NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NOTICE: 00-GSFC-03

National Environmental Policy Act; POES NOAA-L and NOAA-M Mission

AGENCY: NASA Goddard Space Flight Center

ACTION: Finding of No Significant Impact

SUMMARY: Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321, *et seq.*), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508), and NASA policy and procedures (14 CFR Part 1216 Subpart 1216.3), NASA has made a Finding of No Significant Impact (FONSI) with respect to the proposed Polar Operational Environmental Satellites (POES) NOAA-L and NOAA-M missions. The missions involve the processing and launching of the NOAA-L and NOAA-M spacecraft. The NOAA-L spacecraft would be launched from Vandenberg Air Force Base, California using a Titan II launch vehicle in August 2000. The NOAA-M spacecraft would be launched from Vandenberg Air Force Base, California, using a Titan II launch vehicle in May 2001. NOAA-L and NOAA-M are part of the NOAA TIROS-N series of meteorological satellites that continue to provide a platform for instruments that monitor the Earth's atmosphere. These polar-orbiting satellites provide cost-effective data for very immediate and real needs and also for extensive climate and research programs. The satellites also support the Search and Rescue Satellite Aided Tracking part of the COSPAS-SARSAT constellation. The international COSPAS-SARSAT system provides for the detection and location of emergency beacons for ships, aircraft, and people in distress and has contributed to saving more than 10,000 lives since its inception in 1982. The POES Program is part of NASA's Earth Science Enterprise and is managed by NASA Goddard Space Flight Center. POES spacecraft have a minimum expected operational lifetime of 2 years.

DATE: Comments in response to this notice must be provided in writing to NASA within 30 days after publication of this notice.

ADDRESSES: Written comments should be addressed to Ms. Patricia Dunn, Goddard Space Flight Center, Code 480, Greenbelt, Maryland 20771. The Environmental Assessment (EA) prepared for this mission which supports the FONSI may be viewed at:

(a) NASA Headquarters , Library, Room 1J20, 300 E Street SW, Washington, DC 20546 (202-358-0167)

(b) NASA, Goddard Space Flight Center, Greenbelt, MD 20771 (301-286-0840)

(c) Lompoc Public Library, 501 East North Avenue, Lompoc, CA 93436-3406

(d) Santa Maria Public Library, 420 South Broadway, Santa Maria, CA 93454-5199

(e) Santa Barbara Public Library, 40 East Anapamu Street, Santa Barbara, CA 93101-2000

(f) University of California, Santa Barbara Library, Government Publications Department, Santa Barbara, CA 93106-9010

A limited number of copies of the EA are available on a first request basis by contacting Ms. Patricia Dunn at the address or telephone number indicated herein.

FOR FURTHER INFORMATION, CONTACT: Patricia Dunn, 301-286-9729, Patricia.E.Dunn.1@gsfc.nasa.gov, or Kathleen Moxley, 301-286-0717, Kathleen.M.Moxley.1@gsfc.nasa.gov.

SUPPLEMENTAL INFORMATION:

NASA has reviewed the EA for the NOAA-L and NOAA-M missions and has determined that it represents an adequate and accurate analysis of the scope and level of associated environmental impacts. The EA is hereby incorporated by reference in this FONSI.

NASA proposes to process and launch the NOAA-L and NOAA-M satellites into polar orbit to gather environmental and climate information. The POES satellites would be shipped to Vandenberg Air Force Base, California, where they would be processed and launched.

The proposed missions and the no-action alternative were examined in the EA. The no-action alternative would not fulfill the need to obtain global coverage of numerous atmospheric and surface parameters and to provide an aircraft and maritime emergency beacon system. The no-action alternative would also preclude gaining a better understanding of the causes and consequences of long-term climate variations on regional and global scales.

The launch vehicle chosen for these missions is the Titan II. Satellite size, weight, and launch vehicle availability drove the vehicle selection. The Titan II was specifically developed for placing satellites such as NOAA-L and NOAA-M into Low Earth Orbit and has a track record for launch success. It is considered a logical choice for these missions. Vandenberg was chosen as the launch site because of the desire to meet the science objectives via a polar orbit.

The environmental consequences of the pre-launch processing and launching of the satellites were considered. The possible environmental impacts that were considered included, but were not limited to, air and water quality impacts, land resources, noise, marine and biotic resources, cultural and historic resources, socioeconomic effects, hazards, and launch debris. The areas of potential impact included those areas involved in the pre-launch processing and launching at Vandenberg Air Force Base. Expected impacts to the human environment arise almost entirely from activities associated with the launch of the Titan II, which would be short term and not substantial. There would be no impact on threatened or endangered species or critical habitat, cultural resources, wetlands or floodplains. Hazards associated with POES have been analyzed and do not raise any environmental concerns. The missions involve the use of minute quantities of radioactive material for pre-flight calibration (occurring completely on the ground) and pose no hazard to personnel or the environment. No other environmental issues of concern were identified. The activities involved with these missions are within the normal scope and level of operations at the site.

Both the proposed missions and the No-Action Alternative were examined in this EA. The No-Action Alternative would preclude scientists from gathering important information concerning the Earth's atmosphere, its surface and cloud cover, including Earth radiation, atmospheric ozone, aerosol distribution, sea surface temperature, vertical temperature and water profiles in the troposphere and stratosphere; measurement of proton and electron flux at orbit altitude. It would also prevent the use of remote platform data collection and participation in SARSAT.

On the basis of the NOAA-L and NOAA-M EA, NASA has determined that the environmental impacts associated with the missions would not individually or cumulatively have a significant impact on the quality of the human environment.

A.V. Diaz
Director

7/26/00
Date

Environmental Assessment for the Polar Operational Environmental Satellite (POES) Program (NOAA-L and NOAA-M)

July 2000

NOAA NASA POES 40 years

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Environmental Assessment for the Polar Operational Environmental Satellite (POES) Program (NOAA-L and NOAA-M)

Lead Agency	National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Maryland 20771
Proposed Action	NASA proposes to implement the Polar Operational Environmental Satellites (POES) mission that would include the processing of the POES NOAA-L and NOAA-M spacecraft at Vandenberg Air Force Base, California, and then the launching of the spacecraft on a Titan II launch vehicle. The spacecraft would be used as a polar-orbiting platform to support the environmental monitoring instruments for imaging and measurement of the Earth's atmosphere, its surface, and cloud cover, including Earth radiation, atmospheric ozone, aerosol distribution, sea surface temperature, vertical temperature and water profiles in the troposphere and stratosphere; measurement of proton and electron flux at orbit altitude, and remote platform data collection, and for Search and Rescue Satellite Aided Tracking.
For Further Information	Harry McCain Program Manager POES Program Office Goddard Space Flight Center Greenbelt, Maryland 20771 Telephone: 301-286-3250 FAX 301-286-1699
Date	July 2000

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Abbreviations and Acronyms

µm	micrometer
AC	alternating current
AF	Air Force
AFOSH	Air Force Occupational Safety and Health
AGE	Aerospace Ground Equipment
AKM	Apogee Kick Motor
Al_2O_3	Aluminum Oxide
AMSU	Advanced Microwave Sounding Unit
ARAR	Accident Risk Assessment Report
ATN	Advanced TIROS
ATNAGE	ATN Automated Ground Equipment
AVHRR	Advanced Very High Resolution Radiometer
BDA	Beacon Transmitting Antenna
BDB	Battery Discharge Box
C	Celsius/Centigrade
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cs	Cesium
CSD	Command Safety Destruct
dBA	A-weighted decibel
DC	direct current
DCS	Data Collection System
DMSP	Defense Meteorological Satellite Program
DOT	Department of Transportation
EA	Environmental Assessment
EAGE	Electrical Aerospace Ground Equipment
EED	Electro Explosive Device
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Earth Sensor Assembly
ESD	Electro-Static Discharge
ESM	Equipment Support Module
F	Fahrenheit
FDH	Formaldehyde Dimethylhydrazone
GHe	Gaseous Helium
GEO	Geosynchronous Earth Orbit
GFE	Government Furnished Equipment
GN_2	Gaseous Nitrogen
GRD	G-STDN compatible receiver/demodulator
GRU	Ground Reconditioning Unit
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
H_2O	Water
HCl	Hydrogen Chloride
HIRS	High Resolution Infrared Radiation Sounder
Hz	Hertz
I&T	Integration and Test
IMP	Instrument Mounting Platform
IMU	Inertial Measurement Unit
IR	Infrared
KOH	Potassium Hydroxide
KSC	Kennedy Space Center
kW	kilowatt
LEO	Low-Earth-Orbit
LH_2	Liquid Hydrogen
LN_2	Liquid Nitrogen
LOB	Launch Operations Building
LOCC	Launch Operations and Control Center
LO_x	Liquid Oxygen
LSB	Launch Support Building
LUT	Local User Terminal
mA	milli-amp
MAGE	Mechanical Aerospace Ground Equipment
mCi	millicurie
MEPED	Medium Energy Proton/Electron Detector
MHz	megahertz
mph	miles per hour
MST	Mobile Service Tower
N_2	Nitrogen
N_2O_4	Nitrogen Tetroxide
NAAQ	National Ambient Air Quality
NARS	NOAA Antenna Re-Radiation System
NDMA	Nitrosodimethylamine
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	Oxides of Nitrogen
NPD	NASA Policy Directive
NRHP	National Register of Historic Places
NSS	NASA Standard
O_3	Ozone
ODS	Ordnance Device Simulator
OHA	Operations Hazard Analysis
OSHA	Occupational Safety and Health Administration
PCM	Pulse Code Modulation
PHA	Preliminary Hazard Analysis
PLF	Payload Fairing
POES	Polar Operational Environmental Satellite
ppm	Parts Per Million
PPU	Pad Power-Up

psi	pounds per square inch
psig	pounds per square inch (gauge)
RCE	Reaction Control Equipment
RCRA	Resource Conservation and Recovery Act
RCS	Reaction Control System
REA	Reaction Engine Assembly
RF	Radiofrequency
RFM	Risk Factor Matrix
RSS	Reaction Support Structure
S&A	Safe and Arm
SAD	Solar Array Drive
SAGE	Stationary Aerospace Ground Equipment
SAR	Search and Rescue
SARP	Search and Rescue Processor
SARP-M	Search and Rescue Processor with Memory
SARR	Search and Rescue Repeater
SBCAPCD	Santa Barbara County Air Pollution Control District
SBUV/2	Solar Backscatter Ultraviolet Radiometer
SEM	Space Environment Monitor
SHA	System Hazard Analysis
SLA	Search and Rescue Transmitting Antenna (L-Band)
SLC	Space Launch Complex
SLV	Space Launch Vehicle
SO_2	Sulfur Dioxide
SOA	S-Band Omni Antenna
SRA	Search-and-Rescue Receiving Antenna
SRM	Solid Rocket Motor
SSE	System Safety Engineer
SSIP	System Safety Implementation Plan
STE	Special Test Equipment
STX	S-Band Transmitting Antenna
SV/BW	Stray Voltage/Bridgewire Checker
TED	Total Energy Detector
TIP	TIROS Information Processor
TIROS	Television Infrared Observation Satellite
UDA	Ultra High Frequency Data Collection System Antenna
UMDH	Unsymmetrical Dimethylhydrazine
USAF	United States Air Force
USFWS	U.S. Fish and Wildlife Service
UT	Umbilical Tower
UV	Ultraviolet
VAFB	Vandenberg Air Force Base
VHF	Very High Frequency
VRA	Very High Frequency Real-time Antenna
WR	Western Range

Executive Summary

The National Aeronautics and Space Administration (NASA) has determined that an Environmental Assessment (EA) should be prepared in accordance with the National Environmental Policy Act (NEPA) to evaluate the environmental consequences of implementing the Polar Operational Environmental Satellite (POES) NOAA-L and NOAA-M missions. This EA discusses the mission objectives and the potential environmental effects of implementing the missions. The scope of this assessment includes the processing and launching of the POES NOAA-L and NOAA-M spacecraft on a Titan II launch vehicle.

The proposed missions and the no-action alternative were both examined in this EA. The no-action alternative would not fulfill the need for providing global data to NOAA's short- and long-range weather forecasting systems.

The processing and launch activities involved in the NOAA-L and NOAA-M missions are within the normal scope and level of activities conducted at Vandenberg Air force Base, the launch site. These activities would produce no substantial adverse impacts on the existing environment at the site.

1.0 Purpose and Need

NASA has prepared this Environmental Assessment (EA) for the proposed Polar Operational Environmental Satellites (POES) NOAA-L and NOAA-M missions to comply with the National Environmental Policy Act (NEPA) of 1969, as amended (NEPA) (42 U.S.C. 4321, *et seq.*); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508); and NASA policy and procedures (14 CFR Subpart 1216.3). This EA discusses the mission objectives and the potential environmental effects. The scope of this assessment includes the processing and launching of the POES spacecraft.

POES NOAA spacecraft provide global coverage of numerous atmospheric and surface parameters. They also provide an aircraft and maritime emergency beacon system. The instruments monitor the environment and gather data for routine use in numerous weather forecast models that provide weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas; protect life and property; and enhance the national economy.

The systematic observations provided by the POES spacecraft furnish data critical to NASA's Earth Science Enterprise's strategic plan objective of understanding the causes and consequences of long-term climate variations on regional and global scales. In addition, the POES program objectives relate to NASA's objectives as stated in its Strategic Plan. These include providing for distribution of meteorological data to various organizations, improving the capability for forecasting and providing real-time warnings of solar disturbances, and extending knowledge and understanding of the atmosphere and its processes in order to improve short- and long-term weather forecasts. These meet the Agency's objectives of disseminating information about the Earth system, expanding scientific knowledge by characterizing the Earth system, and enabling productive use of Earth Sciences products in the public and private sectors.

2.0 Proposed Action and Alternatives

2.1 Mission Description

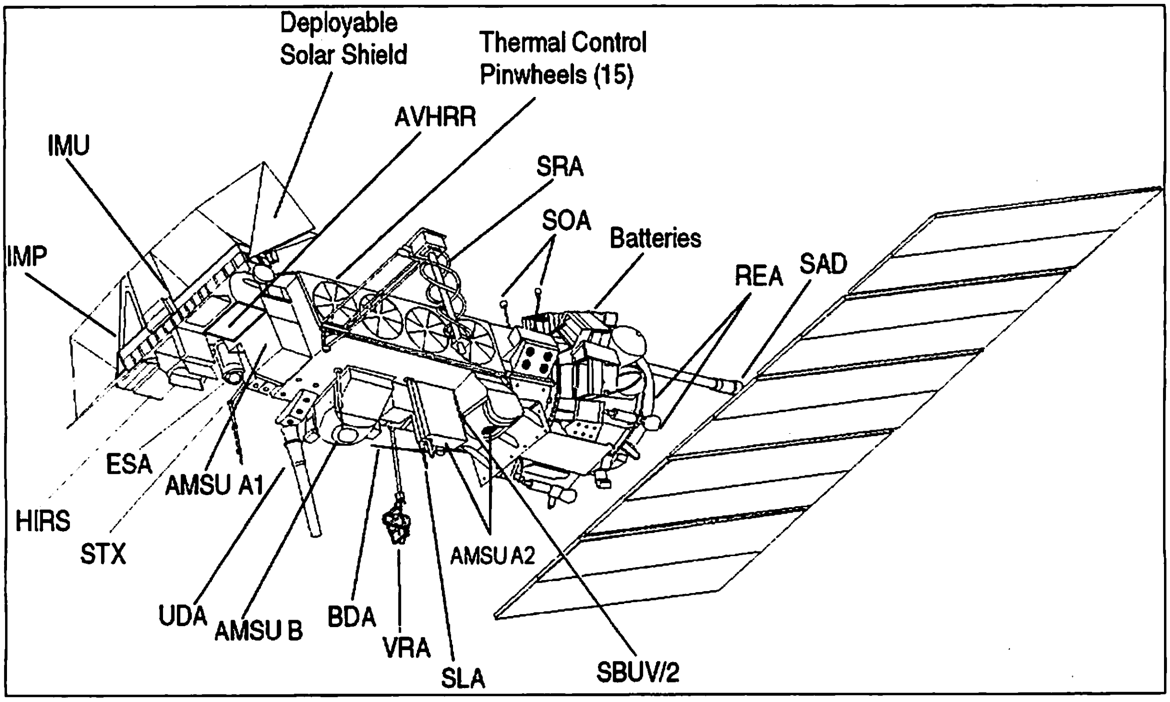
The objectives of the NOAA-L and NOAA-M missions are to procure, develop, test, and launch these satellites into polar orbit so that they would meet the observational requirements as specified by the National Oceanic and Atmospheric Administration (NOAA). The spacecraft would be launched from Space Launch Complex-4 (SLC-4) at Vandenberg Air Force Base (VAFB).

2.2 Spacecraft Structure

The NOAA-L and -M spacecraft are designed to support a complete meteorological payload plus the necessary support subsystems to meet all interface and system requirements,. The structures provide a mounting area that meet the mechanical, thermal, and field-of-view requirements with the required level of mounting accuracy for the payload sensors and maintain the required alignment throughout all phases of testing, launch, and on-orbit mission life. The structures also provide a mounting area for the antennas that are compatible with their patterns and are also designed to provide the mechanical and electrical interfaces to the upper portion of the Titan II booster. The structures comprise three major assemblies: the Instrument Mounting Platform (IMP), the Equipment Support Module (ESM), and the Reaction Control Equipment (RCE) Reaction Support Structure (RSS). Table 2-1 summarizes the primary physical characteristics. Figure 2-1 illustrates the NOAA-L and NOAA-M spacecraft.

Table 2-1. NOAA L and M Characteristics

Parameter	NOAA-L and M Characteristics
General:	
Configuration	3-axis body stabilized
Mission	2-year
Launch Vehicle	Titan II
Spacecraft Size:	
Launch Configuration Envelope	
Expendable Launch Vehicle	
Static Envelope	2.540 m (8.3 ft.))
Fairing Diameter	3.048 m (10 ft.)
On-Orbit Configuration	
Main Body Length	4.2 m (13.75 (ft.)
Main Body Diameter	1.88 m (6.2 ft.)
Array to Body	3.2 m (10.5 ft.)
Overall Length	7.4 m (24.2 ft.)
Spacecraft Mass:	
Dry Satellite	1475 kg (3255.3 pounds (lbs.))
Propellant and Pressurant	756.7 kg (1664.7 lbs.)
Total Launch Weight	2231.7 kg (4920 lbs.)



__Legend__

AMSU	Advanced Microwave Sounding Unit
AVHRR	Advanced Very High Resolution Radiometer
BDA	Beacon Transmitting Antenna
*DCS	Data Collection System
ESA	Earth Sensor Assembly
HIRS	High Resolution Infrared Radiation Sounder
IMP	Instrument Mounting Platform
IMU	Inertial Measurement Unit
*MEPED	Medium Energy Proton/Electron Detector
REA	Reaction Engine Assembly
SAD	Solar Array Drive
*SAR	Search and Rescue
SBUV/2	Solar Backscatter Ultraviolet Radiometer
SEM	Space Environment Monitor
SLA	Search and Rescue Transmitting Antenna (L-Band)
SRA	Search-and-Rescue Receiving Antenna
STX	S-Band Transmitting Antenna (1 of 4 shown)
SOA	S-Band Omni Antenna (2 of 6 shown)
*TED	Total Energy Detector
UDA	Ultra High Frequency Data Collection System Antenna
VRA	Very High Frequency Real-time Antenna

*Not visible in this view

Figure 2-1. NOAA-L and M Spacecraft

2.3 Payload Description

Table 2-2 lists the NOAA-L and M instrument payload and instrument performance capabilities.

Table 2-2. NOAA-L and M Instruments[1]

Instrument	Description
Advanced Very High Resolution Radiometer (AVHRR/3)	A 6-channel, (only five channels can be used at any given time) cross-track scanning instrument providing image and radiometric data in the visible, near-infrared (IR), and far-IR portions of the spectrum.
High Resolution Infrared Radiation Sounder (HIRS/3)	A 20-channel, step-scanned, visible and IR radiometer used to produce atmospheric temperature, humidity, and total ozone profiles.
Data Collection Systems (DCS-2)	A random-access system for the collection of meteorological and other data from in situ platforms, both movable and fixed, such as buoys,

[1] POES Project Plan (reference draft), August 1999, 42.

Instrument	Description
	balloons, and remote weather stations.
Space Environment Monitor (SEM-2)	A multidetector charged-particle spectrometer used to monitor the particle population in the Earth's radiation belts, particle precipitation, and the resulting energy input into the atmosphere.
Solar Backscatter Ultraviolet Spectral Radiometer (SBUV/2)	A multichannel ultraviolet (UV) grating spectrometer, designed to collect radiometric data in 12 selectable in-orbit, spectral bands that are used to deduce total stratospheric ozone and provide soundings to determine the vertical distribution. In addition, it measures the solar spectral irradiance in 12 selectable spectral bands as well as in a continuous scan mode from 160 micrometers (μm) to 405 μm. A separate, fixed spectral band radiometer is provided for determining the cloud cover in the scene for ozone data corrections.
Search and Rescue Repeater (SARR)	A radiofrequency (RF) system that accepts signals from emergency ground transmitters at 121.5 MHz, 243.0 MHz, and 406.05 MHz and uptranslates, multiplexes, and transmits these signals at L-band to Local User Terminals (LUTs).
Search and Rescue Processor (SARP-2)	A receiver and processor that receives 406.05 MHz signals from emergency ground transmitters and demodulates, processes, stores, and relays the data to the SARR where they are combined with the three SARR signals and transmitted at L-band to ground LUTs.
AMSU-A (Advanced Microwave Sounding Unit)	A 15-channel scanning passive microwave radiometer used to produce temperature profiles of the atmosphere.
AMSU-B	A 5-channel microwave radiometer used to produce water vapor and humidity profiles of the atmosphere.

2.4 Electrical Power

Electrical power is provided by a direct energy transfer regulated bus power system. The primary energy converter is a single-axis sun-tracking solar array. The energy storage system consists of a set of three nickel-cadmium batteries, each consisting of two battery packs.

Beginning with the NOAA-L mission, wiring to the pyrotechnic devices that deploy the solar arrays has been redone to provide redundancy in case of a short in one of the batteries.[2]

2.5 Payload Processing and Launch Operations

2.5.1 Ground Facilities

2.5.1.1 Building 1610 Complex

The Building 1610 complex consists of Building 1610 and Building 1605.

Prelaunch operations would be performed in Building 1610 at VAFB (Figure 2-2). The building includes facilities that are ordnance-approved, a clean room, and ventilation equipment that can maintain the appropriate temperature and levels of humidity and which has suitable filtration capability.

[2] Advanced TIROS-N Program, Accident Risk Assessment report (ARAR) for NOAA-KLM, Safety Data Package, Final Submission, Revised October 1999, 3-4.

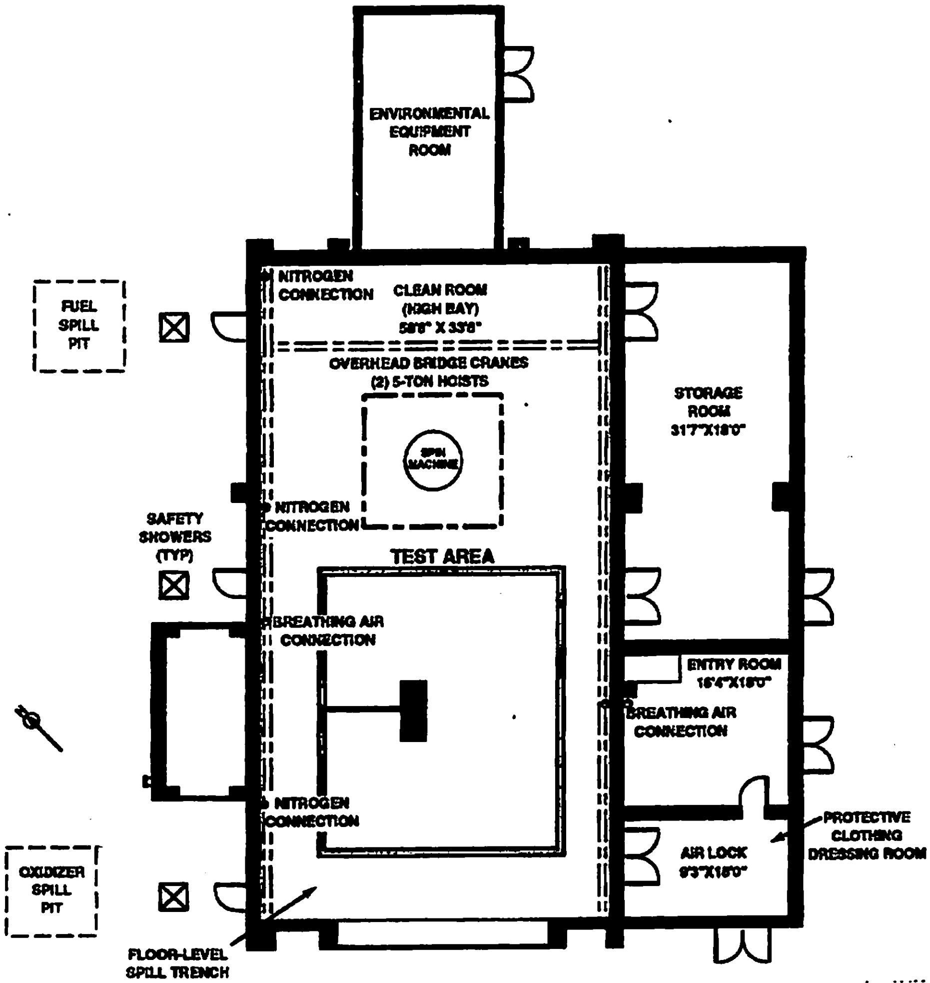


Figure 2-2. Building 1610 Floor Plan

Building 1605 contains a control room, an operations ready room, a fabrication room, and a mechanical/electrical equipment room (Figure 2-3). Television monitors and a two-way intercommunication system provide continual aural and visual monitoring of operations in the test area. Three television cameras strategically located in the test area provide the television monitoring.

This building can perform solid propellant motor buildup and can also perform dynamic balancing of spacecraft and solid propellant rocket motors. It has a detached control room with a control console for the spin machine, television monitors for hazardous processing, and continuous audio and visual monitoring capability. It contains a 250-kilowatt (kW) diesel-powered backup generator. In case of fire, there is a 567,810-liter (150,000-gal.) water tank deluge system (dry pipe) available.

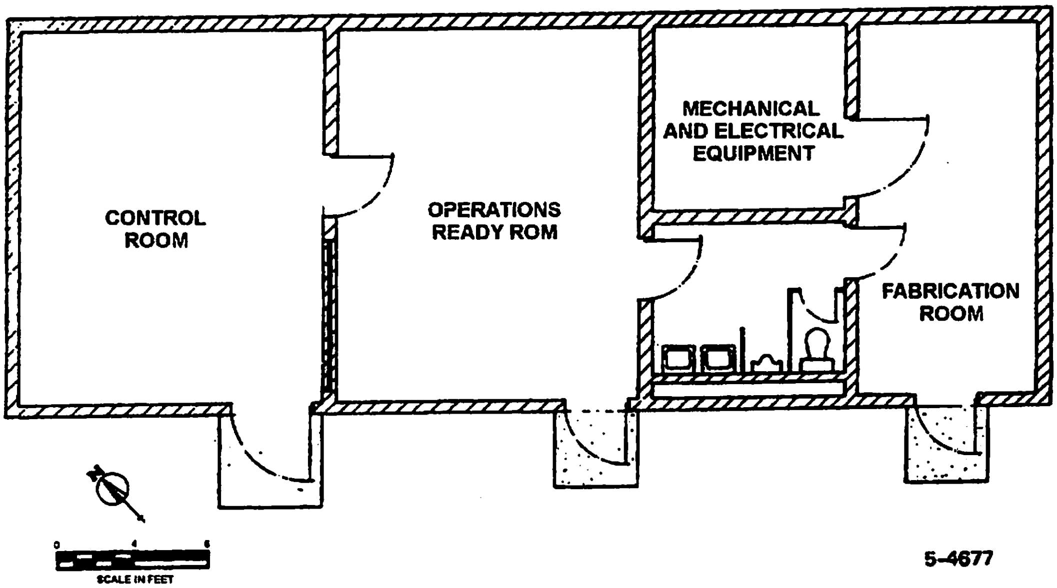


Figure 2-3. Building 1605 Floor Plan

2.5.1.2 Building 1670

Building 1670 is contractor-operated primarily as a solid motor assembly building. Contractor personnel would perform the initial processing of the apogee kick motor (AKM) at this location.

2.5.1.3 Building 7000

Building 7000 houses the Launch Operations and Control Center (LOCC).

2.5.1.4 Building 836

Building 836 (Spacecraft Laboratory Building) includes three spacecraft laboratory work areas, environmental control equipment, clean rooms, a telemetry station, overhead cranes for equipment handling, and office space.

The Ground Station, Data Analysis, and Administrative Areas would be used during POES launch operations. Compressed air at 1,034.3 kilopascals (150 psig) would be available at numerous outlets throughout the facility. Electrical power would be available for use as required (both 50 Hz and 60 Hz). Separate generators would be available to power building air-conditioning equipment.

The data acquisition facilities associated with Building 836 include a data acquisition site, a telemetry station, spacecraft laboratory rooftop antennas, and the stationary aerospace ground equipment (SAGE). Directly adjacent to this building is the 450-ft. antenna tower that provides line-of-sight transmission to Building 1610 and SLC-4W. The data acquisition site consists of an 8.5-m (28-ft.) parabolic tracking antenna, a 2.4-m (8-ft.) parabolic tracking antenna, and an equipment building. The site can track spacecraft and monitor frequencies from 136 to 138 MHz, 1435 to 1710 MHz, and 2200 to 2300 MHz.

2.5.1.5. Space Launch Complex-4 (SLC-4)

The Titan II space launch vehicle (SLV) would be erected, tested, and launched from the Western Range (WR) SLC-4W. SLC-4W is part of a two-launch pad configuration with SLC-4E.

The launch pad area consists of a Mobile Service Tower (MST), a propellant storage area, a high-pressure gas storage area, a Launch Support Building (LSB), and a fixed Umbilical Tower (UT), launch mount, and MST track system. The launch vehicle and payload, when in position on the pad, would be serviced by the MST, the UT, the supporting LOB, and the technical support buildings. The SLC-4W plan view layout is shown in Figure 2-4 and a pictorial layout in Figure 2-5.

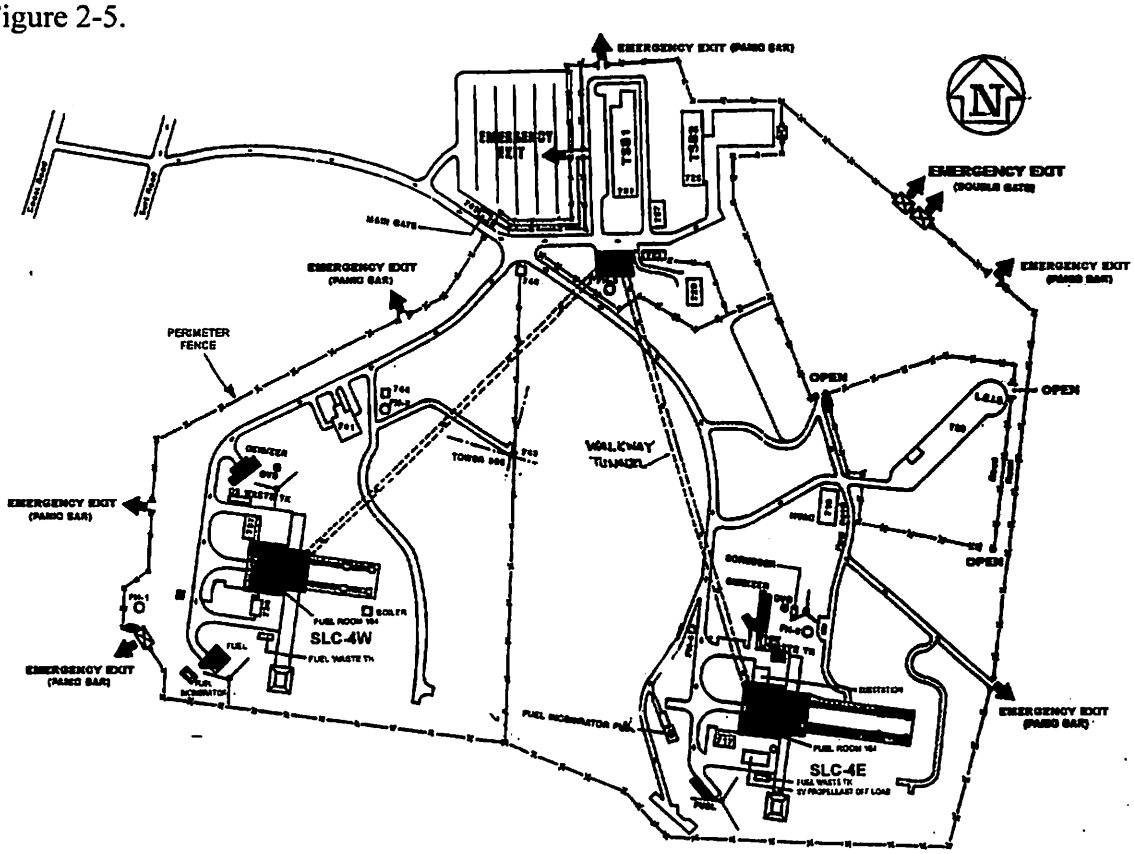


Figure 2-4. SLC-4 Complex

The launch vehicle and payload would be erected and positioned on the launch mount using the MST bridge crane. Power for the launch complex would be supplied from the local commercial power source and the diesel generators. The diesel generators would be used for backup power throughout the launch sequence. The commercial power supply would be used as the primary electrical power for the site and would also be used as the prime source during the launch countdown.

2.5.1.5.1 Mobile Service Tower

The MST would provide facilities for erection and assembly of the launch vehicle and payload. In addition, the MST would provide work platforms at strategic levels to allow for fairing mating and payload servicing and checkout. A bridge crane that would be located at the top of the MST would hoist the spacecraft and payload fairing (PLF).

Elevators and stairs would provide access to all fixed platforms on the north and south sides of the MST. Total capacity of each elevator is 1,814 kg (4,000 lbs.), and the dimensions are approximately 1.5-m by 2.1-m by 2.4-m (5 by 7 by 8-ft.) high.

The entire MST structure would be mounted on self-propelled trucks that ride on fixed rails. Just before launch, the platform levels would be either folded back or retracted, the west doors opened, and the MST moved from its service position on the launch pad to its parked position.

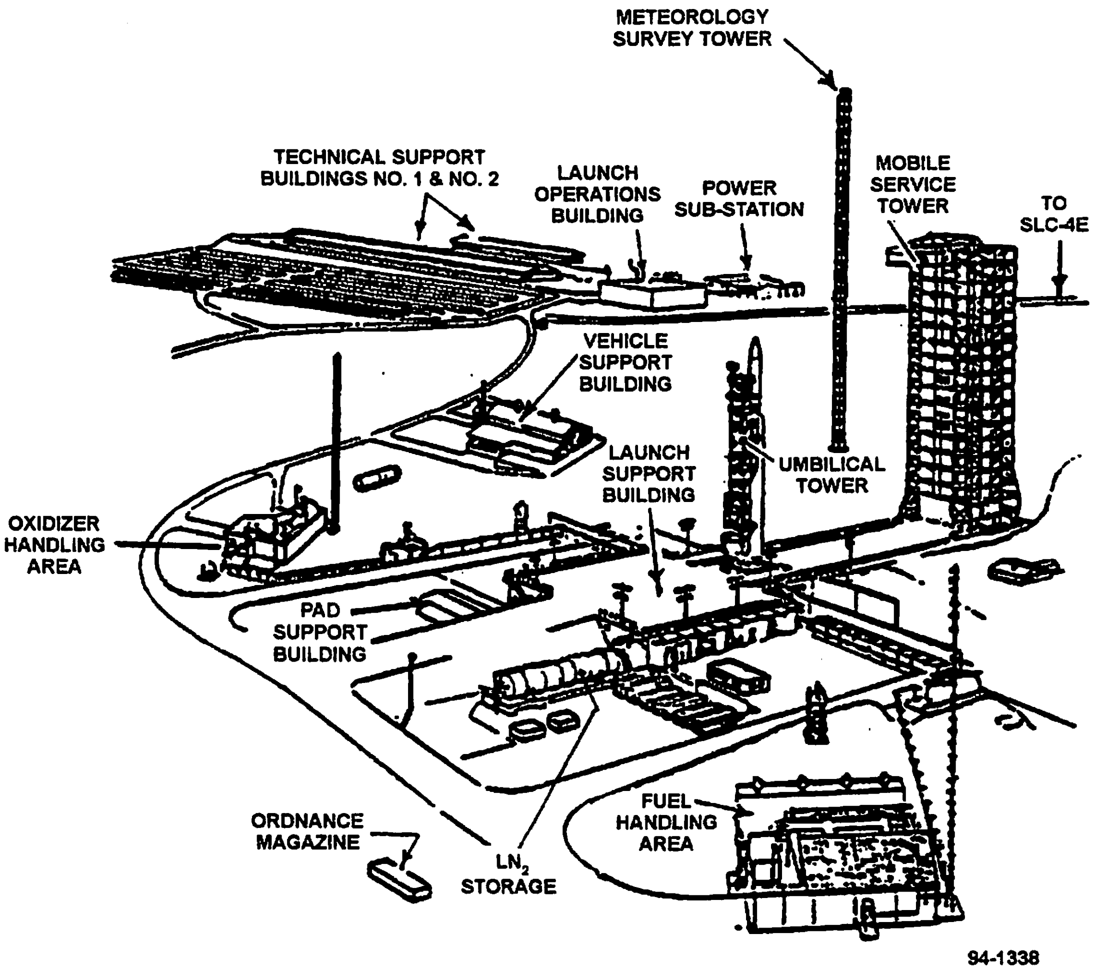


Figure 2-5. SLC-4 West Pad

2.5.1.5.2 Umbilical Tower (UT)

The UT would provide servicing capabilities for electrical components, propellants, and pressurization gases, and conditioned air for the launch vehicle and payload. Three umbilical booms would provide various electrical, propellant, and pressurization gases, and air conditioning services for the launch vehicle, and an additional hydraulically actuated umbilical boom would provide conditioned air for the payload fairing (PLF). The UT would remain stationary during launch. The umbilical booms would be swung away from the vehicle prior to launch. On NOAA-L and -M, the contractor would provide the training and instruction in the loading operations and the potentially hazardous nature of the hydrazine reaction control equipment (RCE) subsystem.

2.5.1.5.3 Launch Support Building (LSB)

The LSB is a single-level structure adjacent to the launch pad that contains the electronic and mechanical equipment necessary to bring the launch vehicle and payload to readiness for launch countdown.

2.5.1.5.4 Launch Operations Building (LOB)

The LOB (located approximately 457 m (1500 ft.) from the launch pad) would accommodate the Titan II and NOAA-L and -M launch control panels and monitoring equipment. The payload consoles are multi-bay enclosures into which control and monitor panels or control chassis required for launch or checkout could be installed for the monitoring of a number of critical parameters such as nitrogen (N_2) and hydrazine (N_2H_4) pressures, tank temperatures, etc., with audible/visible alarms. Uncontaminated fresh air would be supplied as protection against propellant environments. Access to this building would be controlled to limited personnel with specific operations.

2.5.1.5.5 Fuel Depot

SLC-4W-trained and certified Air Force (AF) contractor personnel would perform the NOAA-L and -M fueling operations. NASA contractor personnel would not require access to this facility.

The fuel depot facility includes an operations building, a fuel storage and transfer shed, a disposal pool, and a gaseous nitrogen (GN_2) tank storage building. The fuel storage and transfer shed is an open-sided structure with a cleared area that would be used during hydrazine sampling from the 189-liter (50-gal.) storage drum.

The area is equipped with emergency showers, a communications terminal, and a neutralizing tank. The area has a cement-slab floor with a center drain to the fuel disposal pool. The toxic characteristics of hydrazine require that personnel participating in the actual transfer wear special protective clothing and use air-breathing equipment. Facility power (120 Vac, 60 Hz) would be available.

2.5.1.6 Munitions Storage

The munitions storage facility is a reinforced bunker. The bunker is backed up against a hillside and has a large, hinged, steel double door of sufficient size to allow forklift operation of the apogee kick motor (AKM) in its shipping container. The munitions storage area would be provided by the Air Force. It is anticipated that the AKM would not be in long-term storage at VAFB.

2.5.1.7 Theodolite Site

The spacecraft theodolite site is located approximately 45.7 m (150 ft.) in a westerly direction from the centerline of the SLC-4W launch pad. The site is located at a position that provides an optical line of site to the spacecraft porro-prism for determination of the spacecraft azimuth prior to launch. The isolated slab, the theodolite pier, and the porro-prism pier are included within the structure area. This site would provide environmental protection for personnel and equipment, facility power (120 Vac, 60 Hz, 20A), and two channels would be available for communication to the contractor's consoles in the LOB and the Advanced TIROS (ATN) Automated Ground Equipment (ATNAGE) in Building 836 at Kennedy Space Center (KSC).

2.5.1.8 RF Facilities

RF-link interfaces would exist between the spacecraft RF systems in the various phases of launch preparations and the NASA KSC/VAFB (Building 836) RF ground station (location of the TIROS ATNAGE). Other RF facilities would include video distributor systems, the Pulse Code Modulation (PCM) monitoring and distribution system signal flow, and the microwave link signal flow.

At SLC-4W, the RF links would be configured with the MST in place and with the MST moved back in either a prelaunch or launch mode.

2.5.2 Aerospace Ground Equipment (AGE)

The NOAA-L and -M spacecraft AGE would be used for checkout and launch support of the spacecraft at VAFB. The AGE consists of equipment located at Building 1610, Building 836 stationary aerospace ground equipment (SAGE), and SLC-4W. The AGE located at SLC-4W would temporarily be installed for launch operations only.

The Building 1610 AGE consists of the following functional elements:

- Pad Power-Up Box
- Ordnance Device Simulator
- Spacecraft Support Rack and Remote Power Switch
- SBUV GN_2 Purge Supply
- DCS-M/Search and Rescue Processor With Memory (SARP-M) Special Test Equipment (STE)
- Pick-Up Antennas
- Stray Voltage/Bridgewire Checker
- SARR STE
- High/Low Pressure Panels
- Mechanical Handling Equipment

The portable units, such as the Ordnance Device Simulator (ODS) and Pad Power-Up (PPU) Box, can interface directly with the spacecraft both in a test and launch configuration. RF links provide the interface between Building 1610 and the SAGE, located in Building 836 at KSC.

2.5.2.1 Ordnance Device Simulator

The ODS is a portable, manually operated unit that would be built to meet safety requirements for operation while the spacecraft is mated to the launch vehicle. It would be capable of interfacing directly with the spacecraft in launch configuration to support test operations at the launch site. The ODS simulates spacecraft ordnance but does not interface with live ordnance.

2.5.2.2 Stray Voltage/Bridgewire Checker (SV/BW)

The Stray Voltage/Bridgewire checker is a portable, manually operated unit that can measure any low-level stray voltage that might exist in either the pyrotechnic firing circuits or the thruster enable circuits. Bridgewire resistance checker circuits are fail-safe and current-limited to a maximum of 15 milliamps (mA). The unit has a rechargeable battery pack that must be removed from the tester to access the battery charger AC power circuit. This feature makes it impossible to charge batteries while performing bridgewire checks.

The POES Program has included safety analyses on the SV/BW in the ARAR.[3]

2.5.2.3 Battery Reconditioning Equipment

The Battery Reconditioning Equipment consists of the Ground Reconditioning Unit (GRU), Battery Discharge Box (BDB) and the Extender Module. This equipment would be used to recondition the spacecraft batteries in Building 1610 and at SLC-4W (if required). At SLC-4W, the GRU would be located in the LSB with the BDB and the Extender Module located near the spacecraft in the service tower. The Extender Module would be purged and alarmed to meet explosion-proof requirements. The BDB meets requirements for operating in an explosive environment.

2.5.2.4 Gaseous Nitrogen (GN_2) Purge System for SBUV/2

A special source of clean GN_2 would be provided in Building 1610 for purging the Solar Backscatter Ultraviolet Radiometer (SBUV/2). This source consists of a portable GN_2 supply system (Union Carbide Model PGS-45/S) and a clean, flexible supply line to the spacecraft. The GN_2 supply system stores liquid nitrogen (LN_2) in a vacuum-insulated cylinder that has a nominal liquid capacity of 169 liters (44.6 gal.) or 119.8 kg (264 lbs.) of LN_2. The system would be automatically self-pressurized and with its built-in vaporizer can produce approximately 10.3 m^3 (3640 cu. ft.) of GN_2. Although capable of continuous flow rates of up to 7.1 m^3/hr. (250 cu. ft./hr.), the system would be adjusted for a GN_2 flow rate of 1.5 liters/min. (0.4 gal./min.). At this flow rate, the system would provide at least 30 days of reliable operation.

The GN_2 supply system can be transported by means of a liquefied-gas-cylinder handcart. Additionally, lifting holes provided in the ring supports at the top of the supply system cylinder permit the system to be hoisted and moved by means of a crane. The system would be filled at the WR and placed in Building 1610 three to five days before the arrival of the spacecraft.

2.5.2.5 Hydrazine Monitoring Equipment

A continuous hydrazine-monitoring system capable of detecting hydrazine to 0.01 ppm would be used at SLC-4W during and after hydrazine loading and until liftoff. The monitoring system uses a dual-channel stationary hydrazine/nitrogen dioxide analyzer and a portable single-channel hydrazine analyzer. The stationary systems would provide both local and remote alarms to signal toxic gas detection. The portable system would have only a local audible alarm.

2.6 Launch Vehicle Description[4]

The launch vehicle for the NOAA-L and -M would be a mission-modified standardized baseline Titan II (Figure 2-6). Length of the overall launch vehicle, including fairing for the NOAA-L and -M launches, would be 39.62 m (130 ft.). The maximum diameter of the Titan II would be 3.05 m (10 ft.).

The apogee kick motor (AKM) would be a Thiokol Star 37XPF. It would use a solid propellant TP-H-3340 with a manufactured mass of 871.8 kg (1922 lbs.). Nineteen percent of the solid

[3] ARAR, Appendix A.1.2.
[4] POES Project Plan.

propellant would be removed (off-loaded) for a launch mass of 707 kg (1557 lbs.).[5] The AKM would be an integral part of the spacecraft and would perform the orbit injection maneuver.

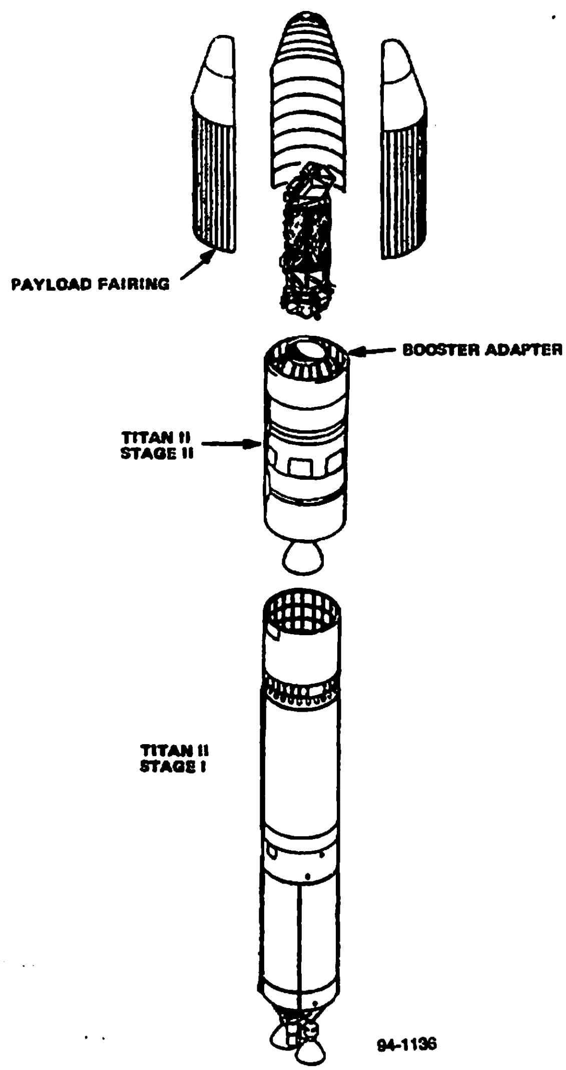


Figure 2-6. Titan II Space Launch Vehicle[6]

The Titan II is a two-stage vehicle. Both stages (I and II) would use liquid hypergolic propellants that can remain aboard in a launch-ready state for extended periods of time. The fuel, Aerozine 50 (A50), is a blend of 50 percent hydrazine and 50 percent unsymmetrical dimethylhydrazine (UMDH). The oxidizer used would be nitrogen tetroxide (N_2O_4). The liquid rocket engines are hydraulically gimbaled, and a turbine pump would feed the propellant. The Stage I engine has two subassemblies that provide pitch, yaw, and roll control. The Stage II engine has one subassembly that provides pitch and yaw control. Stage II roll control would be provided by ducting turbine exhaust through a swiveled roll control nozzle. Each subassembly has a

[5] ARAR, October 1999 revision, 3-3.
[6] ARAR, 1-77.

regeneratively cooled thrust chamber, gas generator start cartridges, connecting plumbing, electrical, and instrumentation wiring harnesses, pressure components, and turbine pumps. The Stage II engine has an ablative nozzle extension.

Table 2-3 lists the propellant quantities for each stage of the Titan II.

Table 2-3. Titan II Propellant Quantities[7] (Published Capacities)

Stage	Propellant type	Quantity in kg (lbs.)
Stage One	N_2O_4	77,112 (170,000)
	Aerozine-50	40,778.6 (89,900)
Stage Two	N_2O_4	17146.1 (37,800)
	Aerozine-50	9,752.4 (21,500)
Attitude Control System	N_2H_4 (Hydrazine)	41.7 (92)

Total Propellant System Mass of hydrazine is 28.3 kg (62.4 lbs.).
Pressurant is 4.7 kg (10.4 lbs.) of nitrogen gas at 4450 psi at 400°C.[8]

The propellant tanks are pressurized on the ground with dry nitrogen. In flight, an autogenous pressurization system would be used to meet the engine pump suction head and the in-flight structural pressure requirements. Stage I would be separated from Stage II by firing gas-separated nuts and using the fire-in-the-hole separation technique.

2.7 *Alternatives to Proposed Launch Vehicle*

Selecting a launch vehicle for POES launches depends upon most closely matching the payload mass and the energy required to achieve the desired orbit to the capabilities of the prospective launch system. The most desirable launch system would meet, but would not greatly exceed, the mission's minimum launch performance requirements. Once launch vehicle performance requirements have been delineated, tolerable launch environments (launch vehicle induced load, vibration, shock, etc.) and payload fairing volume requirements would be defined. If the launch vehicle under consideration would provide adequate performance, would not produce a launch environment potentially damaging to the spacecraft design, and would offer a payload fairing that does not volumetrically constrain the spacecraft. then the launch vehicle could be a reasonable alternative. Finally, launch vehicles are reserved years in advance. Therefore, the launch vehicle must be available during the time frame being considered to be a viable option. Other considerations that must be addressed in selecting a launch system include cost, reliability, and potential environmental impacts associated with its use.[9]

The POES Program had used an Atlas launch vehicle for missions before NOAA-K. While this launch vehicle is still technically suitable, the Air Force, which provides the program with the launch vehicles, has depleted its supply of the appropriate model of Atlas vehicles. New vehicles would have had to be built, incurring a considerable cost as well as a time delay. The Air Force has in its inventory Titan II launch vehicles that would satisfy the requirements stated above. Therefore, GSFC decided that it was the best alternative, from both a technical and economic standpoint, to use the Titan II launch vehicle for the NOAA-L and NOAA-M launches.

[7] New Millennium Program (NMP), Programmatic Environmental Assessment, June 1998, 2-22.
[8] ARAR, 3-3.
[9] NMP, 2-26.

3.0 Existing Environment of Vandenberg Air Force Base

3.1 General

This discussion of the existing environment is limited to those resources, or related resources, that could be affected by the implementation of the NOAA-L and NOAA-M missions.

3.2 Geographic Location

VAFB is located in Santa Barbara County on the coast of South Central California (Figure 3-1). It occupies approximately 400 sq km (150 sq. mi.) of land and is bounded on the west by 56 km (35 mi.) of Pacific Ocean coastline. The nearest cities are Santa Maria, 10 km (6.2 mi.) to the northeast and Lompoc immediately to the east. The base is administratively divided into North Vandenberg and South Vandenberg. North Vandenberg contains SLC-2, and South Vandenberg houses SLC-3, SLC-4 and SLC-6, which is part of the California Commercial Spaceport.

3.3 Land Use and Demography

Launch operations are the primary activity at VAFB, which is the headquarters of the 30th Space Wing, Air Force Space Command. Over 1,700 launches have been conducted since 1958. Among these, space boosters of all sizes have inserted more than 500 uncrewed satellites into polar and high-inclination orbits.

VAFB occupies roughly 6 percent of the total land area of Santa Barbara County. Sixty percent of the base is reserved for open space and recreation. An additional 30 percent is used for grazing and other forms of agriculture. The remaining 10 percent of the land is occupied by facilities and operations associated with USAF activities. South Vandenberg is almost entirely devoted to open space and grazing uses; only 1 percent is occupied by Air Force-related activities.

3.4 Regional Environmental Characteristics of VAFB

3.4.1 Meteorology and Air Quality

3.4.1.1 Meteorology

The climate in the vicinity of VAFB is Mediterranean, which is characterized by warm, dry weather from May to November and cool, wet weather from December to April. The Pacific Ocean exerts a moderating influence on local weather patterns.

At the VAFB airfield, the average annual temperature and the mean annual relative humidity are 12.80°C (55°F) and 77 percent, respectively. The average precipitation is 32.3 cm (12.7 in.) per year, ranging from 6.6 cm (2.6 in.) in February to less than 0.25 cm (0.1 in.) in July. More than 90 percent of annual precipitation falls between November and April. Coastal fog and low clouds are common in the morning hours, especially during the summer months, when inversion conditions intensify.

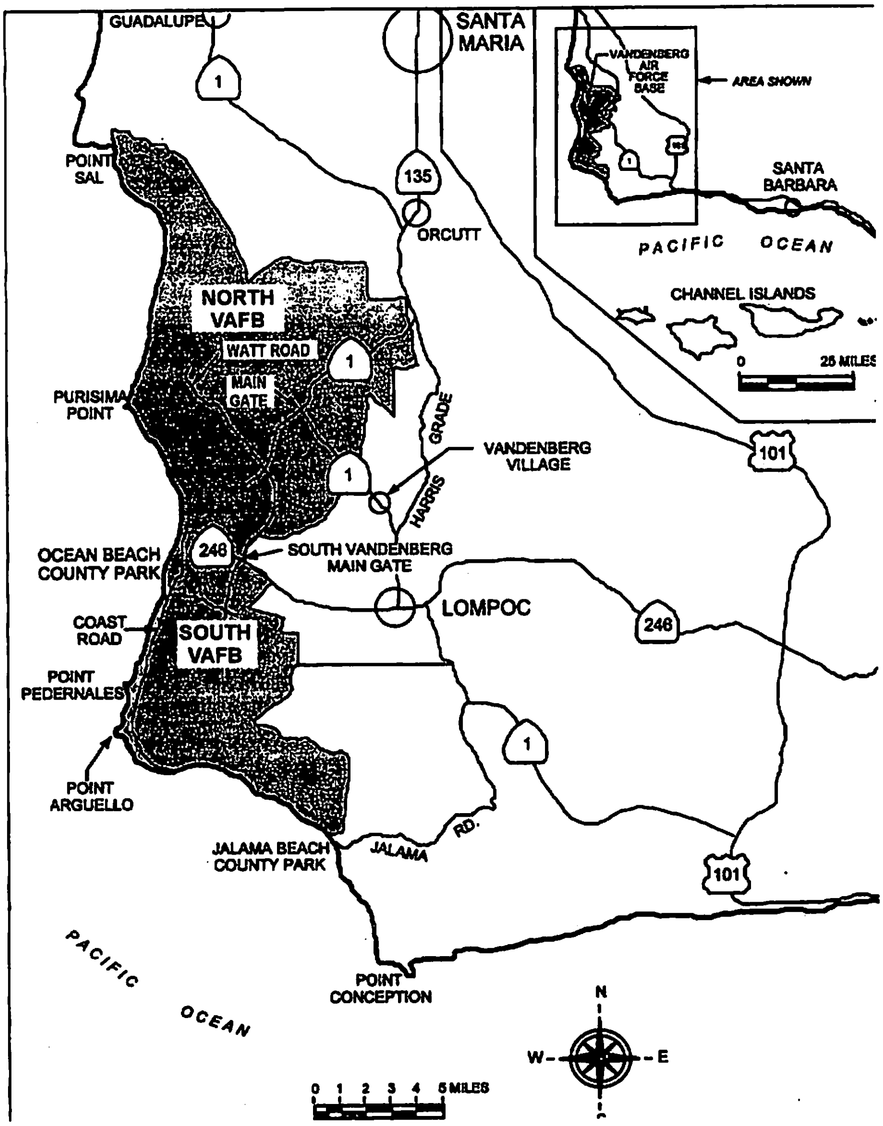


Figure 3-1. Vandenberg Air Force Base Regional Map[10]

Meteorological monitoring is conducted at two sites on VAFB. The first is on Watt Road, near the VAFB Airfield and SLC-2. The second air monitoring station is located adjacent to the SLC-6 power plant, about 1.6 km (1.0 mi.) north of the Spaceport. Since predominate wind flow at SLC-4 is expected to be similar to that of SLC-3 due to its proximity to SLC-3, SLC-3 data was used to create the SLC-4 wind rose (Figure 3-2). Predominate wind flow at SLC-4 is from the northwest at 9.3 to 14.8 km/hr. (5 to 8 knots (5.8 to 9 mph)).

[10] NMP, 4-2.

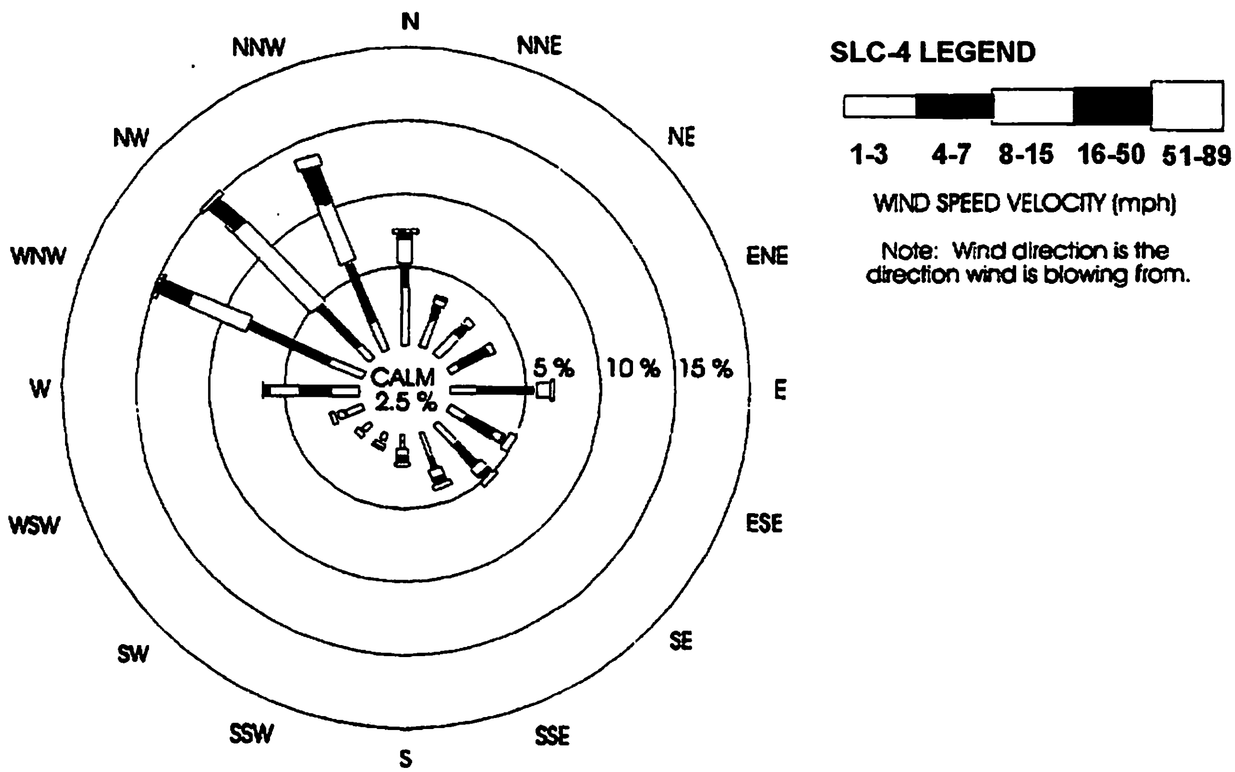


Figure 3-2. Wind Speed and Direction at SLC-4[11]

The mixing height of the atmosphere represents the upper limit of the atmospheric region where pollutants and emissions generally remain. Higher mixing heights (inversion layers) would facilitate dispersion of any trapped air pollutants. The mixing height is controlled by the location in the atmosphere of the first layer of air that is warmer than the air below. At VAFB, the average maximum height ranges from approximately 900 m (2,950 ft.) above sea level in July to 1,350 m (4,430 ft.) above sea level in November. Most frequently, the atmosphere at VAFB is nearly neutral in stability (Pasquill Stability Class D).

3.4.1.2 Air Quality

VAFB and Santa Barbara County are located within the South Central Coast Air Basin. With respect to air quality, Santa Barbara County is divided into North County and South County. VAFB is situated entirely in North County.

Five criteria pollutants, as defined by the Clean Air Act (CAA), are monitored by VAFB: ozone (O_3) carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter under 10 microns in diameter (PM_{10}). In addition, the Air Force monitors for total hydrocarbons and meteorological data. Many parts of Santa Barbara County are not in attainment of the National Ambient Air Quality (NAAQ) standards. For all monitoring stations, Santa Barbara County experiences between 30 and 45 days per year when the state ozone standard is violated and two to eight days per year when the national standard is violated. Santa Barbara County is classified as a "serious" ozone nonattainment area.

[11] NMP, 4-5.

The Air Force and the Santa Barbara County Air Pollution Control District (SBCAPCD) have agreed to cooperate in the air quality program managed by Santa Barbara County. Under this agreement, changes in activities at VAFB are coordinated with and permitted through the SBCAPCD. Any new emissions on VAFB from regulated sources would have to be considered within the context of the agreement.

3.4.2 Land Resources

3.4.2.1 Geology

The recent geologic history of the Vandenberg region is characterized by alternating periods of deposition and uplift. The bedrock underlying the Cypress Ridge area consists of the Upper Monterey Formation, a diatomaceous shale. Marine terrace deposits consisting of beds and lenses of sand, silt, and gravel underlie nearly all of VAFB.

The entire south central coast of California is considered to be a seismically active region. In Santa Barbara County, major earthquakes have been recorded as early as 1769. Of the 90 additional earthquakes that have occurred within a 32-km (20-mi.) radius of VAFB since 1990, their Richter magnitudes have been 7.1 or less. The Santa Ynez fault, about 64 km (40 mi.) to the east of the Cypress Ridge area, is the nearest seismically active, onshore, geologic feature.

3.4.2.2 Soils

The characteristics and development of soils are related to the underlying bedrock, topographic conditions, organisms, and time. The soils immediately to the southeast of SLC-6 were sampled in 1986 in anticipation of the Space Shuttle Program. The acidity of these soils, measured from a 1:1 soil/water mixture, typically ranged from 5.0 to 6.0 pH unites (mean pH = 5.5). The cation exchange capacities ranged from about 5.0 to 35.0 miliequivalents/100 g (mean - 9.6). The mean percent organic matter and percent base saturation were 8.6 (standard deviation = 4.94) and 74.2 (standard deviation - 16.03), respectively.[12] These values are expected to be similar and representative of the soils near SLC-4, which is proposed for use by the POES Program.

3.4.3 Hydrology and Water Quality

3.4.3.1 Surface Waters

Surface water resources include Jalama Creek and the Jalama Creek drainage area, near the southern boundary of VAFB. The Santa Ynez River bisects North and South VAFB and comprises the core of the Santa Ynez drainage system. The Santa Ynez River is the only major drainage on South VAFB. Drainages nearest SLC-4 are the Santa Ynez River and Bear Creek.

South VAFB has no permanent lakes, impoundments, rivers, or flood plains. However, several local drainage areas discharge directly into the Pacific Ocean. The flow rates associated with these drainage areas can be highly variable. Many of them flow only during storms. Intense episodes would be expected to give high intermittent yields due to the relatively steep topography of the area. Some of the drainage areas are spring-fed, although ground percolation frequently traps the water flow before it reaches the ocean.

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[12] NMP, 4-7.

3.4.3.2 Surface Water Quality

Surface flows have been sampled near the space launch complexes on both North and South Vandenberg. Dissolved oxygen and pH values of not less than 5.0 mg/l and 6.5 - 8.5 pH units, respectively, are within the Environmental Protection Agency's (EPA) criteria limits for aquatic life. High levels of total dissolved solids, chloride, lead, and zinc in the surface water have resulted in the water generally being recognized as of poor to medium quality.

3.4.3.3 Ground Waters

The Monterey shale underlying the region supports a minimal amount of ground water in fracture zones. The depths to the water table vary from 42 m (138 ft.) to 40 m (131 ft.).

Ground water in the vicinity of VAFB is present in four ground water basins (Figure 3-3): the Lompoc Upland Basin, the Lompoc Plain Basin, the Lompoc Terrace Basin, and the San Antonio Creek Valley Basin. Ground water is the sole potable water source on VAFB; wells are used to draw water from the basins for domestic and operational use. Ground water pumped by VAFB is also consumed at the adjacent U.S. Penitentiary and Federal Correctional Institute. Increased withdrawals from the area's ground water basins have created an overdraft condition that is affecting the availability and quality of water in these basins. Continued overdraft of the ground water basins could lead to a decrease in the water table levels, a compaction of the basins, and subsidence of the surface land. The POES Program is not expected to exacerbate the situation.

The city of Lompoc and the surrounding incorporated communities receive their water from wells drilled in the Lompoc Plain and Lompoc Upland ground water basins. South VAFB derives all of its water from the Lompoc Terrace Basin. Total VAFB ground water usage is approximately 4,300 acre-ft./year.

3.4.3.4 Ground Water Quality

Ground water quality in the region meets all national Interim Primary Drinking Water Regulation standards. A slight decrease in water quality has occurred in the region due to the use of water for irrigation. As irrigation water flows through the soil and back to the basin, it entrains salt, which increases the salinity of the ground water.

3.4.4 Biotic Resources

VAFB is recognized as a biologically important area, occupying a transitional zone between the cool, moist conditions of northern California and the semi-desert conditions of southern California. Consequently, many plant species, as well as plant communities, reach their northern or southern limits in this area.

The portion of VAFB's coastline that lies within the POES region of influence is occupied by several species of seabirds, marine mammals, and other species of interest (i.e., threatened and endangered species) (Table 3-1). Harbor seals, protected under the Marine Mammal Protection Act, use the beaches south of Rocky Point as breeding areas. Southern sea otters also feed in the offshore kelp beds and occasionally come onshore. Peregrine falcons nest on the rocky cliffs. Western gulls, brown pelicans, pigeon guillemots, marine cormorants, rhinoceros auklets, black oystercatchers, and Brandt's cormorants use the rocky outcrops for roosting or nesting purposes.

Three miles of VAFB's coastline are protected under agreement with the State of California as a marine ecological reserve. This area extends from Lookout Rock to Point Pedernales. VAFB has a memorandum of agreement with the California Department of Fish and Game for access to these areas for military operations and scientific research only.

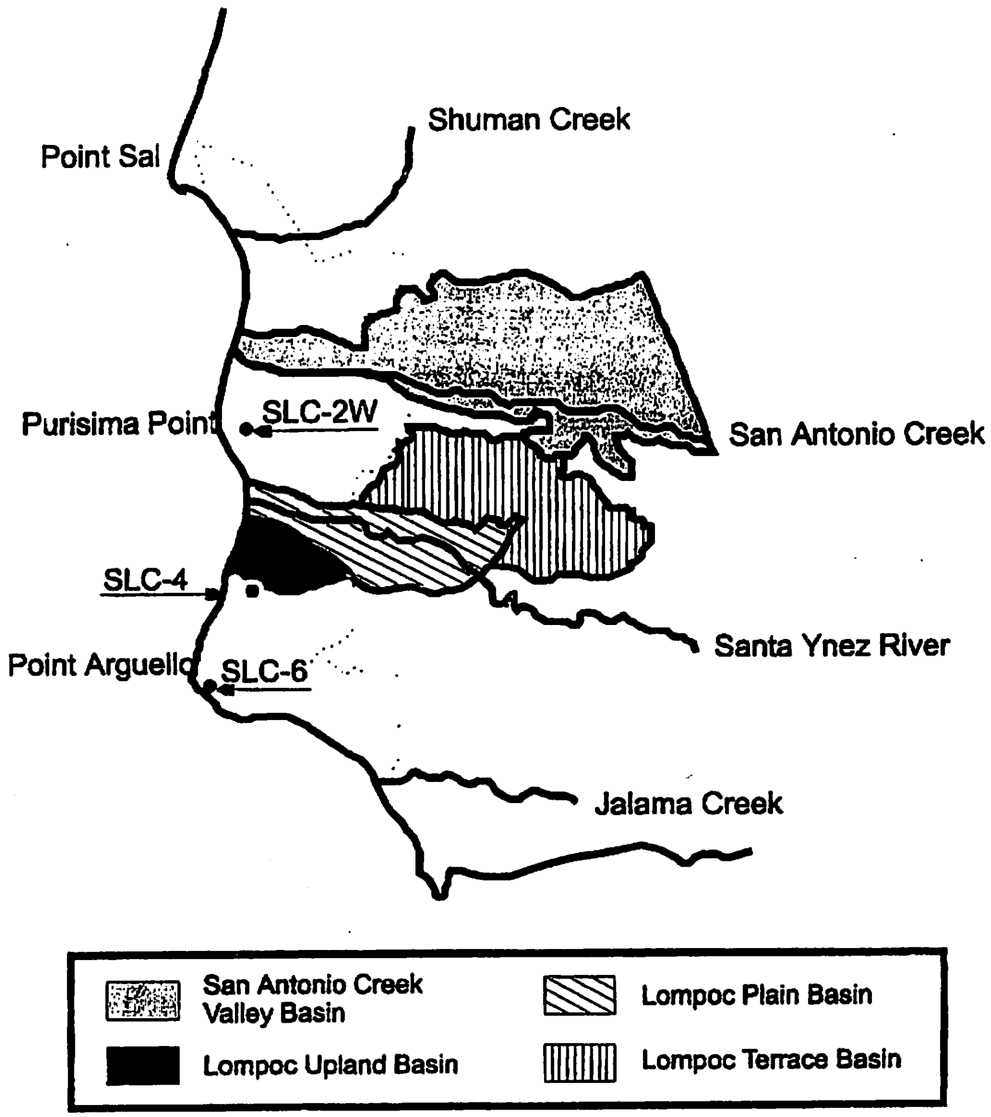

Figure 3-3. Ground Water and Surface Water in the Vicinity of VAFB[13]

Table 3-1. Species in the Vicinity of SLC-4[14]

SPECIES	Potential Occurrence[a]	Status[b] Federal	State	Other
Threatened/Endangered Species				
REPTILES/AMPHIBIANS California red-legged frog *(Rana aurora draytonii)*	x	FT	SC	

[13] NMP, 4-10.
[14] Adapted from NMP, 4-13 - 15.

SPECIES	Potential Occurrence[a]	Status[b] Federal	State	Other
Leatherback sea turtle (*Dermochelys coricea*)	O	FE		
Loggerhead sea turtle (*Caretta caretta*)	O	FT		
Green sea turtle (*Chelonia mydas*)	O	FT		
Pacific Ridley sea turtle	O	FT		
BIRDS				
American peregrine falcon (*Falco peregrinus anatum*)	x	FE	E	
California brown pelican (*Pelecanus occidentalis californianus*) (a transient species)	x	FE	E	
Western snowy plover (*Charadrius alexandrinus nivosus*)	x	FT	SC	
California least tern (*Sterna antillarum browni*)		FE	E	
Southwestern willow flycatcher (*Empidonax traillii extimus*)	x	FE		
PLANTS				
Seaside bird's beak (*Cordylanthus rigidus*)			E	1B
Beach Layia (*Layia Carnosa*)	x	C	E	1B
MAMMALS				
Southern sea otter (*Enhydra lutris nereis*)	x			
Candidate Species				
REPTILES/AMPHIBIANS				
Southwestern pond turtle (*Clemmys marmorata pallida*)	x	F	SC	
Silvery legless lizard (*Anniella pulchra pulchra*)	x	F		
California horned lizard (*Phrynosoma coronatum frontale*)	x	F		
BIRDS				
Western burrowing owl (*Speotyto cunicularia hypugea*)	x	F	SC	
California black rail	x	C	SC	
Ferruginous hawk (*Buteo regalis*) (a transient species)	x	F	SC	
Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)	x	F		
MAMMALS				
San Diego desert woodrat (*Neotoma lepida intermedia*)	x	F		
Townsend's Western big-eared bat (*Plecotus townsendii townsendii*	x	F	SC	
Other species of interest				
Right whale (*Eubalaena glacialis*)	O	FE		
Sperm whale (*Physeter macrocephalus*)	O	FE		
Humpback whale (*Megaptera novaeangliae*)	O	FE		
Blue whale (*Balaenoptera musculus*)	O	FE		
Finback whale (*Balaenoptera physalus*)	O	FE		
Sea whale (*Balaenoptera borealis*)	O	FE		
Gray whale (*Eschrichtius robustus*)	O	FE		
California sea lion (*Zalophus californicus*)	O	P		
Northern fur seal (*Callorhinus ursinus*)	O	P		
Northern elephant seal (*Mirounga angustirostris*)	O	P		
Harbor seal (*Phoca vitulina richardsi*)	O	P		
Guadalupe fur seal (*Arctocephalus townsendii*)	O	FT		
Steller sea lion (*Eumetopias jubata*)	O	FT		
Golden eagle (*Aquila chrysaetos*)				
Habitats of interest				
Pinniped haulout and breeding areas				
Seabird nest and roost sites				
Wetland and riparian habitats				

Source: Adapted from New Millenium Program, Programmatic Environmental Assessment, June 1998.
Legend:
[a]X = Possibly suitable habitat available on site or within the POES region of influence
O = Offshore species in the vicinity of Boathouse Flats are noted as potentially occurring near SLC-6
[b]FE = Federally listed as endangered
FT = Federally listed as threatened
C = Candidate for Federal listing (USFWS has sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species)
F =Federal species of concern (former Category 2 Candidate species) - Such species are the pool from which future candidates for listing will be drawn [Federal register Vol. 61, No. 40, pp. 7457-7463]
E = State listed as endangered
T = State listed as threatened
R = rare
P = Protected by State or Federal law
SC = CDFG species of special concern
1B = Candidate plants considered by the California Native Plant Society (CNPS) to be of highest priority, rare and endangered in California and elsewhere
No other Federally listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) are likely to be affected.

3.4.4.1 Terrestrial Biota

Terrestrial animal life consists of species common to coastal sage scrub, grassland, and chaparral communities. Common mammalian species occurring at VAFB include mule deer, coyote, bobcat, jackrabbit, cottontail, skunk, ground squirrel, and numerous nocturnal rodents. The larger, contiguous, relatively undisturbed tracts of native vegetation on South VAFB provide high-quality foraging habitat for wide-ranging carnivores like mountain lion, bobcat, black bear, badger, gray fox, and coyote, in addition to several regionally rare or declining hawks and owls. The region contains a diversity of bird species, such as red-tailed hawks, American kestrels, white-tailed kites, and numerous common land birds. Shore birds are abundant on all sandy beaches. California brown pelicans and the California least tern occur at several locations along the coast. Brown pelicans do not breed on VAFB but are transient visitors to the coast. The western snowy plover is considered a year-round resident of VAFB.

Due to the predominance of southerly and westerly exposures, the region's vegetation is primarily central coastal scrub or coastal sage scrub, grassland, and chaparral community types. The riparian vegetation of drainages in the area provides important habitat for wildlife. Plant communities of particular interest include tanbark oak forest, bishop pine forest, Burton Mesa chaparral, coastal dune scrub, and a variety of wetland types.

Approximately 30 vegetative assemblages, representing more than 15 distinct plant communities, have been identified within VAFB boundaries. Plant communities include coastal saltmarsh, coastal sage scrub, central dune scrub, riparian woodland, a variety of chaparral types, and diverse upland woodland communities. This diversity results from variation in topography, elevation, geology, and proximity to the coast. Approximately 85 percent of VAFB supports a "natural" vegetation; the remaining 15 percent supports a ruderal, or disturbed, vegetation or is developed for human use.

The flora of VAFB comprises approximately 624 species and subspecies Approximately 21 percent are alien to California; the remaining 79 percent are native. Local flora includes a number of sensitive plant taxa, including several species recognized as rare, threatened, or endangered by the state or federal government.

3.4.4.2 Aquatic Biota

Several snakes, the Pacific tree frog, western toad, and the California legless lizard represent reptiles and amphibians. A harbor seal population haulout site occurs at Purisima Point, which is identified in the National Marine Fisheries Service census as a breeding rookery in their annual harbor seal census. The southern sea otter is found at various rocky areas along the VAFB coastline. A small colony of sea otters was found near Purisima Point in 1990 and was still intact in 1992.

The coastal waters encompassing south VAFB and the northern Channel Islands support diverse marine mammal assemblages. The sea otter, six species of pinniped (seals), and more than 25 species of cetacean (whales) inhabit the regions either as residents or transients. The Marine Mammal Protection Act of 1972 protects all marine mammals inhabiting the study region. The Santa Barbara County Local Coastal Plan identifies marine mammal haulout and pupping grounds as environmentally sensitive habitat and delineates policies designed to help protect these areas.

The National Marine Fisheries Service has granted the U.S. Air Force an incidental-take permit (i.e., for disturbance of pinniped populations in coastal waters near VAFB) effective for up to 20 launches per year at VAFB for the five-year period starting March 1, 1999. This permit applies to launches that use the launch vehicles proposed by the POES Program.

3.4.4.3 Threatened and Endangered Species

Threatened and endangered species, and their approximate locations relative to SLC-4 proposed for use by POES are depicted in Figures 3-4 and 3-5.

There are no threatened or endangered amphibian, reptile, or land mammals known to occur near SLC-4. Three bird species (the California brown pelican, western snowy plover, and American peregrine falcon) and one mammal species (the southern sea otter) that are either federally- or state-listed as endangered or threatened have been reported or are expected to be seen near SLC-4. One state-endangered plant species, Beach Layia, is known to occur near SLC-4.

3.4.5 Economic Population and Employment Factors

3.4.5.1 Socioeconomics

Agriculture is the region's primary industry, particularly in the Santa Maria area. Surface mining for diatomaceous earth is also a major regional industry. The largest employers in the area of Santa Barbara County surrounding VAFB are services, retail trade, government, and manufacturing. Projections are for employment to reach 145,800 by 2005. The unemployment rate is projected to remain between 5 percent and 5-1/2 percent through the year 2005.

The number of persons employed at VAFB has declined from approximately 16,000 in 1985 to less than 10,000 currently. Of these, approximately 68 percent are civilian employees. The base generates about 4,300 jobs for the local economy, and has an overall monetary impact of more than $500 million on the surrounding region. VAFB employs approximately 40 percent of Lompoc's labor force and 9 percent of Santa Maria's[15].

Within a 100-km (62-mi.) distance of the launch site, the 1990 population was estimated at about 544,000 residents. The population within 20 km (l2 mi.) of the launch site was estimated at about 77,000 residents in 1990, and within 10 km (6 mi.), the population was about 8,600. By 2001, the population within 100 km (62 mi.) is expected to increase to about 578,000 residents, and to more than 595,000 in 2005. Similar growth is expected within 20 km (16 mi.) of the launch site during this period. Little growth is projected for the area within 10 km (6 mi.) of the launch site.

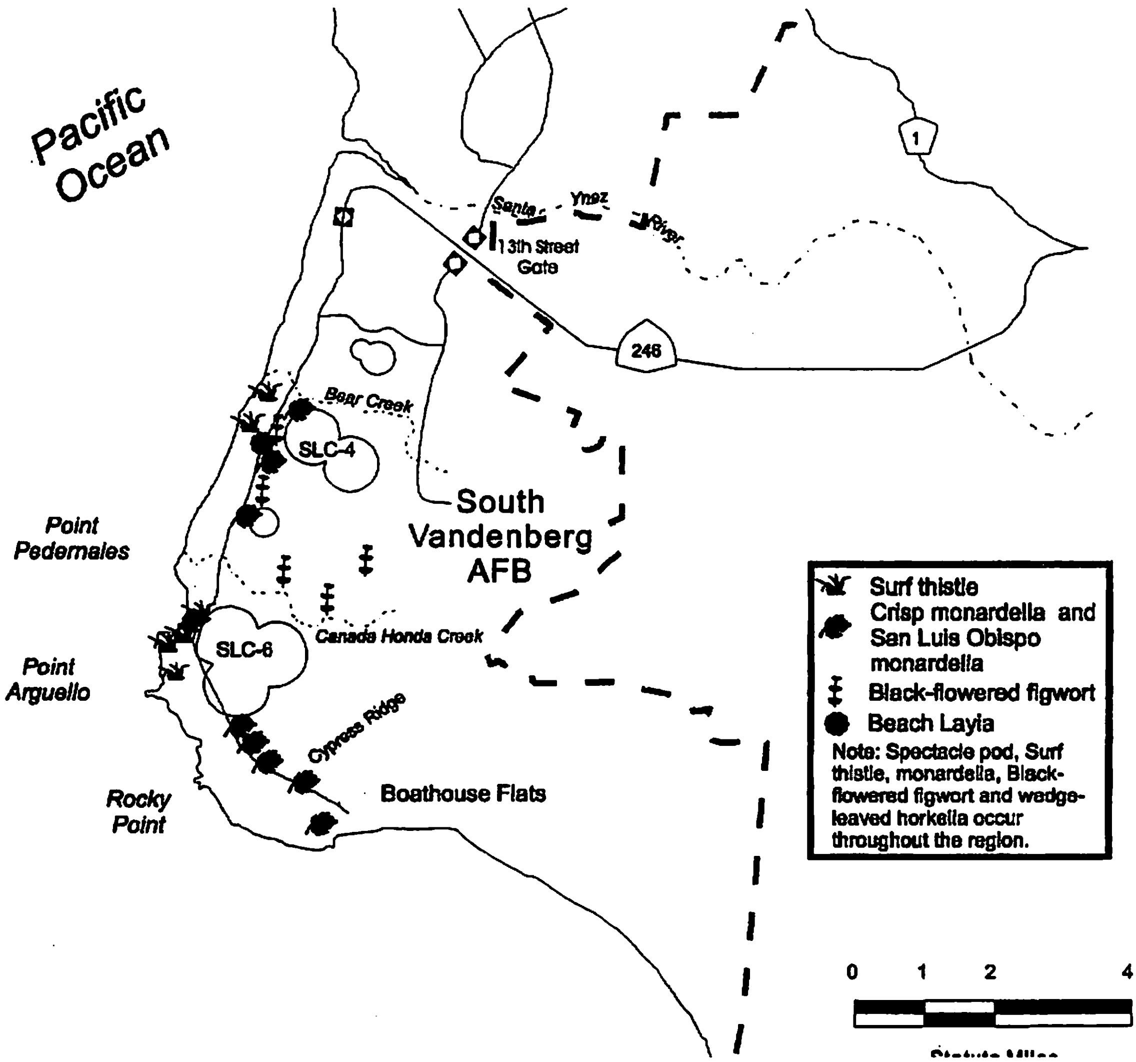

Figure 3-4. Potential Occurrence of Threatened/Endangered Flora Near Vandenberg Launch Sites

15 NMP, 4-21.

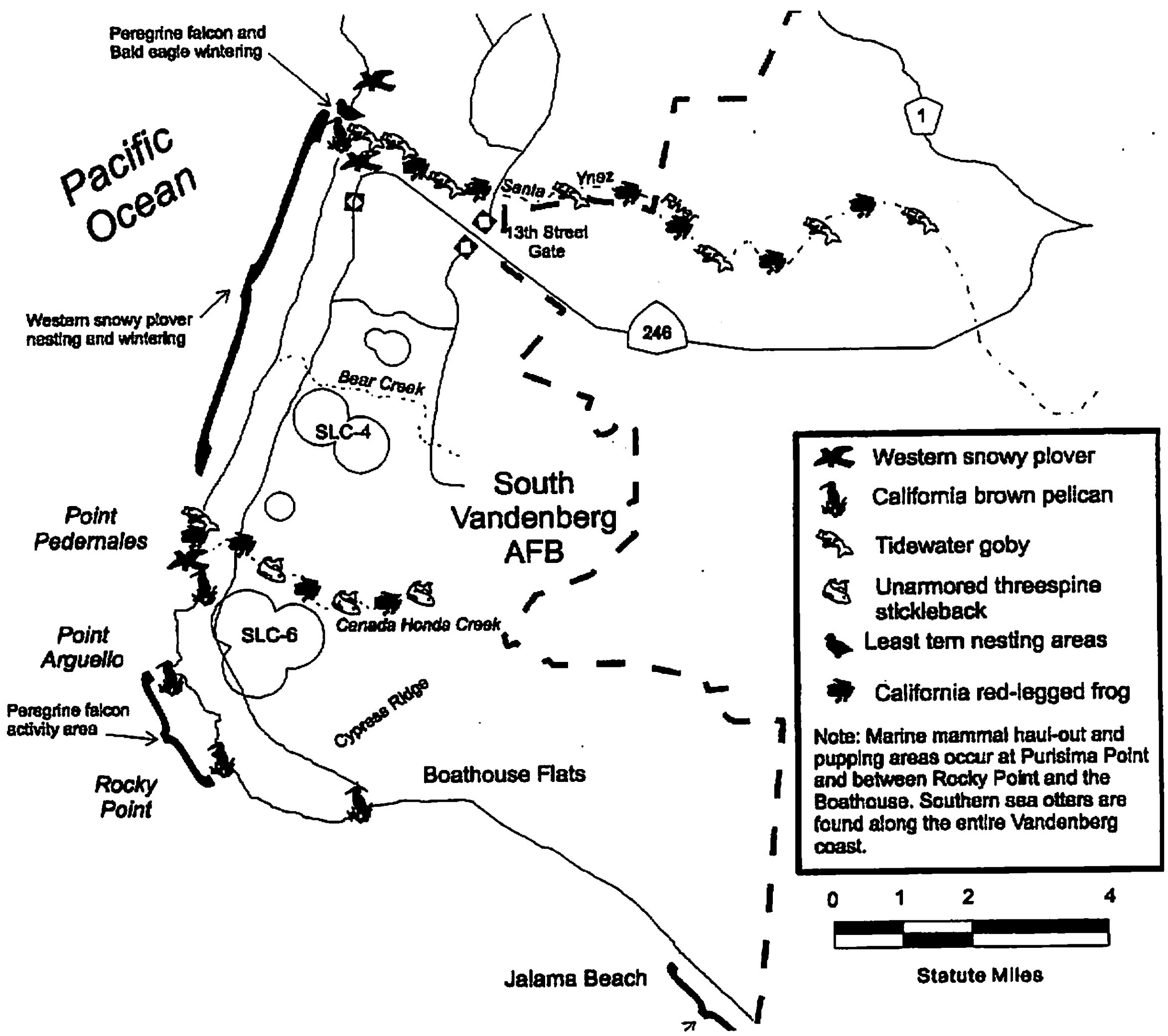

Figure 3-5. Potential Occurrence of Threatened/Endangered Fauna Near Vandenberg Launch Sites[16]

Minorities constituted about 28 percent of the 1990 population within the 100-km (62-mi.) area, and are projected to account for about 37 percent in 2001, and about 40 percent of the population in 2005. Hispanic residents accounted for about 75 percent of the minority population within the 100-km (62-mi.) area, and are expected to constitute about 77 percent of that population in 2005. Within the 20-km (12-mi.) area, minorities accounted for almost 30 percent of the 1990 population with Hispanic residents accounting for about 62 percent of the minority population. The minority population within the 20-km (12-mi) area is projected to increase to about 38 percent in 2001, and 41 percent in 2005, with Hispanic representation accounting for about 67 percent of the 2005 minority population. In 1990, about 13 percent of the population within 100 km (62 mi. of the launch site were at or below the 1990 poverty threshold level. About 10 percent of the population within 20 km (12 mi.) were at or below the 1990 threshold, while within 10 km (6 mi.) of the launch site, about 5 percent were below the threshold.

[16] NMP, 4-19 and 4-20.

3.4.6 Noise, Sonic Boom and Vibration

Noise levels for most of the region surrounding VAFB are normally low. Noise levels temporarily increase due to aircraft flyovers, railroad traffic, and missile launches. Results of noise monitoring were discussed in the NASA New Millennium Program Environmental Assessment (1998).

Peak launch noises are experienced for a very brief time and would therefore not be expected to exceed EPA or Occupational Safety and Health Administration (OSHA) requirements and recommendations. Figure 3-6 depicts noise levels near SLC-4 produced by Titan II launches.

Space launches also generate sonic booms during vehicle ascent and stage reentry. Launch-generated sonic booms are directed upward and in front of the vehicle and occur over the Pacific Ocean. Stage reentry sonic booms also occur over the open ocean and do not impact developed coastal areas.

In recent years, there have been no recorded complaints concerning noise produced by missile launches, which can be attributed to the infrequency of launches and the low annoyance level of rocket motor firings.

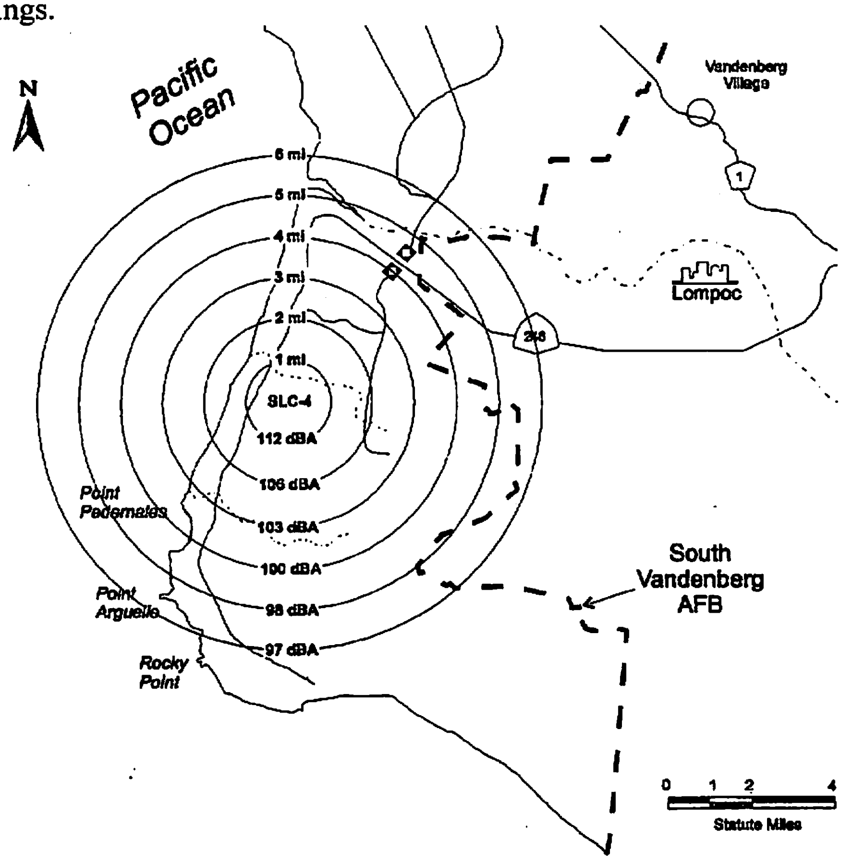

Figure 3-6. Noise Generated by a Titan II Launch From SLC-4[17]

[17] NMP, 4-24.

3.4.7 Historic, Archeological, and Recreational Factors

3.4.7.1 Historic and Archeological Resources

None of the Titan launch complexes at SLC-4 were nominated as historic landmarks nor were they considered eligible for listing in the National Register of Historic Places (NRHP). Archeological surveys conducted as part of the SLC-4 Restoration Program have recorded seven archeological sites but no determination has been made as to whether these sites would be included in the NRHP.

3.4.7.3 Recreation

The Pacific Coast in the vicinity of VAFB provides numerous opportunities for public recreation. Two of these recreation areas are adjacent to South Vandenberg. The first, Ocean Beach County Park, is located 12.1 km (7.5 mi.) to the north of the Cypress Ridge Area at the mouth of the Santa Ynez River. The second, Jalama Beach County Park, is situated at the mouth of Jalama Creek, near the eastern boundary of VAFB.

4.0 Environmental Consequences of Proposed Action

All payload and launch processing procedures at VAFB for NOAA-L and NOAA-M would take place in Building 1610 and SLC-4 using existing trained personnel. The proposed activities fall within the normal scope of operations at VAFB. Launch with the Titan launch vehicle is also within the scope of normal operations at VAFB.

The environmental consequences of Titan operations associated with the processing and launching of the NOAA-L and -M missions are summarized below and are addressed more fully in several environmental documents[18]

4.1 Air Quality

4.1.1 Launch Vehicle Impact

Processing and launching activities would have potential air quality impacts. Processing activities would include cleaning the spacecraft with volatile solvents. These activities would take place indoors with adequate ventilation and would not impact the external environment. They would also be within the normal scope of operations at the facilities.

During the loading of the hydrazine propellant at SLC-4, a minute amount of hydrazine vapor would be released into the air. The predicted values of 0.005 parts per million (ppm) for public exposure would be contained well within the perimeter fence, and no significant environmental impacts would be expected. A hydrazine spill would require short-term mitigative actions and would not be expected to create a health hazard.

Impacts from normal Titan launch operations would not be expected to substantially impact air quality. Emissions from the Titan launch vehicle would be highly localized, of extremely short duration, and would occur at an altitude that would readily facilitate exhaust dissipation. Anticipated emissions for a Titan launch vehicle that would be considered air pollutants are:

- Carbon Monoxide (CO) - 725.8 kg (0.80 tons (1,600 lbs.))
- Oxides of Nitrogen (NO_x)- 544.3 kg (0.60 tons (1,200 lbs.))[19]

The exhaust plume that persists in the launch pad area during and after ignition is known as the ground cloud. For the Titan II space booster, this cloud would consist primarily of water vapor and carbon monoxide (CO). At combustion temperatures, CO formed during ignition would be further oxidized to carbon dioxide (CO_2) because of the abundance of oxygen in the atmosphere. Oxides of nitrogen (NO_x) would be formed much later in the trajectory (when it reaches the stratosphere) of the space vehicle. NO_x formation downrange distance from the launch site would be estimated to be about 25.8 km (16 mi.).[20]

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[18] *Final Environmental Assessment, USAF Space Launch Vehicles, CCAFS and VAFB*, February 1995; *Environmental Assessment, Titan II Space Launch Vehicle Modification and Launch Operations Program*, VAFB, August 1987; *Biological Assessment, Titan II and IV Space Launch Vehicle Modifications and Launch Operations Programs*, VAFB, June 1988.

[19] NMP, 5-3.

[20] NMP, 2-22-23.

Launch vehicle exhaust emissions have a potential for increasing ozone-depleting chlorine compounds. Such emissions would be considered highly localized and transient in nature. Due to the small amount of solid rocket propellant, the impact on stratospheric ozone from a Titan launch would be negligible.

Table 4-1 shows the highest ground level concentrations for potential air contaminants under worst-case weather conditions, i.e., those that involve a combination of a strong low-level temperature inversion coupled with light winds and uniform wind directions.

Table 4-1. Peak Concentrations and 60-Minute Mean Concentrations for Titan II Normal Launch Emissions at VAFB Using a Hypothetical No Wind Shear Meteorological Profile[21]

Exhaust Cloud Constituent	Peak Concentration (ppm)	Maximum 60-Minute Mean (ppm)	Distance From SLC-2/4 Peak-Mean (km)
CO	1.31	0.39	8-12
CO_2	0.79	0.23	8-12
NO**	0.16	0.05	8-12

The gaseous concentrations predicted using this meteorological case (no wind shear) may not represent the highest concentrations that might occur under other meteorological conditions.
**NO is generally unstable in the atmosphere and oxidizes to NO_2.

4.1.2 Clean Air Act Conformity

The POES Program would not increase approved launch rates nor utilize launch systems beyond the scope of approved programs at VAFB. The Clean Air Act general conformity analyses have been completed for the previous licensing of the proposed site.

4.2 Land Resources

Processing of NOAA-L and NOAA-M at VAFB would take place indoors, in existing facilities, using existing personnel, and would fall under the scope of normal activities at VAFB. No unique effects on land resources would result from these activities.

No wetlands or floodplains were identified in environmental assessment documents for SLC-4.

4.3 Hydrology and Water Quality

4.3.1 Local Water Quality

Water usage for satellite payload processing would fit within the current scope of water discharge permit definitions. Local and regional water sources would not be affected since there would be no groundwater withdrawals. Water utility piping would be used at VAFB to meet miscellaneous onsite needs. Solvents used during processing would be disposed of as hazardous wastes in compliance with Federal, state, and base regulations. No substantial hydrologic or water quality effects are expected from processing the NOAA-L and -M spacecraft.

[21] NMP, p. 5-5.

Launch vehicle processing would result in the generation of hydrazine-contaminated liquid and solid waste from the propellant transfer process. The hazardous waste would be disposed of in accordance with approved procedures and the VAFB Hazardous Waste Management Plan.[22]

The nearest bodies of surface water are beyond the range of expected impacts. Moreover, the high acid neutralization characteristics of the local drainages would counteract any acidic deposition from rocket launches. In the event that rainwater would absorb hydrogen chloride (HCl) that might then be deposited on the ground, the natural buffering capacity of the streams would result in negligible or no change in water quality

4.3.2 Ocean Environment

In a normal launch from VAFB, both the first and second stages of the launch vehicle would burn to depletion following spacecraft separation. No propellants would impact the ocean.

4.4 Noise, Sonic Boom, and Vibration

Processing activities would occur during normal hours at VAFB and would not be expected to generate any noise above normal operational activities at VAFB. There would be no measurable noise impact to resident populations during launch.

Shipping in the area likely to be affected would be warned of the impending launches as a matter of routine, so that all sonic booms would be expected and of no practical consequence.

Peak launch noise for the Titan II launch vehicles would be in the range of 112 dBA and would be experienced for a very brief time period (approximately 5 seconds). Sound levels and duration would not be expected to exceed EPA or OSHA requirements and recommendations.

4.5 Biotic Resources

Normal processing as well as Titan launch operations would not be expected to cause substantial impacts to the biota at VAFB. The listed endangered or threatened species are located in colonies away from rocket launch and launch staging activities and thus away from the immediate influence of these activities.

Any action that may affect federally-listed species or their critical habitats requires consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act of 1973 (as amended). The USFWS and the NMFS have previously reviewed those actions that would be associated with the launch of the Titan II launch vehicles from VAFB. Currently no POES-specific processing or launch activities have been identified that would require permits and/or mitigation measures beyond the baseline permits and mitigation measures already necessary or in coordination for VAFB launches.

Previous environmental analyses for the Titan IV/Centaur and the Space Shuttle indicated there would be no significant impacts to terrestrial and marine animal life as a result of the farfield deposition of the exhaust emission. Since the Space Shuttle is much larger than the rocket system

[22] Hazardous Waste Management Plan, 30 SW Plan 32-7043-A (Change 1, 24 July 1999) 24 July 1998, Headquarters Thirtieth Space Wing, Vandenberg Air Force Base, California.

proposed for the NOAA-L and NOAA-M, it would be expected that the cumulative impacts to flora and fauna and to the biological environment from their launch would not be substantial.[23]

4.6 Historic, Archeological, and Recreational Resources

Since no surface or subsurface areas would be disturbed and rocket launches are typical activities at VAFB, no archaeological, historic, or cultural sites listed or eligible to be listed in the NRHP would be expected to be affected by the processing or launching of NOAA-L and NOAA-M.

The POES Program would not increase launch rates nor utilize launch systems beyond the scope of approved programs at VAFB; therefore, POES would not impact the use of public parks and other public use areas, and of private properties.

4.7 Economic Population and Employment Factors

Processing and launch activities would take place using existing personnel, far away from any residential areas. No jobs would be created or relocated during these activities. There would be no substantial socioeconomic effects resulting from the POES NOAA-L and NOAA-M missions.

Launching the NOAA-L and NOAA-M spacecraft would have a negligible, if any, impact on local communities, since no additional permanent personnel would be expected beyond the current VAFB staff. The POES Program would cause no additional adverse impacts on community facilities, services, or existing land uses.

4.8 Hazards

The information that follows was developed primarily from the POES Program's Accident Risk Assessment Report and the New Millenium Program Environmental Assessment[24] and discusses potential hazards, causes, and controls. It has been concluded that the hazards would be within the normal scope of operations at VAFB and would meet all NASA safety requirements. No substantial environmental consequences would be associated with these activities. Table 4-2 presents potential hazards and mitigation measures.

Table 4-2. NOAA-L and M Spacecraft Hazards and Mitigation Measures[25]

System/Subsystem/ Component	Hazard	Mitigation
Structure and Propulsion Module Assembly	Structural failure causing hardware to collide with launch vehicle (LV)	Stress analysis, dynamic analysis, environmental testing, and inspections
Solar Array Deployment	Inadvertent deployment resulting in injury and/or collision with LV	Actuators can be operated by the spacecraft main computer only
Reaction Control	Inadvertent activation of the thrusters	A minimum of one fault tolerant to the release of fuel or thruster firing at all times, mechanically independent valve seats, hydrazine sniffers to detect leaks, leak tests, and acceptance tests

[23] NMP, 5-26.
[24] ARAR and NMP.
[25] Adapted from NMP, 5-30.

System/Subsystem/ Component	Hazard	Mitigation
	Over-pressure of the feed system	Contamination control procedures, unique inlet fittings and connect procedures, temperature would be controlled, inspections performed, proof tests, leak tests, and a high factor of safety
	Structural failure of the feed system	Detailed handling procedures, random vibration tests, and non-destructive evaluation and proof tests
Electrical and Electronic Subsystem	Inadvertent operation of the separation circuit	Single fault tolerant separation initiation, separation breakwire, signal shorting wire, shorting plug, internal undervoltage shutdown circuit
	Exposure to high voltages	All high voltages are contained within the power processing unit and grounded to chassis
Cabling	Damage to electrical power circuitry leading to loss of safety circuitry and redundant power, generation of toxic products	Wire size and circuit protection analysis, bent pin analysis, pyro devices cables would have separate connectors and wire bundles
Electrical Power and Distribution	Deployment of solar arrays and/or diagnostic sensor boom, initiation of separation sequence, generation of exposed high voltages and rapid increase in battery pressure	Shorting plug/separation connector, 91V lines insulated to withstand 600V, high voltage metal interconnects are concealed, battery pressure vessels meets MIL-STD-1522A, spare battery subjected to qualification shock and random vibration, temperature monitoring
Telecommunication	Personnel exposure to radio frequency radiation	RF absorbing hats, RF absorbing wall, RF monitors, prohibited access during tests, hazardous commands would be flagged, at least two inhibits
Autonomy/Flight Software	Commands which could cause the system to reach a hazardous state	A "hazardous operations test mode" would inhibit turning on power

4.8.1 Hazardous Materials and Waste Generation, Treatment, Transportation, Disposal, and Storage

Handling and use of hazardous and toxic materials would be limited. The apogee kick motor, which uses solid fuel, would be fueled at the factory and would arrive at VAFB as a completely assembled, painted, encapsulated unit. The NOAA-L and -M hydrazine loading/off loading would be performed on-stand at SLC-4W by a trained government contractor. The spacecraft contractor would not be performing this operation but would provide the procedural technical support required. These operations would result in hazardous waste including unused propellant, system flushing, hazardous waste containers, residue, etc., which would be the responsibility of the government-appointed hydrazine-transfer personnel.[26]

4.8.1.1 Solvents and Related Materials

The NOAA-L and NOAA-M spacecraft would use standard cleaning solvents in their buildup. Reactive solvents, thinners, and reducers have been eliminated from NOAA-L and -M processing. The cleaning at spacecraft level uses only deionized water and isopropanol alcohol.[27]

[26] ARAR, I.d-1/A.d-2
[27] ARAR, I.d-1/A.d-2

4.8.1.2 Beryllium

The spacecraft contains 17.7 kg (33 lbs.) of a beryllium alloy that would be an integral part of a scientific instrument. Severe destruction of the instrument would be required to release this material.

4.8.1.3 Cesium 137 (Cs-137)

The NOAA-L and NOAA-M SEM Medium Energy Proton/Electron Detector (MEPED) and Total Energy Detector (TED) instruments would be calibrated prior to flight using the radioactive isotope Cesium (Cs)-137. The calibration process, which takes place entirely on the ground, would use 1 millicurie (mCi) of Cs-137. This amount of ionizing radiation would be below the threshold quantity of 1.35×10^{-2} Ci. Based on this quantity of radioactive source material, no Safety Analysis Summary would be required.

The Cs-137 would be doubly encapsulated in stainless steel. At its last swipe in April 2000, no detectable contamination was found. It would be swiped again at the contractor's facility just prior to shipping to VAFB.

The Cs-137 would be used to calibrate the SEM MEPED on the ground. The calibration instrument would be positioned manually near the SEM using a 45.7-cm (18-in.)-long handle and held in place for approximately two minutes at each of up to four locations. Testing would require approximately 1 to 2 hours (worst case) total. Typically, the Cs-137 would be removed from its storage container for less than 30 minutes total. Calibration functions would be performed in accordance with provided procedures (TIROS Procedure TP-SPT 3278200). After its use at VAFB, the calibration instrument with the Cs-137 would be returned to the contractor's facility. Maximum time at VAFB would be no more than two months.

The calibration instrument would be shipped commercially to the test range. Personnel would wear film badges whenever the instrument would be handled, and a survey instrument would be on hand at VAFB if leakage were detected.

If contamination were suspected, procedures mandate the evacuation and isolation of the areas of suspected contamination. No personnel or equipment would be allowed to leave the scene until cleared by radiation safety personnel.

The material is registered with the state of California and holds California License #016943 and NRC 241 Form, which permits its use at VAFB.

Users of the calibration instrument have been identified and have attended a contractor-provided Radiation Safety Course.[28]

4.8.1.4 Batteries

The spacecraft each contain three nickel-cadmium (NiCd) batteries. The batteries contain electrolytes that would not present a hazard during normal operations. They would be trickle-charged during ground operations at VAFB. A hazard would exist if a battery were ruptured.

[28] POES/NOAA-L Satellite Mission Assessment, VAFB Radiation Safety Committee Briefing (RADSAFCOM), May 11, 2000.

However, these batteries would be encapsulated in an aluminum box. Each of the three batteries has 17 NiCd SAFT cells connected in series and rated at 40 Ah. These are different batteries from the 50 Ah, "workhorse" batteries that were involved in the mishap at VAFB in 1998.[29]

4.8.1.4.1 Battery Monitoring and Reconditioning

A new plan for battery monitoring and reconditioning for the NOAA-L mission has been written and its methods incorporated into the procedures: Battery Handling Plan for All Defense Meteorological Satellite Program (DMSP) and TIROS Flight and Workhorse 40, 42, 47, and 50 Ah Batteries, PN-D/T 20058205. This plan considers lessons learned from past operations and standardizes handling methods.

One new ground reconditioning unit (GRU) has been built for NOAA-L and -M. This has been used at the contractor's facility and would be used at the contractor's processing facility at VAFB. The GRU would use the same spacecraft connector as for previous battery monitoring. For each battery, the GRU would monitor the voltage of each cell as well as battery temperature. A new unit that would be based on a modified GRU design is being built for use at the SLC.

4.8.1.5 Shipping of Spacecraft[30]

Shipping of the spacecraft from the contractor's facility to VAFB would require transporting the following gases and hazardous materials on board the cargo aircraft (Table 4-3).

Table 4-3. Hazardous Materials

Nitrogen venting into cargo area	
Type of Gas (non-flammable)	Gaseous Nitrogen (GN_2)
Outgas Flow Rate	0.06 m^3/hr. (2 cubic feet/hour)
Type of bottles	K bottles
Number of bottles	Eight 13.6 kg (30 lbs.) mass GN_2 each)
DOT Certification of Bottles	3AA2015
Service Pressure	2015 PSI
Burst Pressure*	5000 PSI
*This pressure is the over-pressure relieve valve operation pressure on the bottle valves.	

Ordnance				
Ordnance installed on spacecraft				
Nomenclature	Quantity	DOT Class	Explosive Weight (each)	Total Explosive Weight
Initiators	2	C	115 mg	330 mg
Initiators	14	C	156 mg	2,184 mg
Initiators	2	C	200 mg	400 mg
Initiators	2	C	250 mg	500 mg
Initiators	2	C	470 mg	940 mg
Initiators	2	C	750 mg	1,500 mg
				5,854 mg (5.85 grams)

4.8.1.5.1 Transporting Batteries

Three batteries would be installed on the spacecraft during transportation. The Department of Transportation (DOT) classification of these batteries, per provision A-67, is non-hazardous and non-spillable. The batteries would be transported in the discharged and shorted state resulting in an internal pressure of 0 psig. The battery cells would be standard prismatic hermetically sealed

[29] ARAR, 3-3.

[30] Memorandum from Dino Sakkas, NOAA-L Launch Site Manager to Glenn Stewart, NASA/GSFC, Code 214.2, May 8, 2000.

aerospace cells. There would be 17 cells per battery. Each cell would contain a small amount of potassium hydroxide (KOH) electrolyte (150 ml or 9.2 cu. in) as well as cadmium. The total amount of KOH on board this shipment would be 7,650 ml (466.7 cu. in).

4.8.2 Hazardous Waste Management

Hazardous and solid waste management would comply with all existing federal, applicable state and local base environmental regulations. VAFB operates as a generator of hazardous waste and as a Treatment, Storage, and Disposal Facility (TSDF). The transportation and disposal activities for POES-generated waste can be performed by VAFB host base services. VAFB has developed and implemented a Hazardous Waste Management Plan to ensure compliance with Resource Conservation and Recovery Act (RCRA) requirements[31]. In addition to the Hazardous Waste Management Plan, the base has also developed a Hazardous Waste Source Reduction Compliance Plan to provide information and procedures to reduce and minimize the generation of hazardous wastes on the base.

The hazardous wastes generated during the processing and launch of NOAA-L and NOAA-M would be managed in accordance with VAFB's Hazardous Waste Management Plan. The hazardous materials anticipated are the usual materials normally encountered in the space industry. The primary liquid rocket motor propellants include hydrazine (N_2H_4), nitrogen tetroxide (N_2O_4), kerosene (RP-1), and liquid oxygen (LO_x). Liquid hydrogen (LH_2), high-pressure helium (GHe), gaseous nitrogen (GN_2), and other materials would also be on the complex.[32] Procedures are documented for material safety in the event that any personnel come into unplanned contact with hazardous materials.[33] Material Safety Data Sheets are provided to all individuals who would use, handle, store, transport, or otherwise be exposed to hazardous products.

4.8.3 Potential RF Hazards

4.8.3.1 Communications Links

The NOAA-L and -M spacecraft contain eight data transmitters and an L-band transmitter for the SARR. All transmitters can be operated while the spacecraft is in the fairing on the launch pad. STX-4 is operational during ascent. S-band omni coverage for commands is provided by a dual G-STDN compatible receiver/demodulator (GRD) using a set of antennas mounted on the +X and -X sides of the spacecraft. Counting the SAR-nested, helix-receiving antenna system as a single unit, the spacecraft has 14 individual antennas.

While the NOAA-L or NOAA-M spacecraft is in Building 1610 at VAFB, communications is carried out by means of "hard-wiring" between the spacecraft and the communications system in Building 1610. During this time, some antennas would be operable and radiation would be emanating from some spacecraft antennas when the antennas are receiving or transmitting data. The Building 1610 rooftop antennas would interface with the spacecraft via the NOAA antenna re-radiation system (NARS) and pickup antennas located close to the spacecraft in the Building

[31] VAFB Hazardous Waster Management Plan.
[32] NMP, 5-27.
[33] ARAR, Appendix A.d.2, Appendix A.j. Material Safety Data Sheets.

1610 clean room. Warning lights within the MST would alert personnel when the spacecraft is about to emit RF radiation.

When the spacecraft would be moved to SLC-4W, the MST would provide facilities for payload servicing and checkout. Some communications would occur by means of pickup antennas for certain transmitters as well as via the GRD receiver, although most communications would still take place through hard-wire. Warning lights within the MST would alert personnel when the spacecraft is about to emit RF radiation

During ascent, the satellite transmits TIROS Information Processor (TIP) real-time data via the STX-4 and the S-band omni antenna (SOA)-3 and -4 to the ground equipment and to the ARIA aircraft.

RF radiation hazard analysis will be performed prior to the start of I&T operations. Previous experience with similar spacecraft transmitters has not identified any instances of inadvertent ordnance ignition or exposure of personnel to hazardous RF levels due to transmitter operation during launch operations or during ascent.[34]

4.8.3.2 Pyro Safety

Pyro analysis demonstrated that the worst case RF pickup power by the NOAA-L and -M pyro circuits exposed to the worst case electric field environment would not cause inadvertent firing of any of the 32 electro-explosive devices (EED) on the spacecraft. Both apogee kick motor (AKM) pyro circuits and non-AKM pyro circuits were analyzed at Building 1610 and SLC-4W locations. The no-fire analysis criteria is based on MIL-STD-1576, July 1984, which requires that the power produced at the EED by the RF environment shall be at least 20 dB below the maximum 1-watt, pin-to-pin DC no-fire power of the EED.[35]

4.9 System Safety

System safety analyses for the NOAA-L and -M spacecraft were completed in accordance with requirements of MIL-STD-1574A and the System Safety Implementation Plan (SSIP) for NOAA-KLM spacecraft. number 3267408.[36] The safety analyses performed for the NOAA-L and -M spacecraft include the following:

- Preliminary Hazard Analysis (PHA)
- System Safety Checklists
- System Hazard Analysis (SHA)
  - Spacecraft, AGE, and Software
  - Integration and Test, and Launch-Site Operations

[34] ARAR, Appendix A.b, RF Radiation.
[35] ARAR, Appendix A.F.11, Pyro Safety Analysis.
[36] MIL-STD-1574A was canceled and replaced with MIL-STD 882D, Standard Practice for System Safety, February 10, 2000. Also, System Safety Implementation Plan (SSIP) for NOAA-K, L, M Satellites, Vol. 021.

4.9.1 Preliminary Hazard Analysis (PHA)

The PHA was conducted early in the design and development phase of the NOAA-KLM Program to identify potential accident risk factors associated with spacecraft subsystems, software, and ground operations and is not relevant to this Environmental Assessment.

4.9.2 System Safety Checklists

System safety checklists were completed for the following safety documents:

- MIL-STD- 1574A, System Safety Program for Space and Missile Systems
- EWR 127-1 (October 1997) (formerly WSMCR 127-1 (15 May 1985) Range Safety Requirements[37] - applicable to operations
- WSMCR 127-1 (15 May 1985) Range Safety Requirements - applicable to spacecraft design

These checklists were used to assess the compliance with program and safety design requirements. The checklists show Compliant, Non-Compliant, Not Applicable designations, as well as technical comments and resolutions where applicable. All non-compliant items were closed based on approval of the Final NOAA-KLM ARAR.[38]

The NOAA-KLM System Safety Implementation Plan (SSIP), 3267408, is in full compliance with the requirements of MIL-STD-1574A.

4.9.3 Systems Hazard Analysis

The SHA was conducted in accordance with the requirements of MIL-STD-1574A and the NOAA-KLM SSIP. The SHA for NOAA-L and -M was performed as three separate analyses: (1) spacecraft and aerospace ground equipment (AGE) hazard analyses, (2) operational hazard analyses, and (3) software hazard analyses. The analyses include potential hardware failures (spacecraft and AGE), e.g., short circuit, structural failure, component failure, etc., and human errors. The analyses include operations performed during manufacturing, integration, and test at the contractor's factory and at VAFB.

The components with potential identified hazardous energy sources are shown in Table 4-4.

Table 4-4. Hazardous Item Location List

Component	Potential Hazardous Energy
Rocket Motor	High Temperatures
	Toxic Exhaust Gas
	Acoustics
	Thrust
	Explosion/Fragmentation*
NiCd Batteries	High Current
	Corrosive Fluid
	High Temperature*
	Explosion/Fragmentation*
Transmitter Antennas	RF Energy - UBF, VHF, S-Band and L-Band

[37] EWR 127-1, *Range Safety Requirements*, 31 October 1997 (formerly WSMCR-127-1).
[38] ARAR, Appendix H.c.

Component	Potential Hazardous Energy
	Max output power I to 10 watts at the antenna
Hydrazine Tanks/Plumbing	Pressurized Flammable Liquid
	Pressurized Toxic Liquid
	Organic Solvent
	Explosion/Fragmentation*
Hydrazine Thrusters	Hot Exhaust Gas
	Thrust
	Noise
	Toxic Fume
Nitrogen Tanks	High Pressure
	Explosion/Fragmentation*
	Asphyxiate
Nitrogen Thrusters	Noise
	Thrust
	Gas Jet
	Asphyxiate
Separation Clamps	Spring Action
	Pyrotechnic
	Altered Dynamic Response*
Pyrotechnic Deployed Devices	Mechanical Force
	Impact
	Pyroshock
	Heat
	Altered Dynamic Response*
Reaction Wheels	High Speed Rotors
	Gyroscopic Force
	Toxic Internal Parts
	High Current
	Combustible Metal

*Present only due to failure conditions.

4.9.4 Operations Hazard Analysis

The Operations Hazard Analysis (OHA) for NOAA-KLM was conducted in accordance with the SSIP. The OHA is an extension of the PHA/SHA and identifies and evaluates hazards resulting from the implementation of I&T operations or tasks performed by personnel. Separate OHAs have been prepared for the contractor's and VAFB operations.

4.9.5 Government Furnished Equipment (GFE) Hazard Analysis

The safety assessment of the GFE would be the responsibility of NASA/GSFC. GSFC would perform the monitoring of the safety requirements imposed upon their instrument manufacturers, identifying to the contractor any specific hazards associated with the instruments. The contractor would provide the integration of the payload to the spacecraft, incorporating where required the external instrument safety features and hazard-preventing interfaces.

The payload safety analyses provided by the instrument manufacturers were reviewed by GSFC, and the responses to an 18-part safety questionnaire that summarizes the findings have been provided by GSFC. The questionnaire and responses for each instrument are provided in the ARAR, 1996 revision.[39]

[39] ARAR, 2-7 - 2-14.

4.9.6 Software Safety Hazard Analysis

The Software Hazard Analysis was performed to identify and assess hazards related to "test," "prelaunch," and "ascent flight" software. The software hazard controls are the subject of an independent verification and validation audit conducted by Software Quality Assurance.

The NOAA-KLM Software Safety Analysis concluded that the spacecraft hardware design and test flow, combined with flight software operating modes and constraints, preclude the occurrence of personnel and equipment hazards due to anomalous ground and flight software operation. It further concluded that the spacecraft hardware configuration and test flow provide at least three inhibits from premature activation of the AKM or EEDs and from inadvertent hazardous hydrazine thruster firings due to test software or operator errors. Also, adequate procedural safeguards exist to reduce the possibility of inadvertent hazardous RF radiation.

4.10 Safety-Related Testing and Checkout Requirements

The following safety-related testing and checkout requirements have been or would be performed on the NOAA-L and -M missions:

- Proof testing of mechanical aerospace ground equipment (MAGE), e.g., slings, handling fixtures, fork lifts, etc., per EWR 127-1 (formerly WSMCR 127-1) and ANSI B30 Series
- Proof testing of cranes and hoists per EWR 127-1 (formerly WSMCR 127-1) and ANSI B30 Series
- Proof testing of pressurized systems (reaction control system (RCS)) per MIL-STD-1522A[40]
- Stray voltage and bridgewire checkouts of ordnance and ordnance firing circuits
- Mechanical and electrical checks of the safe and arm (S&A) device
- Continuity and resistance measurements
- Leak tests of RCS
- RF field test

4.11 Safety Program

All pertinent safety requirements would be adhered to in compliance with applicable instructions or addressed in appropriate safety plans. The POES Program has established a comprehensive System Safety Program for the missions in accordance with *System Safety for Orbital Flight Projects*, GMI 1700.3A; *System Safety Program Requirements*, MIL-STD-882D; and EWR 127-1 (formerly WSMCR 127-1).

In addition, a Range Safety Program in accordance with EWR 127-1 (formerly WSMCR 127-1) would be implemented for each launch to ensure that the launch and flight of launch vehicles and payloads would present no greater risk to the general public than that imposed by the overflight of conventional aircraft. In addition to public protection, range safety on a national range includes launch area safety, launch complex safety, and the protection of national resources.

[40] MIL-STD 1522A, *Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems*, September 4, 1992.

4.12 Emergency Equipment

Appropriate emergency equipment would be available to support NOAA-L and -M launch-site (VAFB) operations. The equipment would be provided in accordance with the applicable Missile Operation Support Requirements.

NOAA-L and -M ground processing personnel would be provided with adequate protective equipment to safely conduct hazardous operations and to protect against any unplanned hazardous mishaps.

4.12.1 Launch Site (Building 1610 and/or SLC-4W)

Safety and Protective Equipment for personnel is described in the Launch Complex Safety Plan T3J-WLCSP-4C for potentially hazardous operations at SLC-4W.

4.13 Ground Handling, Storage, and Transportation

NOAA-L and -M ground processing provides for the safety of personnel and equipment during all operations. This would be accomplished through the incorporation of design safety features into the AGE, the inclusion of specific safety requirements procedures, and the adherence to accepted safety practices. The spacecraft contractor is in compliance with applicable federal and state OSHA requirements. The POES Program is also compliant with the applicable Air Force Occupational Safety and Health (AFOSH) standards. Safety requirements are included in the appropriate documentation as well as in NOAA-KLM test procedures.

4.14 Safety-Critical Operations

Safety-critical operations are defined as those that involve risk factors that could precipitate a catastrophic accident.

The NOAA safety-critical operations would be identified in test procedures designated as "Hazardous." System Safety would review each of the hazardous procedures to ensure that the procedures meet all safety requirements, contain appropriate cautions and warnings, and that all potentially hazardous operations are identified. The procedures would contain suitable hazardous identification and warning nomenclature preceding the actual hazardous operation; the termination point of hazardous operations would also be defined.

4.15 Accident Risk Assessment

4.15.1 Summary

This accident risk assessment for the NOAA missions would be based on the hazard analysis discussed previously and in the hazard reports. All hazard reports for the missions are "Closed."

4.15.2 Accident Risk Factor Identification and Control

Hazard analyses have been performed on the NOAA-L and -M spacecraft resulting in the identification of potential hazards, causes, and controls. The hazard analyses for the spacecraft and Aerospace Ground Equipment (AGE) have been identified, and the identified risks are listed in the risk factor matrix described below.

4.15.2.1 Risk Factor Matrix[41]

The **Risk Factor Matrix (RFM)** (Table 4-5) is a system safety tool that identifies accident risk factors associated with the NOAA-L and M spacecraft and AGE. The seven hazard groups (types) analyzed and evaluated for NOAA-L and M include:

- Collision.
- Contamination/Toxicity
- Fire/Explosion
- Electrical Shock/Secondary Damage.
- Corrosion
- Temperature
- Radiation

For purposes of this assessment, the operational phases for the NOAA-L and -M Risk Factor matrix include

- Phase 2 - Ground operations at VAFB up to final countdown for launch.
- Phase 3 - Launch operations and ascent up to orbit injection.

Table 4-5. NOAA-L and M Risk Factor Matrix

		Phase	
Risk Factor No.	Risk Factor	2	3
1.0	**COLLISION**		
1.1	NOAA-LM Satellite		
1.1.1	Inadvertent Separation/Deployment		
1.1.1.1	Premature EED Initiation	X	X
1.1.1.2	Structural Failure	X	X
1.1.2	Failure to Separate/Deploy		
1.1.2.1	EED Failure		X
1.1.2.2	Structural Failure		X
1.1.3	Structural Failure	X	X
1.1.4	AKM Failure		X
1.1.5	Reaction Wheel Assembly Failure	X	
1.2	AGE		
1.2.1	Structural Failure	X	
1.2.2	Human Error	X	
2.0	**CONTAMINATION/TOXICITY**		
2.1	NOAA-LM Satellite		
2.1.1	Battery Rupture	X	X
2.1.2	Hydrazine Leakage	X	X
2.2	AGE		
2.2.1	Toxic Materials	X	
2.2.2	Asphyxiates.	X	
3.0	**FIRE/EXPLOSION**		
3.1	NOAA-LM Satellite		

[41] ARAR, 2-1.

		Phase	
Risk Factor			
No.	**Risk Factor**	**2**	**3**
3.1.1	Premature Propulsion Subsystem Activation	X	X
3.1.2	Propulsion Subsystem Structural Failure	X	X
3.1.3	Premature AKM Firing	X	X
3.1.4	Flammable Materials	X	
3.1.5	Electrical Failure	X	
3.2	AGE		
3.2.1	Overpressurization	X	
3.2.2	AGE Failure	X	
3.2.3	Flammable Material	X	
4.0	**ELECTRICAL SHOCK/SECONDARY DAMAGE**		
4.1	NOAA-LM Satellite		
4.1.1	Electrical Failure		X
4.1.2	High Voltage/High Current	X	
4.2	AGE		
4.2.1	Electrical Failure	X	
4.2.2	High Voltage/High Current		X
5.0	**CORROSION**		
5.1	NOAA-LM Satellite		
5.1.1	Exposure to Corrosive Agents	X	
6.0	**TEMPERATURE**		
6.1	NOAA-LM Satellite		
6.1.1	High Surface Temperature	X	
6.2	AGE		
6.2.1	High Surface Temperature	X	
6.2.2	Cryogenics	X	
7.0	**RADIATION**		
7.1	NOAA-LM Satellite		
7.1.2	RF Radiation	X	
7.1.3	EMI/RFI/ESD (Electro-Static Discharge)	X	X
7.2	AGE		
7.2.1	Ionizing Radiation	X	
7.2.2	AGE Produced RF	X	

4.15.3 Residual Risks

Residual risks, i.e., accident risk potential that exists after the implementation of hazard controls, are identified and assessed for each hazard report. Each hazard report has been evaluated for residual risks, and these risks and the controls that make the risk acceptable are specified in the residual risk summary appearing in Table 4-6.

Table 4-6. Residual Risk Summary

Residual Risks	Assessment
Human error in assembly or test operations Hazard Probability - Occasional* for Category II hazards - Remote* for Category I hazards	Appropriate WARNINGS and CAUTIONS have been identified. QA verifies assembly/test operations are correctly performed, but the potential for human error cannot be totally eliminated.
Hydrazine leakage from zero fault tolerant RCS Hazard Probability - Remote**	RCS is zero fault tolerant to the inadvertent flow of hydrazine. Risk associated with hydrazine leakage through a thruster valve is addressed in Waiver Request (see Appendix F of POES Accident Risk Assessment Report)

Ignition of flammable material Hazard Probability - Remote**	Analysis of flammable material for TIROS-KLM is included in Appendix C of POES Accident Risk Assessment Report.
Electrical shock due to contact with "hot" pins Hazard Probability - Remote**	WARNING in procedures alerts personnel to hazard.
Electrical circuit protection Hazard Probability - Remote**	Current limiting and fusing do not protect all powered circuits. Procedural controls are provided during ground test operations.
Untested ordnance hardness shielding Hazard Probability - Remote**	Effectiveness of RF shielding has been demonstrated by analysis. Procedural controls limit potential RF environments. Previous TIROS-HIJ spacecraft have been exposed to VAFB SLC-3 environments without incident.
Battery rupture due to overpressure from overcharging Hazard Probability - Remote**	Current limiting devices are not used with SC batteries. electrical AGE (EAGE) is used to control batteries during charging. (See checklist Appendix H.b.1 Item No. 3-330 of POES Accident Risk Assessment Report.)
Overpressurization of hydrazine tanks due to pressure regulator failure Hazard Probability - Improbable***	Component inspection required to ensure that manufacturing defect does not exist. RCS is single fault tolerant to overpressurization.
* Occasional - likely to occur sometime in the life of the NOAA-LM spacecraft program. ** Remote - not likely, but possible to occur in the life of the NOAA-LM spacecraft program. *** Improbable -so unlikely, it can be assumed occurrence may not be experienced.	

These residual risks are considered acceptable. A waiver has been approved for one single point failure (unacceptable condition) that could cause a Category I hazard, i.e., RCS is zero fault tolerant to flow of hydrazine through thruster valve. A failure of the regulator at full flow would result in overpressurization of the hydrazine tanks (Category I hazard). Full flow of the regulator would not be considered a credible failure. The regulator would be considered single fault tolerant (non-compliant) with a relief valve that could handle the maximum flow rate from a failed regulator.

4.16 Accidents and Launch Failures

4.16.1 Liquid Propellant Spill

The potential for an accidental release of liquid propellants would be minimized by strict adherence to applicable USAF and NASA safety procedures. All spills would be managed in accordance with a Spill Response Plan. First stage propellants would be stored in tanks near the launch pad within cement containment basins designed to retain 110 percent of the storage tank volumes. Post-fueling spills from the launch vehicle would be channeled into a sealed concrete catchment basin and disposed of according to the appropriate state and federal regulations. Second-stage propellants are not stored at the SLCs and would be transported to the launch site by specialized vehicles.

At VAFB, the most severe propellant spill accident scenario would be releasing the entire Titan II launch vehicle load of nitrogen tetroxide at the launch pad while conducting propellant transfer operations. Under adverse weather conditions, it would be predicted that a plume from a spill involving a Titan may reach as far as 4 km (2.5 mi.) before nitrogen oxide concentrations are lowered to 5 ppm and would travel several miles farther before being lowered to 1 ppm. If the direction of the wind and the critical distance for hazardous vapor dispersal were to include an on-base or off-base uncontrolled area, propellant loading would be postponed. Activating the launch pad water deluge system would substantially reduce the evaporation rate, limiting exposure to concentrations that are above federally established standards to the vicinity of the spill. Propellant transfer personnel would be outfitted with protective clothing and breathing equipment. Personnel not involved in transfer operations would be excluded from the area.[42]

4.16.2 Launch Failures

Accidents either on the launch pads or within a few seconds of launch present the most threat to people, mainly the launch complex work force. Due to Range Safety requirements and operational requirements, all personnel are sufficiently far away from the launch site so as not to be affected by debris and other direct impacts of such accidents. There are potential short-term effects including localized effects of a fireball, fragments from the explosion, and release of some propellants and combustion products.

Range Safety requirements mandate command safety destruct (CSD) systems on liquid propellant tanks and solid rocket motors. In the event of a CSD action, combustion products would include: aluminum oxide (Al_2O_3) particulates, hydrogen chloride (HCl), carbon monoxide (CO), oxides of nitrogen (NO_x) from the solids and carbon dioxide (CO_2) and nitrogen (N_2) from the hypergols. The amount of dilution would depend on existing meteorological conditions at the time of launch. The flight of the vehicle would be monitored by AF personnel who have authority to destroy the launch vehicle in the event of abnormal operations or a departure from the approved limits of flight.[43]

Some uncombusted propellants could enter nearby surface waters or the Pacific Ocean. Depending on the amount of fuel reaching the water bodies, aquatic biota could be subject to short-term impacts including death to biota in the immediate area due to hydrazine or nitrogen tetroxide releases. Immediate on-pad effects to terrestrial plants and animals due to the fireball are possible. These effects, although severe, would be transient and would occur only one time if there would be an accident on the pad.[44]

The Titan II is a two-stage core vehicle that utilizes liquid Aerozine-50 fuel (a 50/50 blend of hydrazine and unsymmetrical dimethylhydrazine (UDMH) and nitrogen tetroxide oxidizer in both stages. Both the liquid fuel and oxidizer are toxic chemicals in their liquid and vapor states. However, however, under nominal engine performance, the fuel and oxidizer react to produce non-toxic or low-toxicity combustion products. Titan launch vehicle failures present a unique hazard due to the large quantities of hypergolic liquid propellants used on the vehicle. The failure of the Titan 34D-9 at VAFB in 1986 demonstrated the probability of incomplete mixing and reaction of the fuel and oxidizer components during vehicle breakup. By design, the Titan propellant tanks are ruptured during a command destruct action, but theoretical and empirical evaluations suggest that less than 25 percent of the fuel and oxidizer would react. The residual portions of the hydrazine fuel and nitrogen tetroxide oxidizer are believed to thermally decompose or vaporize. Ammonia and methane are predicted to form as byproducts of the hydrazine and UDMH thermal decomposition. Further atmospheric decay of vaporized UDMH

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[42] NMP, 5-8.
[43] Conversation with Heidi Schultz, System Safety, Lockheed Martin Astronautics Operations, VAFB.
[44] NMP, 5-9.

would be predicted to form NDMA (nitrosodimethylamine) and FDH (formaldehyde dimethyl hydrazone). The concentration predictions for these and other chemicals predicted to result from a Titan II abort are listed in Table 4-7.[45]

Table 4-7. Peak Concentration and 60-Minute Mean Concentration Predictions for Titan II Launch Abort Emissions at VAFB Using a Hypothetical No Wind Shear Meteorological Profile

Exhaust Cloud Constituent	Peak Concentration (ppm)	Maximum 60-Minute Mean (ppm)	Distance From SLC-4 Peak-Mean (km)
CO	1.59	0.53	9-13
CO_2	0.98	0.33	9-13
UDMH	1.24	0.41	9-13
NH_3	7.51	2.50	9-13
NO_2	19.44	6.39	9-13
N_2H_4	0.38	0.11	8-11
NDMA	Trace*	Trace*	No Data
FDH	0.03	0.01	13-21
HNO_3	0.66	0.33	13-21

*Trace quantities are >0.01

Under normal or catastrophic launch scenarios, concentrations would not be hazardous except in the immediate vicinity of the launch pad for approximately two minutes after launch or near the center of the launch cloud for a short time after the launch. The launch cloud would be several hundred meters above ground level, depending on weather conditions. These hazardous concentrations near the center of the launch cloud would persist for an estimated 10 minutes but could occur for shorter or longer periods depending on meteorological conditions. Prior to launch, personnel are cleared from the areas where potentially hazardous concentrations would occur, and there should be no hazard to humans associated with exhaust effluents.

For the propellants that would be dispersed to the air in the event of a catastrophic launch failure, hazardous concentrations would not occur except in the immediate vicinity of the launch complex. Since personnel would be cleared from the area prior to launch, there should be no hazard to humans from dispersed propellants in the event of a catastrophic launch failure.

4.17 Orbital Space Debris

NPD 8710.3 states that NASA's policy is to "employ design and operations practices that limit the generation of orbital debris, consistent with mission requirements and cost-effectiveness."[46] This directive applies to (a) payloads that can no longer perform their mission; (b) rocket bodies and other hardware left in orbit as a result of normal launch and operational activities, and (c) fragmentation debris produced by failure or collision.

NASA policy requires, as appropriate, that each program or project conduct a formal assessment for the potential to generate orbital debris. General methods to accomplish this policy include:

- Depleting on-board energy sources after completion of mission

[45] NMP, 5-11
[46] NASA Policy Directive (NPD) 8710.3, *NASA Policy for Limiting Orbital Debris Generation*, May 29, 1997.

- Limiting orbit lifetime after mission completion to 25 years or maneuvering to a disposal orbit
- Limiting the generation of debris associated with normal space operations
- Limiting the consequences of impact with existing orbital debris or meteoroids
- Limiting the risk from space system components surviving reentry as a result of post-mission disposal

In addition, NASA Standard (NSS) 8719.14, *Guidelines and Assessment Procedures for Limiting Orbit Debris*, lists three methods for disposing of spacecraft or upper stages passing through low-Earth-orbit (less than 2000-km (1,240 mi) altitude) in their final mission orbit. These are:

1. Atmospheric reentry option: Leave the structure in an orbit in which, using conservative projections for solar activity, atmospheric drag would limit the lifetime to no longer than 25 years after completion of mission. If drag enhancement devices are to be used to reduce the orbit lifetime, it should be demonstrated that such devices would significantly reduce the area-time product of the system or would not cause spacecraft or large debris to fragment if a collision occurs while the system is decaying from orbit.
2. Maneuvering to a storage orbit between low-Earth-orbit (LEO) and geosynchronous Earth orbit (GEO): Maneuver to an orbit with perigee altitude above 2500 km (1550 mi.) and apogee altitude below 35,288 km (21,879 mi.) (500 km (310 mi.) below GEO altitude).
3. Direct retrieval: Retrieve the structure and remove it from orbit within 10 years after completion of mission.[47]

The POES Program would comply with all requirements of and would complete a Debris Assessment as required by NPD 8710.3. In the event that POES NOAA-L and/or NOAA-M deorbited, no solid debris would strike the Earth's surface.

4.18 Cumulative Effects

4.18.1 Impacts on Stratospheric Ozone

During the last 20 years, there has been an increased concern about human activities affecting the upper atmosphere. Substantial decreases of total ozone in the middle and high latitudes of both hemispheres have been documented. The links between ozone losses in the Antarctic spring and Arctic winter stratosphere and human-made chlorine and bromine increases have been established.

Space vehicles that use solid rocket motors (SRMs) have been studied concerning potential contributions to ozone depletion due to exhaust products. Primary constituents of exhaust from solid-fueled rocket motors are hydrogen chloride (HCl), carbon dioxide (CO_2), carbon monoxide (CO), and aluminum oxide (Al_2O_3). To date, most attention has focused on the chlorine emissions of rockets as the largest threat to stratospheric ozone. Through reaction with OH ($OH + HCl \rightarrow Cl + H_2O$), the chlorine atom from HCl would be released to play a role in ozone loss. One such catalytic loss cycle would be:

[47] NASA Standard (NSS) 8719.14, *Guidelines and Assessment Procedures for Limiting Orbital Debris*, August 1995.

$$Cl + O_3 \rightarrow ClO + O_2$$
$$ClO + O \rightarrow Cl + O_2$$
$$\text{Net: } O_3 + O \rightarrow O_2 + O_2$$

The Cl is not consumed in this loss process, thus one Cl atom can be responsible for the loss of many hundreds of thousands of ozone molecules before reacting with another atmospheric constituent and ending the catalytic loss cycle.

Since the Titan II launch vehicle would result in emissions of exhaust products into the stratosphere, its effect on stratospheric ozone depletion was evaluated. The average global stratospheric ozone depletion rates for the types of chemicals emitted were calculated as a percent O_3 reduction (in a global annually averaged sense) per ton of exhaust emissions.

For a Titan II launch vehicle the percent of stratospheric ozone reduction was calculated as shown below (in tons/launch):[48]

HCl:	0
Al_2O_3:	0
NO_x:	0.6
Percent ozone depletion ($HCl + Al_2O_3 + NO_x$):	9.6×10^{-7}

Extensive analyses have been performed and concluded that "the effects of rocket propulsion on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming were extremely small compared to other anthropogenic impacts, and therefore that there would be no pressing need to change propellants of current launch systems."[49]

4.18.2 Pollution Prevention

In implementing the POES NOAA-L and NOAA-M missions, NASA would comply with Toxic Release Inventory Reporting requirements, Emergency Planning and Community Right-to-Know responsibilities, and State and Local Right-to-Know and Pollution Prevention requirements. NASA would support the Local Emergency Planning Committee as requested and would make available all Pollution Prevention and Community Right-to-Know information upon request (NPG 8820.3 - March 1, 1999).

In compliance with Executive Order 12856, "Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements," NASA has developed a comprehensive agency program to prevent adverse environmental impacts by: 1) moving ahead of compliance; 2) emphasizing pollution source elimination and waste reduction; and 3) involving communities in NASA decision processes. By the end of 1999, NASA and the USAF would have achieved a 50 percent reduction (1994 baseline) in total releases of toxic chemicals to the environment and off-site transfers of such materials for treatment and disposal. The POES NOAA-L and NOAA-M missions would be managed in compliance with both NASA and USAF requirements and objectives for pollution prevention.

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[48] NMP, 5-21

[49] American Institute of Aeronautics and Astronautics Workshop, Atmospheric effects of chemical rocket propulsion workshop report to the American Institute of Aeronautics and Astronautics, Washington, DC, 1991 quoted in NMP, 5-21.

The POES Program, during spacecraft processing, would not use, create, accumulate, or store any significant amounts of toxic, corrosive, flammable, reactive, or irritant hazardous material waste requiring special collection/disposal methods. Reactive solvents, thinners, and reducers have been eliminated from NOAA-L and -M processing. The cleaning at spacecraft level uses only deionized water and isopropanol alcohol.[50]

4.18.3 Environmental Justice

The POES NOAA-L and NOAA-M missions do not raise any environmental justice concerns. The missions would not produce any substantial environmental or human health impacts on the population. Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*, directs federal agencies to identify and address disproportionately high and adverse human health environmental effects of their activities on low-income populations or minority populations in the United States. The POES NOAA-L and NOAA-M missions would not generate any disproportionately high or adverse impacts on minority or low-income populations arising from implementation.

4.19 No-Action Alternative

The No-Action alternative would mean the launch of NOAA-L and NOAA-M would not be undertaken and the immediate local (i.e., launch site) impacts would be precluded. Although the absence of launching operations might spare the environment immediately off the coast of VAFB from potential environmental impacts, the launch of the Titan II would be within the scope of existing operations at VAFB and would have limited impact on the surrounding environment. In addition, cancellation of the missions would preclude scientists and the public from increasing their knowledge of atmospheric and surface conditions that affect long- and short-term meteorological and climate forecasting.

[50] ARAR, A.d-1/A.d-2.

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