or explosion due to pressurized component mechanical failure or leakage	Remote	Marginal	Extremely Remote
Radiation exposure (ionizing and non-ionizing)	Extremely Remote	Critical	Extremely Remote
Short circuit of battery pack	Remote	Critical	Extremely Remote
Leakage of potassium hydroxide battery electrolyte	Remote	Marginal	Remote
Electric shock	Occasional	Critical	Remote

Source: DSI, 1994

The identified safety concerns have been considered in planning for the STEP M3 including processing, launch, operation, and disposal. Detailed procedures and training for all hazardous processes have been or are being prepared and implemented. They include use of adequate safeguards and inhibits, clearing personnel from the vicinity during testing, appropriate use of personal protective equipment, and toxic and hazardous materials monitoring. Required safety actions and procedures are described in detail in the ARAR (DSI, 1994). All safety procedures have been or will be reviewed and approved by the STEP M3 System Safety Manager. Satellite processing and launch will be conducted in strict compliance with all applicable safety plans and regulations.

All of the identified primary hazards have a remote or extremely remote potential for occurrence. Therefore, despite the potential for critical or catastrophic accidents, final risk probabilities are considered acceptable. No significant adverse impacts are anticipated.

4.3 CUMULATIVE IMPACTS

VAFB is the location from which intercontinental ballistic missiles and polar-orbiting space satellites are launched. Launch of STEP M3 is planned for the third quarter of fiscal year 1994, and there are also other ongoing launches and various testing and tracking projects on base. However, there are no related projects planned or reasonably foreseen in the vicinity or duration of the proposed action. Subsequent missions of the STEP or AFSLV may be planned for VAFB or other locations in the future. Each of these other actions would be subject to separate environmental reviews as required. For the most part, each of these actions would result in intermittent and short-term impacts to the environment. For these reasons, cumulative impacts of the proposed action are not anticipated or evaluated in this EA.

CHAPTER 5

LIST OF PREPARERS

CHAPTER 5

LIST OF PREPARERS

5.1 U.S. Air Force

Name	Professional Discipline	Experience	Document Responsibility
Hashad, Adel, P.E. (SMC/CEV)	Environmental Engineering and Management	4 yr. Environmental Management; 7 yr. Space Systems Facilities Management; 25 yr. Hydrologic Facilities, Refineries, Public Works, Industrial Design, and Construction	Technical Project Manager
Matta, Richard, Capt (AL/OEB)	Environmental Science and Engineering	10 yr. Environmental Science and Engineering	Contract Management
Hardy, James W., Capt (SMC/CULS)	Developmental Engineering	3 yr. Developmental Engineering	Technical Review
Medoff, Lara, Lt (SMC/CULS)	Developmental Engineering	1 yr. Developmental Engineering	Technical Review
Morell, Michael, Lt (SMC/CULO)	Operations Manager	1 yr. Management	Technical Review

5.2 Engineering-Science

Name	Professional Discipline	Experience	Document Responsibility
Baxter, Robert A., C.C.M.	Meteorology	17 yr. Meteorology/Air Quality	Air Quality Global Climate Change; Stratospheric Ozone; Space Debris
Crisologo, Rosemarie S.	Biology/Environmental Engineering	15 yr. Environmental Sciences	Project Manager; Project Description & Alternatives
Gaddi, Elvira V., P.E.	Chemical Engineering	6 yr. Environmental Sciences; 4 yr. Chemical Engineering; 3 yr. Research & Development	Air Quality
Luptowitz, Lisa	Geology/Paleontology	4 yr. Environmental Sciences	Waste Management; Safety and Risk; Regulatory Review; Document Coordination
Wooten, R.C.	Environmental Science	28 yr. Environmental Studies	Technical Advisor

CHAPTER 6

PERSONS AND AGENCIES CONSULTED

CHAPTER 6

PERSONS AND AGENCIES CONSULTED

The following individuals were consulted during the preparation of this Environmental Assessment.

FEDERAL AGENCIES

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LOCAL AGENCIES

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APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

REGULATORY REVIEW AND PERMIT REQUIREMENTS

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REGULATORY REVIEW AND PERMIT REQUIREMENTS

This appendix presents an overview of the environmental regulatory and permit requirements that may be applicable to the Space Test Experiments Platform Mission 3 (STEP M3) Program. Environmental permit requirements were identified from an analysis of previous Air Force space launch programs and an evaluation of federal, State of California, and local laws and regulations applicable to the program. Provisions of regulations may be jointly administered by federal, state, or local agencies. These requirements are discussed in the following sections for each environmental area. The STEP M3 will be required to comply with all applicable Air Force environmental regulations.

AIR QUALITY

Operations or activities that result in emission of any air contaminant are regulated by Region IX of the U.S. Environmental Protection Agency (EPA), under the federal Clean Air Act of 1963. Under provisions of the Clean Air Act, the local agency is delegated the authority to administer federal policies and grant permits. The California Air Resources Board is responsible at the state level for mobile sources. The local Air Pollution Control District is the Santa Barbara County Air Pollution Control District (SBCAPCD). SBCAPCD has authority over stationary sources of air pollutants emitted from Vandenberg Air Force Base (VAFB). On July 18, 1991, SBCAPCD signed a Memorandum of Agreement with the Air Force to consider (or classify) VAFB as a single stationary source with regard to air quality issues.

The STEP M3 program utilizes the airborne launch concept. SBCAPCD regulations (Rule 202) allow an exemption for aircraft used to transport passengers or freight. Ground operational activities will utilize active sites where all support equipment exists (i.e., new stationary sources of air emissions will not be installed). The STEP program is designed such that the space vehicle arrives fully integrated and flight certified at the launch site. Vehicle assembly, testing, and payload integration will be accomplished at the subcontractor's facilities in McLean, Virginia. Final vehicle testing and integration will occur at the existing Vehicle Integration Facility (Building 1555) on VAFB.

Processing and launch of the STEP M3 from VAFB is not anticipated to require any new air quality permits. An exemption under the existing VAFB permit will be obtained from VAFB Environmental Management (30 SPW/ET) prior to STEP M3 processing. This de minimis emissions exemption will allow the one-time processing and launch of the STEP M3 under the proposed action. Records of processing activities, including solvent use for satellite cleaning, will be kept for verification of the proposed action's exempt status. Additional future regulatory requirements resulting from revision to SBCAPCD rules are not expected to affect the proposed action due to its short duration (i.e., one -time event), and no additional new air quality permits will be required.

HAZARDOUS WASTE

Handling of hazardous waste from all launch programs requires permits and licenses from federal, state and local agencies. The Resource Conservation and Recovery Act (RCRA) of 1976 delegates the EPA to administer a nationwide program to regulate hazardous wastes from generation to disposal. On the state level, Chapter 6.5 of Division 20 of the California Health and Safety Code and the Porter-Cologne Act water quality control provisions operate jointly in the regulation and issuance of permits for hazardous waste facilities. The California Environmental Protection Agency, Department of Toxic Substance Control administers the state's hazardous waste program and maintains the authorization from the EPA to implement the federal program in California. If an operation involves waste discharge that affects water quality, permits must include any limits or requirements imposed by the Regional Water Quality Control Board (RWQCB). A waste is considered hazardous if it contains substances on the lists of hazardous wastes included in 40 Code of Federal Regulations (CFR) Part 261, and the California Code of Regulations (CCR) Title 22, Section 66680.

Under RCRA regulations, VAFB and its tenant programs are considered a hazardous waste treatment, storage and disposal facility (TSDF) because waste is stored on base for more than 90 days. Therefore, the base must comply with general facility standards and technical requirements established by the EPA and California Department of Health Services (CDHS). At present, a Hazardous Waste Storage Facility is allowed to operate under interim status at VAFB. A revised RCRA Part B permit application package was last submitted by the Air Force to CDHS for approval in April, 1993, and is currently still pending. Launching of government payloads would fall under the existing base permitted hazardous waste handling systems.

The California Source Reduction and Hazardous Waste Management Review Act of 1989, commonly referred to as Senate Bill (SB) 14, requires examination of current hazardous waste generating processes for hazardous waste minimization opportunities, and creation of a plan to implement workable alternatives. Any hazardous waste that is treated or recycled on site and hazardous waste that is manifested for off-site recycling, treatment or disposal are subject to the requirements of SB 14. This would include any dilute hazardous waste streams such as contaminated surface water runoff and hazardous waste streams that are pretreated before being discharged to sewers. Spills of liquid propellants (such as hydrazine) or other hazardous waste generated from emergency response actions would be excluded.

Only final ground processing, including satellite cleaning and testing, and launch of the satellite will occur at VAFB. Bldg 1555 at VAFB is equipped to accommodate processing for the proposed action. The existing system for collecting hazardous waste at Bldg 1555, including the above ground storage tank and associated piping, meet the requirements of 40 CFR 265 Subpart J (hazardous waste tank systems).

WATER QUALITY

Wastewater. The RWQCB, Central Coast Region, administers the federal Clean Water Act amended 1989, and the state Porter-Cologne Act of 1969 for Santa Barbara County. The state issues one discharge permit for purposes of both state and federal laws. Under the state law, the permit is called a Waste Discharge Requirement. Under federal law, the permit is called a National Pollutant Discharge Elimination System (NPDES) permit. A NPDES permit is required of all point source discharges of pollutants into surface waters of the United States. No wastewater generation or discharge from final satellite integration at VAFB is anticipated. Therefore, no wastewater permitting activities will be required.

Stormwater. California and federal stormwater regulations do not include government launch activities (Standard Industrial Classification Codes 9711 and 9661). However, the state has authority to designate these activities if they determine discharges are a threat to United States waters. Due to the airborne launch concept for STEP M3, no such threat is anticipated. No changes in the existing stormwater discharge are expected to be caused by STEP M3. Therefore, no permitting will be required.

COASTAL ZONE MANAGEMENT

The federal Coastal Zone Management Act of 1972, as amended (16 USC Section 1456(c)), and Section 307(c)(1) with Section 930.34 et seq. of the National Oceanic and Atmospheric Administration (NOAA) Federal Consistency Regulations (15 CFR 930, revised), require that a Coastal Consistency Determination (CCD) be submitted for proposed actions within the coastal zone. Generally, the coastal zone extends from the state's three-mile seaward limit to an average of approximately 1,000 yards inland from the mean high tide of the sea. The purpose of the CCD is to assure that proposed undertakings by federal agencies are consistent to the "maximum extent practicable" with the NOAA-approved state Coastal Management Plan (CMP).

In California, the California Coastal Commission, as lead agency for the CMP, coordinates the evaluation of a determination and develops a formal state consistency response. As stated in 15 CFR 930, federal activities on federal property are excluded from state-designated coastal zones. However, if a federal activity has a direct impact on the state's coastal zone, this activity must be consistent with the state CMP.

The potential launch site for the STEP M3 is located within federal property. The mission does not involve any new construction in the coastal zone, nor will it have any direct impacts on the coastal zone. Therefore, a consistency determination is not required.

APPENDIX C

AIR FORCE FORM AF-813 FOR STEP M3 PROGRAM

REQUEST FOR ENVIRONMENTAL IMPACT ANALYSIS

FOR ENVIRONMENTAL PLANNING USE ONLY

I REQUEST

1. TO: (Environmental Planning Function) SMC/CUV

2. FROM: (Organization and Office Symbol) SMC/CUL

3. CONTROL NUMBER

4. ESTIMATED COMP DATE 15 Feb 94

5. ACQUISITOR (Name, Office Symbol and Phone No.) Captain Janet Meyer, SMC/CULS, (310)363-6344

6. TYPE OF ANALYSIS NEEDED

X	CATEX DETERMINATION	PRELIMINARY ENVIRONMENTAL SURVEY	ENVIRONMENTAL ASSESSMENT	ENVIRONMENTAL IMPACT STATEMENT

7. TITLE OF PROPOSED ACTION

STEP Mission 3 Space Vehicle Environmental Assessment

II PROPOSED ACTION AND ALTERNATIVES

8. PURPOSE OF AND NEED FOR ACTION (Continued on Sheets)

The Department of Defense (DOD) Space Test Program (STP) proposes to launch and operate the Space Test Experiments Program Mission 3 (STEP M3)spacecraft. The purpose of STEP M3 is to provide inexpensive access to space by procurring a Class C equivalent space vehicle (SV) (per DOD Handbook 343, Design, Construction, and Testing Requirements for a One-of-a-Kind Space Equipment), based on an adaptable spacecraft bus, to support five STP experiments.

9. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (DOPAA) (Continued on Sheets)

The proposed action is to launch and operate STEP M3, in order to fly five DOD experiments at a 68°/77° inclination, 475 km circular orbit. STEP M3 SV is the fourth in the series of STEP SVs being developed to support STP experiments. STEP M3 is scheduled to launch during the third quarter of FY94, and will stay in orbit for approximately three years. It will be launched out of Vandenberg AFB on a Pegasus XL vehicle. The experiments on board STEP M3 include:

- ACTEX II: Advanced Materials Applications to Space Structures
- EDMM: Erasable Disk Mass Memory
- SAMMES: Space Active Modular Material Experiment
- SAWAFE: Satellite Attack Warning and Assessment Flight Experiment
- SQUOD: Space Qualifiable Optical Disk

Descriptions of the experiments are provided on the appended sheets.

10. ORGANIZATIONAL APPROVAL (Name and Grade of Commander) LARRY RENSING, Lt Col, USAF Dep Prog Mgr, Space Test & Small Launch Vehicle | SIGNATURE Larry Rensing | DATE 2 Aug 93

III ENVIRONMENTAL PLANNING RESPONSE

11. RESPONSES ATTACHED

	Preliminary Environmental survey (AF Form 814) attached
	Proposed action qualified for Catex (Appropriate Documentation attached)
	Proposed action does not qualify for Catex, assessment required

12. REMARKS

Since a launch site contract was obtained between Vandenberg and STP, the environmental assessment need only cover the SV launch site processing, launch, on orbit operation, and reentry and breakup.

13. ENVIRONMENTAL PLANNER CERTIFICATION (Name and Grade) | SIGNATURE | DATE

14. ENVIRONMENTAL PROTECTION COMMITTEE APPROVAL (Name and Grade) | SIGNATURE | DATE

STEP M3 includes the following experiments:

ACTEX II will provide a demonstration of "smart cut" technology in space and will also evaluate long term space effects. It consist of a solar array drive assembly (SADA), a graphite-polycyanate actively damped yoke with lead zironconate utanate (PZT) embedded cotrol (ECE). The SADA includes a visoelatic material (VEM) passively damped joint and a biaxial drive assembly, the aluminum frame instrumented with accelerourneters which have integral heaters, and the yoke is instrumented with temperature sensors and has surface mounted active damping control.

EDMM will provide an evaluation of high density magnetic mass memory in a space environent. It consisit of a magnetic mass memory unit assembled from standard, commercially available disk drives. The hardware includes two counter rotating drives, their housing electrical power converters, anti-latchup circutiary, and instrumentation sensors.

SAMMES will provide an evaluation of the effects of natural LEO space environment on materials that will be used on projected space systems. It consisit of a System Control Module 9SCM) and five test Modules ™. The SCM includes two micro controllers, spacecraft communicaition (MIL-STD-1553B bus), TM communications (MIL-STD-1553B bus), 8 mega bytes data storage, power mangement circuitry and analog and bilevel inputs/outputs. Each of the TM's has a specific function and contains a coplement of specific sensors to measure thte effect of the space environment on various materials. The TM's and their respective sensors are summarizes in the following table:

TM's and Their Respective Sensors

Test Module	Sensors
LEO environment Monitor Module	• 2 second surfsce mirror (SSM) calorimeters • 1 black caliorimeter • 2 Kapton/ silver actinometer units • 2 carbon film actinometer units • 1 RAOFET total radiation monitor • 1 temperature controlled Mk-16 OCM(TOCM) • 1 coaled Mk-16 TOCM • 1 sun sensor • 1 sun position sensor
TOCM/Actinometer Module	• 4 test material coated Mk-16 TOCM • 7 test material coated actinmoeter units
RAM Calorimater Module	• 8 test material coated calorimeters • 1BSU calorimeter • 1 sun sensor
WAKE Calorimeter Module	• 7 test materials coated calorimeter • 1BSU calorimeter • 1 black calorimeter • 1 sun sensor
Solar Photovoalc Module	• 2 Remote Solar PV Test Articles • 2 TM mounted test cells/siring • 1 TM-mounted referance siring dose monitor • 1 SSM calorimeter • 1 RAOFET total radiation dose monitor • 1 sun sensor • 1 sun position sensor

SAWAFE will demonstrate that “smart skin” technologies are capable of detecting attacks on spacee assets and will provide an evaluation of environmental effects on the “smart skin” detectors. It consist of an integrally-mounted panel wit h embedded sensors amd a separate electronies box. The sensor panel will be a structural member of the STEP M3 SV.

SQUOD will provid an orbit test and qualification for optical disk technology. It consist of an optical disk mass memory that uses a laser diode source to activate magneto-optic storage meia. A high power disk laser setting is used to hear a small spot on the medium to allow a relatively small magnetic field to induce a flip in the medium’s state of magnetization. The magneto-optic medium also has a high-value magnetic Kerr coeffecient, so that a probe beam, provided by a low-power laser setting, experiences a polarization rotation when passing through the medium at thet spot. The rotated return beam is passed through an analyzer for comparison with the original beam to detect intemsity changes and therby determine the presence of a data bit. To erase the data bitm, the laser high power setting is used to restore the magnetoptic meida ath the spot to its original state. The electromagnetic coikl responsblr for the magnetizing field need not to be precisely positioned since only the heated spot within the recording layer has a coercivity low enough to be affected by the field.

Alternatives:

Since te STEP M3 mission is not urgent, one alternative is not conduct it. Other alteratives include finding launch platform for the payloads, or having the payloads ride piggyback on another mission. These alternatives ae not considered feasible or benefecial.

CONFORMITY DETERMINATION: EPA FINAL CONFORMITY RULE 40 CFR PART 93 SUBPART B (NOVEMBER 1993)

for

SPACE TEST EXPERIMENTS PLATFORM MISSION 3

VANDENBERG AIR FORCE BASE, CALIFORNIA

Prepared for

HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER/CEV
DIRECTORATE OF ACQUISITION CIVIL ENGINEERING
LOS ANGELES AIR FORCE BASE, CALIFORNIA

and

ARMSTRONG LABORATORY/OEB
BROOKS AIR FORCE BASE, TEXAS

Contract No. F33615-89-D-4003
Order No. 081

1 SEPTEMBER 1994

Prepared by

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ES Project No. 723437.00001

CONFORMITY DETERMINATION
EPA FINAL CONFORMITY RULE
40 CFR PART 93 SUBPART B (30 November 1993)
Space Test Experiments Platform (STEP) Mission 3 (M3)
Vandenberg Air Force Base (VAFB), California

PURPOSE: The Air Force is required to make a formal Conformity Determination as to whether the Proposed Action, launch of the Space Test Experiments Platform (STEP) Mission 3 (M3) spacecraft from Vandenberg Air Force Base (VAFB), California, complies with the New Conformity Rule of the Amended Clean Air Act.

BACKGROUND: The United States Environmental Protection Agency (EPA) has issued regulations clarifying the applicability and procedures for ensuring that Federal activities comply with the amended Clean Air Act. The EPA Final Conformity Rule, 40 CFR Parts 93, subpart B (for Federal agencies), and 40 CFR 51, subpart W (for state requirements), implements Section 176(c) of the Clean Air Act, as amended in 1990, 42 U.S.C. Section 7506(c). This new rule was published in the Federal Register on November 30, 1993, and took effect on January 31, 1994.

The new EPA Conformity Rule requires all Federal agencies to ensure that any agency activity conforms with an approved or promulgated state implementation plan (SIP) or Federal implementation plan (FIP). Conformity means compliance with a SIP/FIP's purpose of attaining or maintaining the national ambient air quality standards (NAAQS). Specifically, this means ensuring the federal activity will not: (1) cause a new violation of the NAAQS; (2) contribute to an increase in the frequency or severity of existing NAAQS; or (3) delay the timely attainment of any NAAQS, interim milestones, or other milestones to achieve attainment. NAAQS are established for six criteria pollutants: ozone (O_3), carbon monoxide (CO), particulate matter (PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). The current ruling applies to Federal actions in NAAQS nonattainment or maintenance areas only.

EPA's Final Conformity Rule applies immediately to all Federal agencies until the applicable state's SIP conformity requirements are approved by EPA.

STATUS: The Proposed Action would be located on VAFB, which is in Santa Barbara County, California. Air quality management in Santa Barbara County is under the jurisdiction of the Santa Barbara County Air Pollution Control District (SBCAPCD). In 1991, the SBCAPCD submitted an Air Quality Attainment Plan (AQAP) to the California Air Resources Board (CARB) for the purpose of presenting a comprehensive strategy to bring the County into compliance with the state ambient air quality standards. Because the CARB is still in the process of integrating similar AQAPs from various counties throughout the state, there is no EPA-approved SIP at this time. As a result, the individual counties, such as Santa Barbara are following federal implementation guidelines.

The area of Santa Barbara County containing VAFB is designated "cannot be classified" for SO_2 and PM_{10}, and "cannot be classified or better than national standards" for NO_2 and CO. The entire Santa Barbara County is classified as "moderate" nonattainment for O_3. The classification of the lead standard has not been determined.

The new EPA conformity rule requires that total direct and indirect emissions of criteria pollutants, including ozone precursors (i.e., volatile organic compounds and nitrogen oxides) be considered in determining conformity. The rule does not apply to actions where the total direct and indirect emissions of criteria pollutants will be de minimis. In addition, ongoing activities currently being conducted are exempt from the rule so long as there is no increase in emissions above the de minimis levels specified in the rule. The de minimis threshold levels in nonattainment areas are shown on Table 1. The de minimis threshold level in Santa Barbara County is 100 tons per year.

Table 1
De Minimis Thresholds in Nonattainment Areas

Criteria Pollutant	Degree of Nonattainment	Tons/year
Ozone (VOCs and NOx)	Serious	50
	Severe	25
	Extreme	10
	Other ozone nonattainment areas outside of ozone transport region	100
VOCs	Marginal/moderate nonattainment within ozone transport region	50
NOx	Marginal/moderate nonattainment within ozone transport region	100
Carbon monoxide (CO)	All	100
Particulate matter (PM_{10})	Moderate	100
	Serious	70
Sulfur/nitrogen dioxide (SO_2/NO_2)	All	100
Lead (Pb)	All	25

Source: 40 CFR 93.153 (b)

SUMMARY OF AIR POLLUTANT EMISSIONS ATTRIBUTED TO THIS PROPOSED ACTION:

The emissions of ozone precursors (hydrocarbons and nitrogen oxides) that would result from implementation of the proposed action are shown in Table 2. As shown, the combined emissions from ground support operations, carrier aircraft takeoff and landing result in a total of 256.85 lbs, or 0.13 ton, of hydrocarbons and 80.64 lbs, or 0.04 ton, of nitrogen oxides per launch. A total of one launch would occur for the Proposed Action, and this would occur within a single year. This emission total is below the de minimis threshold level of 100 tons per year.

Table 2
STEP M3 Ground Support
and Launch Operations Emissions of Ozone Precursors

Activity	Emissions, lbs/launch HC	NO_x
Ground Support Operations Emissions		
Forklift unloading[a] 0.05	0.44	
Alcohol wipedown[b]6.57	---	
Assembly truck transfer[c]	0.08	0.65
Hydraulic lift for attachment	0.15	1.55
Subtotal, Ground Support	**6.85**	**2.64**
Launch Operations Emissions		
L-1011 Landing/Takeoff Cycle[d]	249.00	63.00
F-16 Landing/Takeoff Cycle[e]	1.00	15.00
Subtotal, Launch	**250.00**	**78.00**
Total, STEP M3 Emissions	**256.85**	**80.64**

Source: Engineering-Science
HC hydrocarbons (volatile organic compounds, VOC)
NO_X nitrogen oxides

a Based on 1-hour operation of a diesel-fueled 50-horsepower forklift
b Based on maximum use of 1 gallon of isopropyl alcohol
c Based on a maximum 20-mile roundtrip
d Based on EPA AP-42 emission factors and one landing/takeoff cycle each
e Based on EPA AP-42 emission factors

DETERMINATION: The total direct and indirect emissions from the Proposed Action do not exceed the de minimis threshold for the criteria nonattainment pollutant, and therefore, this Proposed Action is deemed de minimis and exempted from the conformity requirements of the EPA Conformity Rule 40 CFR part 93.153(b) and (c), in accordance with Section 176 (c) of the Clean Air Act, as amended in 1990, 42 U.S.C. Section 7506(c).

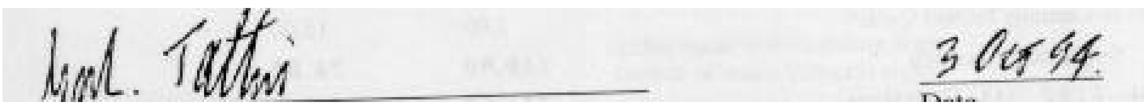
POINT OF CONTACT: Comments on this Conformity Determination may be submitted to:

HQ SMC/CEV
Mr. Adel A. Hashad, P.E.
Environmental Engineer
2420 Vela Way, Suite 1467
Los Angeles AFB, CA 90245-4659

Phone: (310) 363-0934

APPROVED:

HQ SMC Environmental Protection Committee



EUGENE TATTINI — Date
Brigadier General, USAF
Chairperson, Environmental Protection Committee