Environmental Impact Analysis Process

ENVIRONMENTAL REVIEW

STARLAB SITE
ON ASCENSION ISLAND

28 AUGUST 1990

DEPARTMENT OF THE AIR FORCE

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ENVIRONMENTAL REVIEW

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28 August 1990

Prepared for

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE SYSTEMS DIVISION
ENVIRONMENTAL PLANNING DIVISION

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ACRONYMS AND ABBREVATIONS

AFOSH	Air Force Occupational Safety and Health
AFR	Air Force Regulation
AMOS	Air Force Maui Optical Station
ANSI	American National Standards Institute
ATP	acquisition, tracking, and pointing
Cm	centimeter
DOD	U.S. Department of Defense
EA	Environmental Assessment
ETR	Eastern Test Range
IRPA	International Radiation Protection Association
Km	kilometer
LMSC	Lockheed Missile and Space Company
M	meter
MPE	Maximum permissible exposure
NASA	National Aeronautics and Space Administration
ORNL	Oak Ridge National Laboratory
POCC	Payload Operations Control Center
S	seconds
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
STO	Space Test Object
SWAT	Short Wave Adaptive Technology
USAF	U.S. AIR FORCE
USASDC	U.S. Army Strategic Defense Command
USFWS	U.S. Fish and Wildlife Service

August 1990

SUMMARY

This Environmental Review has been prepared in accordance with the Department of Defense Directive 6050.7 and Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions), as implemented by Air Force Regulation 19-3 (Environmental Impact Analysis Process Overseas). The Proposed action evaluated in this Environmental Review is to construct and operate a ground calibration site at Cotar Hill on Ascension Island, a dependency of the British Island of St. Helena. The ground calibration site would be used during a portion of the British Island of St. Helena. The ground calibration site would be used during a portion of the Starlab Program experiments that have been described in a previous Environmental Assessment (USAF 1990). The purpose of these engagements and experiments is to advance the research program of the Strategic Defense Initiative Organization (SDIO), particularly that involving the acquisition, tracking, and pointing capabilities of Electro-optical and laser systems.

The proposed ground calibration experiments would use the green and red Starlab lasers on the Space Shuttle to locate and actively scan a site on Ascension Island. The experiments would demonstrate tracking and pointing accuracy of the laser system prior to conducting other Starlab experiment.

The most significant issue addresses in this Environmental Review is the potential exposure of people and/or wildlife to laser beams. The USAF has prepared extensive analyses of potential laser effects, which provide critical input to the evaluation in this Environmental Review. Detailed safety analyses of the effects of laser systems conducted by the USAF and independent calculators done in preparing the Starlab Program EA (USAF 1990) indicate that no significant impact to humans or wildlife would occur from exposure to lasers because the probability of people or wildlife seeing one plus is so small (1x 10-9) and the duration of exposure would be so short (25 nanoseconds).

Other issues that are discussed and evaluated here are the potential environmental impacts of constructing and operating the ground calibration site on land use, ecological resources, endangered and threatened species, and cultural resources. Construction and operation impacts of a ground calibration site on Ascension Island have little potential for causing adverse environmental impacts. The Cotar Hill site is already disturbed and supports other U.S. Air Force facilities. A population of the rare plant *Euphoria origanoids* is located on the slopes of Cotar Hill about 360m from the proposed site. No direct impacts of construction on this population would occur, and indirect impacts are unlikely because mitigative measures would be implemented to keep construction personnel and activities away from the population. A sooty tern rookery, about 900m from the site, would also be unlikely to be affected by construction activities. If the laser apparatus were to malfunction and the beam were to travel across the rookery; it is highly unlikely that any birds would be adversely affected. ETR personnel would consult with local officials and experts to identify any additional local concerns prior to initiating any construction activities.

August 1990

1. INTRODUCTION

This environmental Review has been prepared to identify and evaluate potential environmental issues associated with the proposed construction and operation of a ground calibration site on Ascension Island. Ascension Island is a dependency of St. Helena, which is itself a member of the British Commonwealth. The proposed site would be used during a series of laser experiments that are part of the Starlab Program and are described in a separate Environmental Assessment (USAF 1990).

1.1 PRUPOSE AND NEED

Former President Reagan announced on March 23, 1983, that he was directing a "comprehensive and intensive effort to define a long term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles." To implement this directive, the President created the Strategic Defense Initiative Organization (SDIO), which was charted to oversee activities related to the Strategic Defense Initiative (SDI).

The Starlab program is an SDI activity that consists of a dedicated Space Shuttle mission having the objectives of demonstrating "proof of concepts" for several space based defense experiments and new concepts for performing strategic space experiments using the Space Shuttle/Spacelab capability. Under a Memorandum of Agreement between the National Aeronautics and Space Administration (NASA) and DOD, NASA will provide launch services for the Space Shuttle and overall Starlab mission coordination and support. SDIO is the DOD sponsor for the Starlab program (NASA and DOD 1989), AND THE u.s. Air Force (USAF) is responsible for developing the Starlab payload and conducting the experiments. The U.S. Army Strategic Defense Command (USASDC) is responsible for the ground launch vehicles (i.e., Project Starbird) associated with Starlab. The Eastern Test Range (ETR) is responsible for preparing and operating the ground calibration sites.

The Starlab program includes a serious of experiments that use Electro-optical and laser systems aboard the Space Shuttle and on ground. These experiments are designed to (1) demonstrate acquisition, tracking, and pointing (ATP) of laser systems; (2) collect plume and background information to narrow phenomenology uncertainties; and (3) provide a basis for making an informed decision on the design of a weapon ATP system. Starlab includes experiments that use laser beams propagated by equipment from the orbiter and to and from the ground. The laser experiments involve (1) calibration of the Electro-optical systems, using objects deployed from the orbiter (i.e., space test objects) and scoreboards at ground calibration sites on Antique in the Caribbean and Ascension Island in the Atlantic Ocean; (2) ATP activities associated with Starbird test vehicle launches from Wake Island in the Pacific Ocean and Cape Canaveral, Florida; (3) participation in Short Wave Adaptive Technology (SWAT) experiments at the Air Force Maui Optical Station (AMOS), Hawaii; and (4) wave front control experiments. In addition to these laser experiments, background data on the composition of visible and other spectral radiation from planets and stars would be collected during the Starlab mission to assist in calibrating the Electro-optical systems.

1-2 SCOPE

This Environmental Review evaluates potential environmental effects of developing and operating a ground calibration site for Starlab experiments on Ascension Island, a dependency of the British Island of St. Helena. The Environmental Review addresses site specific activities on Ascension Island that are not addressed in the Environmental Assessment (EA) on the Starlab Program (USAF 1990). This document has been prepared pursuant to DOD Directive 6050.7 and Executive Order 12114 (environmental Effects Abroad of Major Federal Actions), as implemented by Air Force Regulation (AFR) 19-3 (Environmental Impact Analysis Process Overseas). Executive Order 12114 is applicable because the Starlab programs involve activities in a foreign country and over international waters. The Purpose of an environment review (AFR 19-3, 6) is to identify the important issues of a proposed action in a foreign country and to "review what, if any, consideration has been or can be given to the environment by the United States and by any foreign government involved in taking the action."

A major issue addressed in this document and in Starlab Program EA is the potential exposure of people and/or wildlife to laser light. The USAF has prepared extensive analyses of potential laser effects [Payload Experiment Package (PEP)-20 (LMSC 1989)], which provide critical input to the evaluation in this Environmental Review to verify conclusions reached in the PEP-20 analysis. Other issues that are evaluated include the potential impacts of constructing and operating Starlab facilities on land use, ecological resources, endangered and threatened species, and cultural resources.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 DESCRIPTION OF THE PROPOSED ACTION

The proposed action would use the Space Shuttle (Fig. 1) to conduct and complete SDI experiments within a scheduled 7- day mission in the second quarter of 1992. These experiments would use Spacelab hardware located in the obiter bay to interact with ground sites, missiles in flight, and space test objects (STOs) deployed from the orbiter.

The experiments are primarily designed to demonstrate the feasibility of using space based, Electro-optical and laser systems for the acquisition, subsequent tracking, and marking of missiles from space. Some of the proposed experiments use the Electro-optical system in a passive fashion, while others use it in a mix of active and passive modes. A passive experiment uses the Electro-optical system camera to capture images with available light (e.g., the calibration and background experiment described inSect.2.1.3.1). An active segment of an experiment uses lasers to provide the necessary illumination [e.g., acquiring and tracking a ground launched Starbird vehicle and its plume (Sect. 2.1.3.4)]. Approximately 20 separate events or engagements are scheduled for Starlab as parts of six experiments.

Figure 2 shows a typical earth orbital path for the orbiter and indicates the ground sites involved in the experiments. These sites include Wake Island, Cape Canaveral, and the Hawaiian Island of Maui, as well as Antigua and Ascension Island.

2.1.1 General Description of the Starlab

Figure 1 shows the orbiter with its bay doors open and the experimental Starlab payload exposed. The major components of the payload (Fig.3) include the Spacelab module and the Spacelab pallet. As shown in Fig. 3, the crew via an umbilical connection (i.e., egress tunnel) accesses the Spacelab module, located forward of the pallet. Primary tasks of the payload specialists include observing and evaluating the Starlab experiments and being ready to correct problems with the equipment should arise. In this capacity, the specialist will serve as systems safety officer by having the ability to shut down any experiment or modify experimental operating parameters. The specialist will observe and control the experiments through devices contained in the experiment control racks (Fig. 3).

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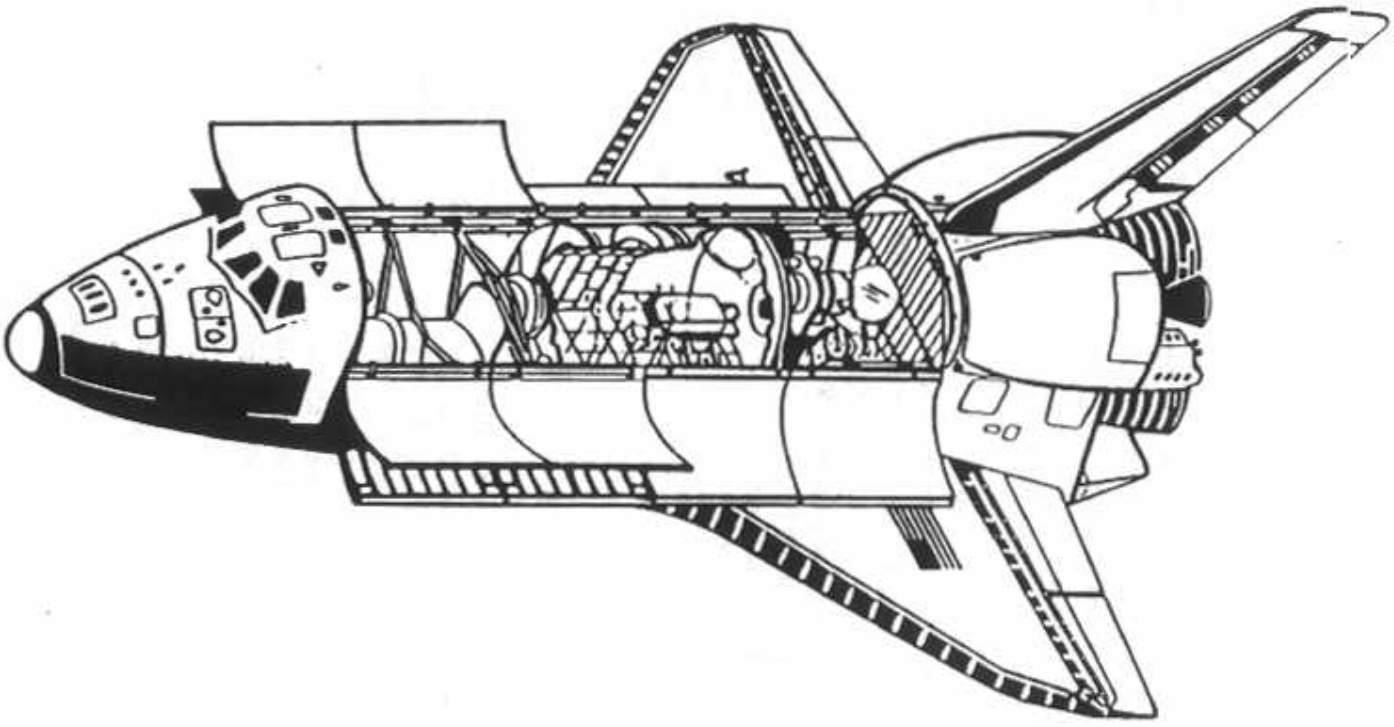

Fig. 2-1. The Space Shuttle (Orbiter).

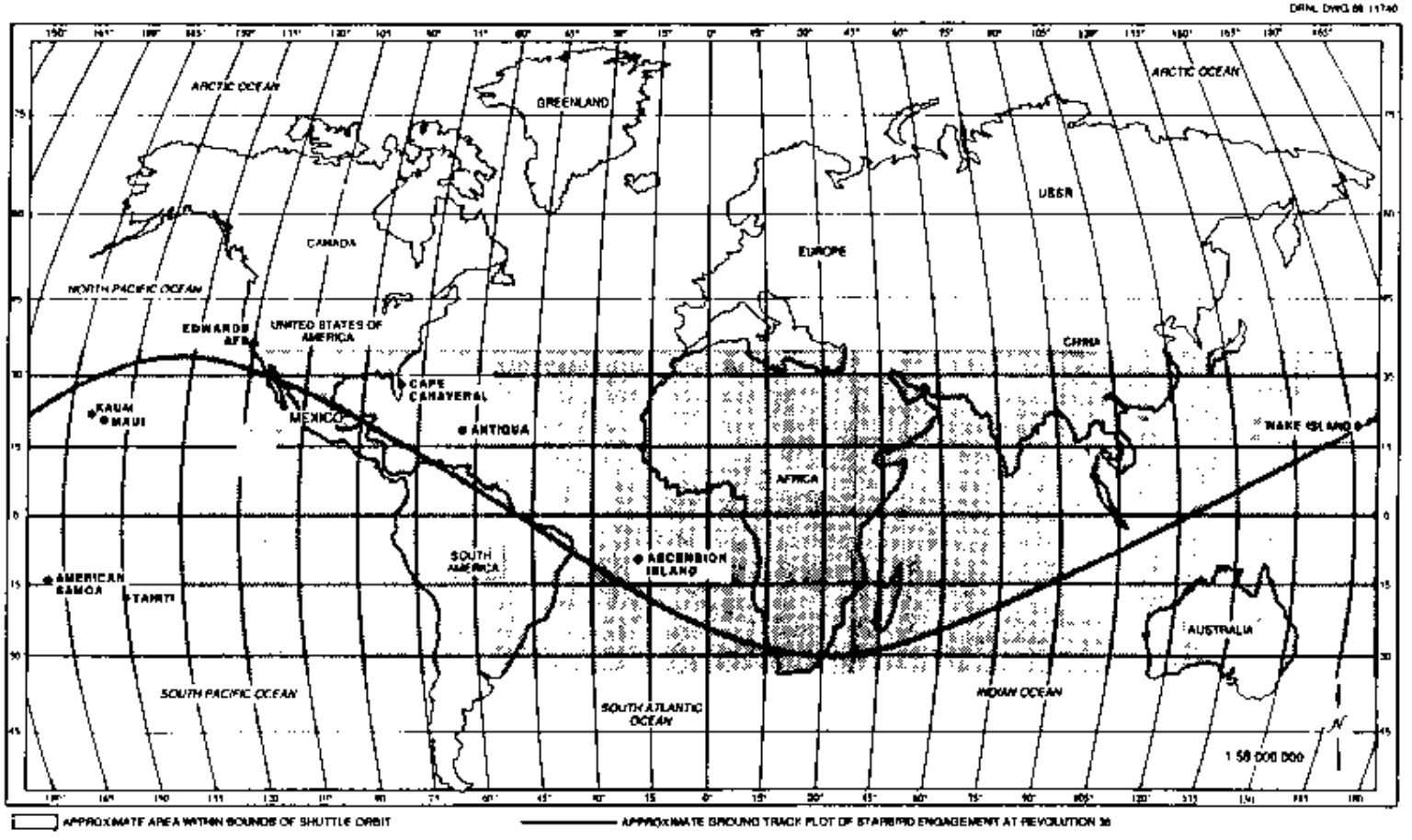

Fig. 2-2. Typical orbit and Starlab ground sites.

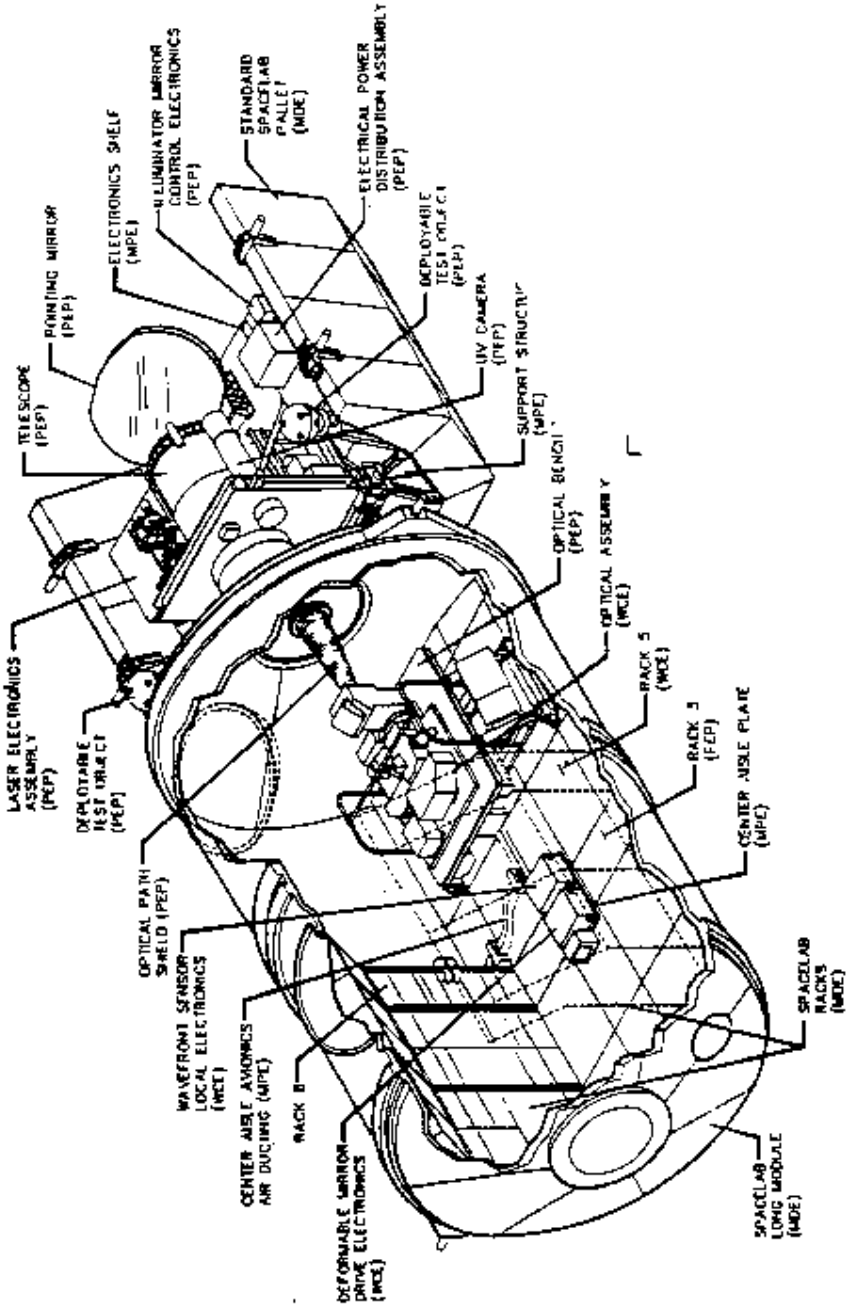

Fig. 2-3. The Starlab payload.

The module will contain the optical bench that houses the maker laser and associated electronics (Fig. 3). The marker laser will be used to mark experimental objects once they have been identified and are being tracked. The Spacelab module and pallet are Electro-optically linked and will function in a coordinated fashion during the experiments, with the marker beam traveling through the optical viewpoint into the Spacelab pallet.

Major elements contained within the Spacelab pallet (Fig. 3) will be the illuminator laser; a 31.5-in. (80-cm) telescope; ultraviolet, acquisition video, and infrared cameras; a 5-ft (1.5-m) pointing mirror; and STOs. The Spacelab pallet will be open to space. The marker laser beam passes through the optical viewpoint, is routed through the telescope, and is subsequently reflected by the pointing mirror to its destination. All other optical beams and images are reflected by the pointing mirror. The cameras are used for initial acquisition and during the passive portions of experiments to assist in identifying experimental test objects under a variety of conditions. The illuminator laser will be used in active mode to illuminate and track experimental objects.

The two types of lasers that will be transmitted from the orbiter are the “marker” (red) and “illuminator” (green) lasers. A back up to the illuminator laser will be provided. . Some general characteristics of the lasers are given in Table 1. A more detailed technical description of the lasers is provided in Appendix E of the Starlab Program EA (USAF 1990).

2.1.2 Ground Operations

Ground operations include (1) experiment command, control, and configuration; (2) experiment performance assessment; (3) data analyses; and (4) dedicated planning. Operations during the mission will be controlled from and coordinated with the NASA Marshall Space Flight facility at Huntsville, Alabama. Ground control facilities will be located at Cape Canaveral and Wake Island for the Starbird engagements and at Maui for the SWAT experiments. These control facilities will be in continuo communication with NASA throughout the 7-day mission.

2.1.3 Starlab Experiments

The experiments and engagements included in the proposed action (Table 2) can be grouped for discussion as passive and active experiments. Passive experiments do not involve lasers and are used to gather background data and calibrate equipment. Active experiments use lasers include the Ground Calibration engagements. Experiments other than ground calibration are described in detail in the starlab Program EA (USAF 1990).

Table 2-1. Characteristics of lasers to be used in Starlab experiments[a]

Characteristic	On the shuttle		At Maui[b]	
	Illuminator	Marker	Beacon	Uplink
Wavelength	0.5321 μm	0.6328 μm	0.4880 μm	0.5145 μm
Color	green	red	blue	green
Beam energy (at laser aperture)	220 mJ/pulse	<5 mW	4 W	5 mW
Mode of operation	pulsed	continuous	continuous	continuous
Maximum permissible exposure to the eye[c]	3.34×10^{-7} J/cm^2	6.36×10^{-4} J/cm^2 (for 0.25 sec)	6.36×10^{-4} J/cm^2 (for 0.25 sec)	6.36×10^{-4} J/cm^2 (for 0.25 sec)

[a]Table E-1 (Appendix E) presents more detailed information on laser characteristics.
[b]Maui is the location of the Air Force Maui Optical Station (AMOS), the ground location for the Short Wave Adaptive Technology (SWAT) experiments.
[c]International Radiation Protection Association (1985).

Table 2-2. Summary of proposed Starlab experiments/engagements

Experiment/engagement	Ground location(s)	Action(s)
Background experiment	Non-specific	Collect and analyze ultraviolet and and infrared data by passively scanning the earth's surface.
Planets and stars background experiment	None	Passively observe the stars and planets from the orbiter to calibrate the electro-optical system.
Space test objects and rapid retargeting experiment	None	Boresight the illuminator laser to the marker laser; demonstrate ability to change from tracking one STO to acquiring and tracking a second STO.
Ground calibration engagements	1. Ascension Island 2. Antigua	Locate and actively scan sites with red and green lasers, which are then reflected back to the orbiter.
Starbird engagements	1. Wake Island, Peacock Point 2. Cape Canaveral, Launch Complex 20	Actively identify and track Starbird vehicles and plumes from the orbiter using green and red lasers.
Short Wave Adaptive Technology experiment	Air Force Maui Optical Station (AMOS)	Actively link the orbiter and AMOS with blue and green lasers from AMOS and a red laser from the orbiter.

2.1.4 Ground Calibration Engagements

Specific ground calibration locations will be established so that the orbiting Starlab can calibrate its optical control system in flight prior to subsequent Starbird engagements involving the launching of Vehicles from Cape Canaveral and Wake Island. Ground Calibration sites were selected on Antigua and Ascension Island. The preferred Ascension Island site is on top of the Cotar Hill site. The Antigua ground calibration site is evaluated in a separate in a separate Environmental Review document. A discussion of the selection process for these sites is provided in Sect. 2.2.2

The USAF ETR is responsible for establishing each of the Calibration sites. Preparation of three concrete pads [15x20 ft (4.6 x 6.1 m), 12 x 22 ft (3.7x 6.7 m), and 10 x 7 ft (3 x 2.1 m)] is the only construction that will be required to mount contractor furnished equipment. Existing ETR buildings will house NASA communications equipment and contractor equipment for remotely controlling the scoreboard area. Cabling between equipment locations is required.

The general layout is shown in Fig 5. The site will consist of a scoreboard area and an operations center. The boundary markers around the calibration site will consist of temporary signs and manned roadblocks that will be installed immediately before each Starlab engagement. This additional precaution will be taken despite the conclusions that eye damage could not occur even with binoculars (Sect 4.2.1). No personnel will be at the scoreboard area during an engagement.

A fence to prevent personnel form entering the area during the engagement and to provide security for the installed equipment will surround the Scoreboard area. The equipment within the fence simulates various stages of a Starbird vehicle for the calibration exercise. The layout of equipment within the fenced area is shown in Fig.6. The scoreboard itself represents the payload on a Starbird vehicle. The Scoreboard has a 5 x 8-ft (1.5 X 2.4 m) reflective surface mounted on a structure that permits it to be tilted to face the orbiting Starlab. The structure will be bolted to a concrete pad and will be aligned with the Starlab ground track. A set of beacon lights consisting of 15, 1000-watt lamps simulates the third and fourth stag e plumes of a Starbird vehicle. These lights provide a 140-degree x 10-degree wedge of light and require a 60-kw diesel generator. A pair of retroflectors (i.e., a special type of prism reflector) oriented 60 degrees apart will be mounted on the scoreboard. A video camera records the mark laser beam as it impinges on the scoreboard.

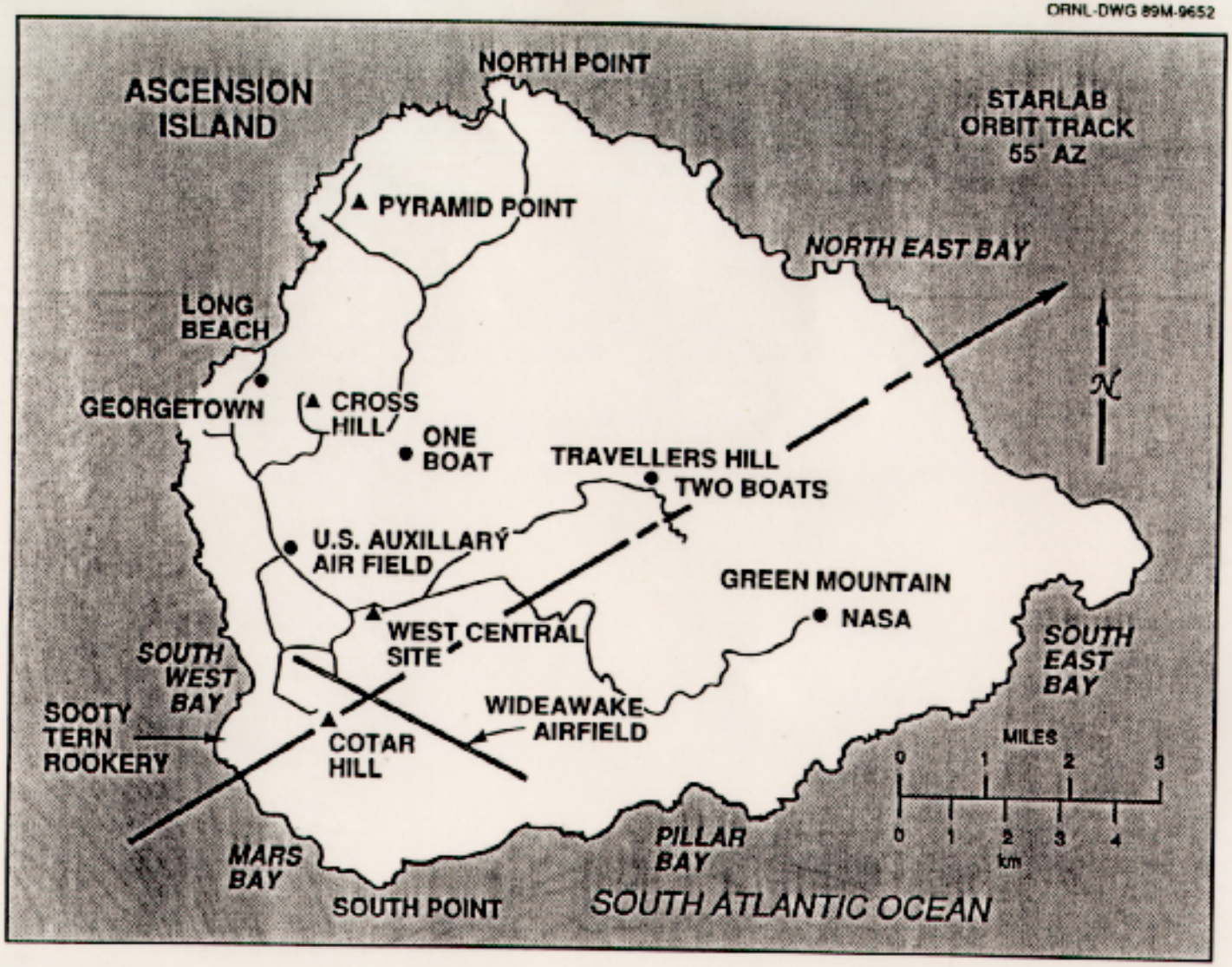

Fig. 4. Location of sites on Ascension Island.

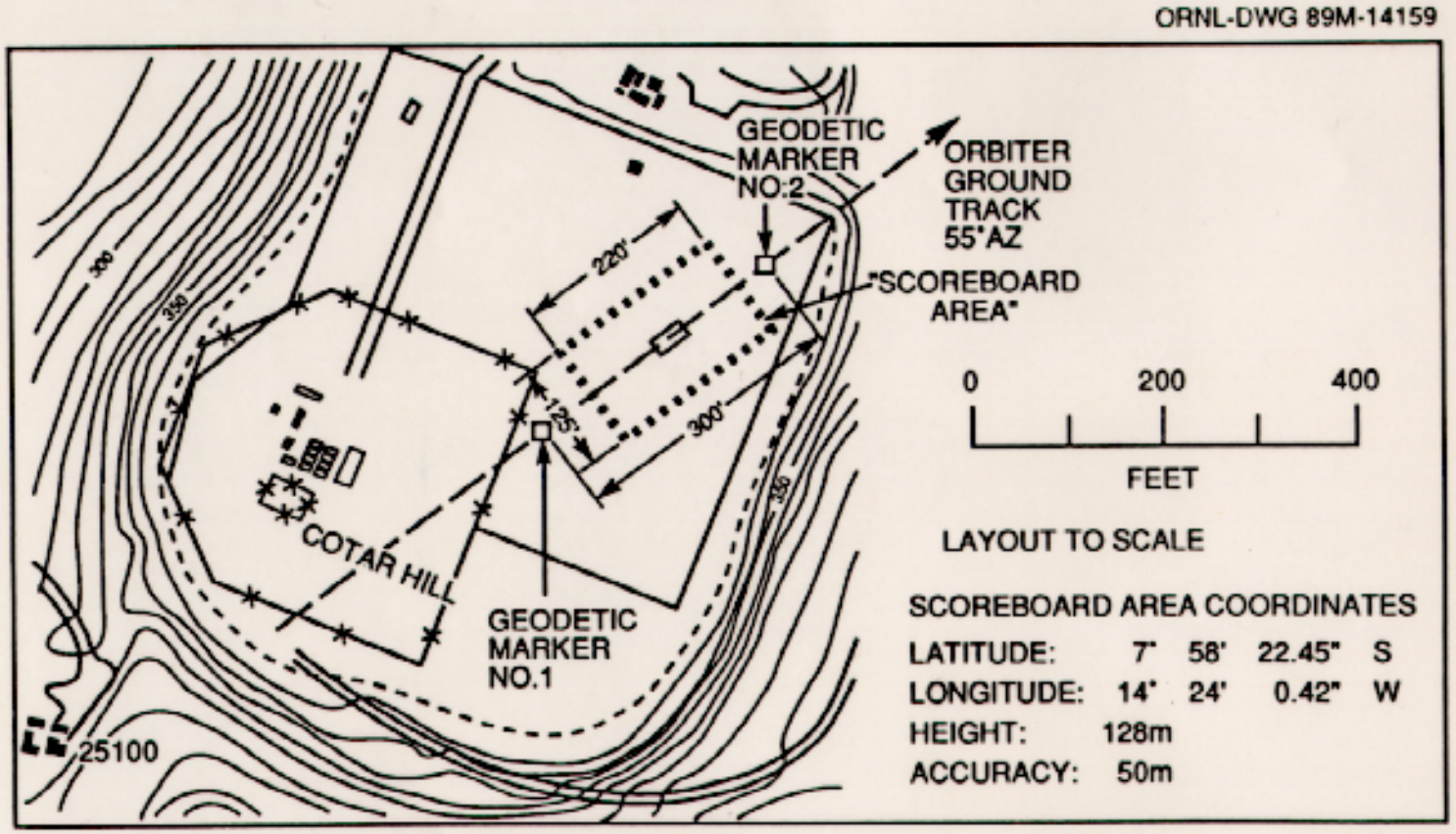

Fig. 5. General layout of the Cotar Hill site on Ascension Island.

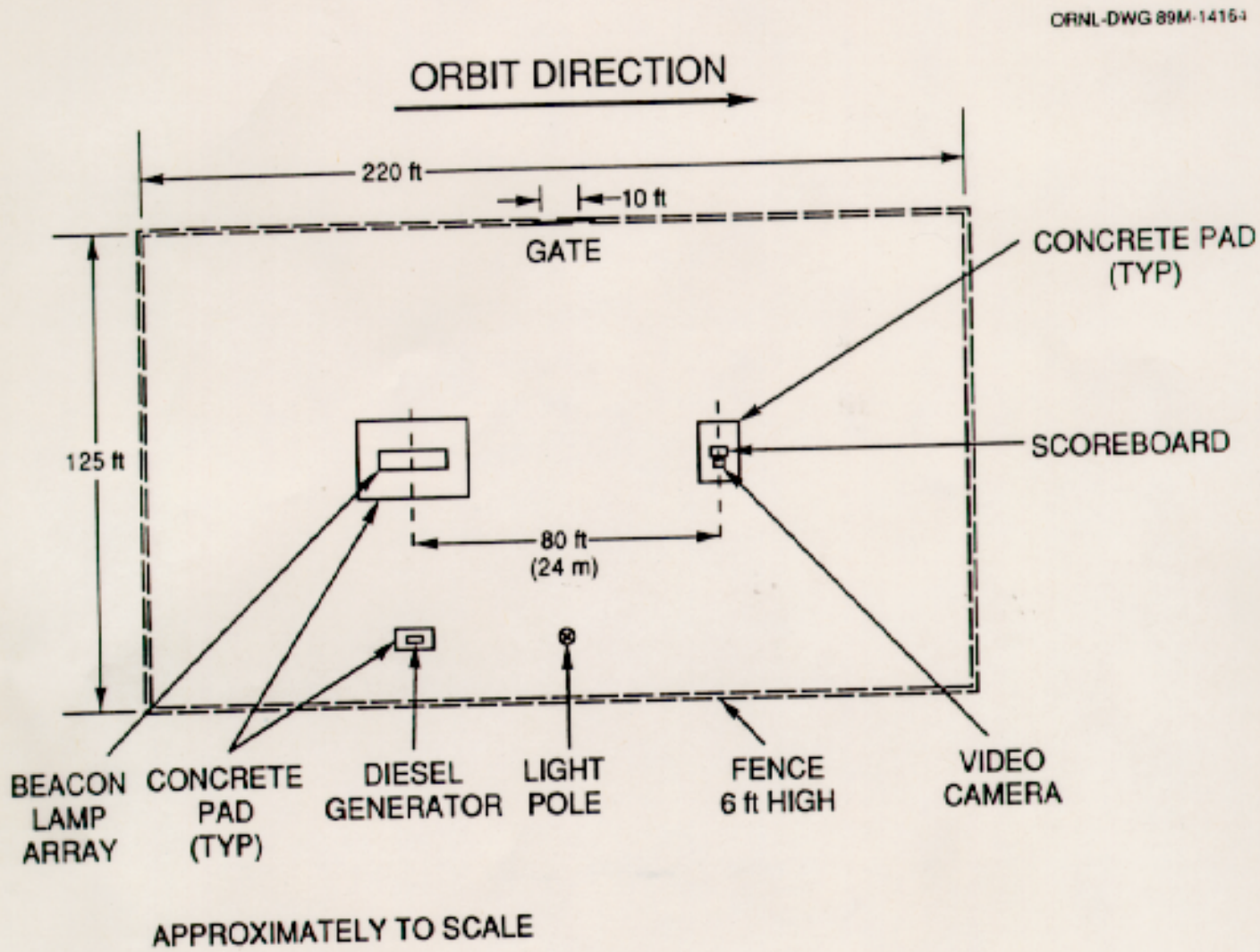

Fig. 6. Generalized layout of equipment at a ground calibration site.

The operations building will be the manned control center for operation of ground equipment during the Starlab calibration engagements. This control center positions stations for overall site control, beacon lamp control, video camera monitoring, and communications existing building at the Cotar Hill site on Ascension Island will be used to house the operations control center.

Contractor and NASA personnel will set up and check out their equipment at the two calibration sites. Contractor personnel will operate the equipment during the engagement. ETR will provide housing, meals, and transportation on Ascension Island.

Preparation of the calibration site will be ignited six months before the engagement. ETR will perform ground construction work and prepare the existing building for use as the operations control center. Four months before the mission, the equipment for the experiment will be transported to Ascension Island by air and then by truce to the calibration site. Three months before the mission, NASA and contract personnel will begin to set up and check out the equipment. Checks of the communication link between the calibration site and NASA's POCC will occur during the second month before the mission, and a stimulated engagement will be performed during the month immediately preceding the mission. After the completion of the Starlab engagement, the equipment will be returned to NASA and the contractors, and ETR will restore the site to its original condition.

Because the length of the Starlab mission will be seven days, the calibration site must be in operational status for six days, with up to three engagements scheduled. Engagements will normally occur between 0100 and 0400 local time.

Prior to engagements, the site will report weather conditions and equipment readiness to the POCC. Approximately five people will be presents at the site during the engagements. Thirty minutes before the engagements, all systems will be checked and the status reported to NASA at Huntsville, Alabama. Ten minutes prior to the engagement, clearance from the POCC will be given. The payload specialist aboard the shuttle will use the acquisition camera to innate the engagement by locating the high intensity lights at the ground calibration site (see Fig 6). The illuminator laser will then be turned on for active tracking of the target. Once tracking is demonstrated, the marker laser will be turned on to demonstrate pointing accuracy and for beam evaluation purposes. Thee exercises will serve to verify Starlab system operation prior to Starbird engagements. Each engagement will last approximately 4.5 min.

2.1.5 Mitigation Measures

The proposed action includes the following mitigation measure to ensure that no significant impacts will occur:

1. All facilities constructed at the ground calibration site on Ascension Island will be removed after the mission is completed, and the site will be restored to its original condition. All trash will be removed from the area and properly disposed.

2. Access restrictions will me minimized at the ground calibration site, allowing roads to be open to all traffic except immediately prior to, during, and immediately after the engagements. ETR will provide adequate roadblocks and warning signs near the ground calibration site to keep people away from any areas where accidental exposure to laser beams could occur.

3. Before any site preparation activities are ignited, ETR will consult with the Ascension Island government concerning protected species, cultural resources, and other resources that may be of concern.

4. ETR will consult with Ascension Island government officials and other appropriate local authorities to ensure that no aircraft operations occur during the ground calibration engagements.

5. ETR will limit construction activities to the already disturbed area on top of Cotar Hill to avoid disturbance to ecological resources, especially a population of the rare plant *Euphoria organdies* and a sooty tern rookery.

2.2 ALTERNATIVES TO THE PROPOSED ACTION

This section discusses the no-action alternative and alternatives to the proposed action, focusing on alternative ground locations where impacts could occur.

2.2.1 No-Action Alternative

Under the no-action alternative, the Starlab experiments would not be conducted. The no-action alternative would not satisfy the DOD need for research and experimentation to support the SDI program. If the Starlab program were not implemented, the environmental impacts resulting from the proposed construction and operation of the ground calibration site on Ascension Island would not occur, and alternative means of achieving program goals would need to be explored. In summary, pursuing this type of alternative would not meet Starlab Program requirements and scientific objectives.

2.2.2 Alternative Ground Calibration Locations

The USAF when considering the objectives of the Starlab Program identified a number of potential sites. Screening of site locations was first done on the basis of technical criteria. Environmental considerations were factored into the process during the selection of specific locations. To meet the maximum number of scientific objectives, the site selection process was governed by three primary technical factors: (1) orbit, (2) experiment function and scheduling, and (3) geographic location. Orbit criteria were determined by meeting the launch and landing restrictions orbit ephemeris (i.e., known position of a body at regular intervals), and the desired timing for various experiments. Meeting the objectives of the experiment ensures that the maximum amount of scientific information wold be obtained from each activity. Specific geographic sites were selected because they fell within the view of the Starlab and because they could be used on repeat orbits to collect additional data and provide data replication. Application of these technical criteria resulted in the identification of four potential locations for ground calibration sites; namely, Roi Namura, Maui, Antigua, and Ascension Island.

The site screening process resulted in the selection of Ascension Island and Antigua as ground calibration sites. These sites were selected using the following criteria: (1) the field of view must fall within certain limits; (2) the sites must be sufficiently remote that if a laser tracking malfunction should occur, a stray laser beam would not pass over a populated area or sensitive wildlife area; (3) bright lights should not be present near the site or, if present, bright lights could be turned off before and during the starlab engagement; (4) the site must be owned or leased by either the USAF or another U.S. government agency and must be away from public view; (5) the area selected must be sufficiently large to allow an outer boundary of 3000 x 7600ft (900 x 2300 m) (fig. 7) to be created that will exclude any areas containing private dwellings; and (6) tight control of access into the area must be possible. A further evaluation, including analysis of potential environmental impacts, was conducted to identify specific locations on Ascension Island (Sect. 2.2.3).

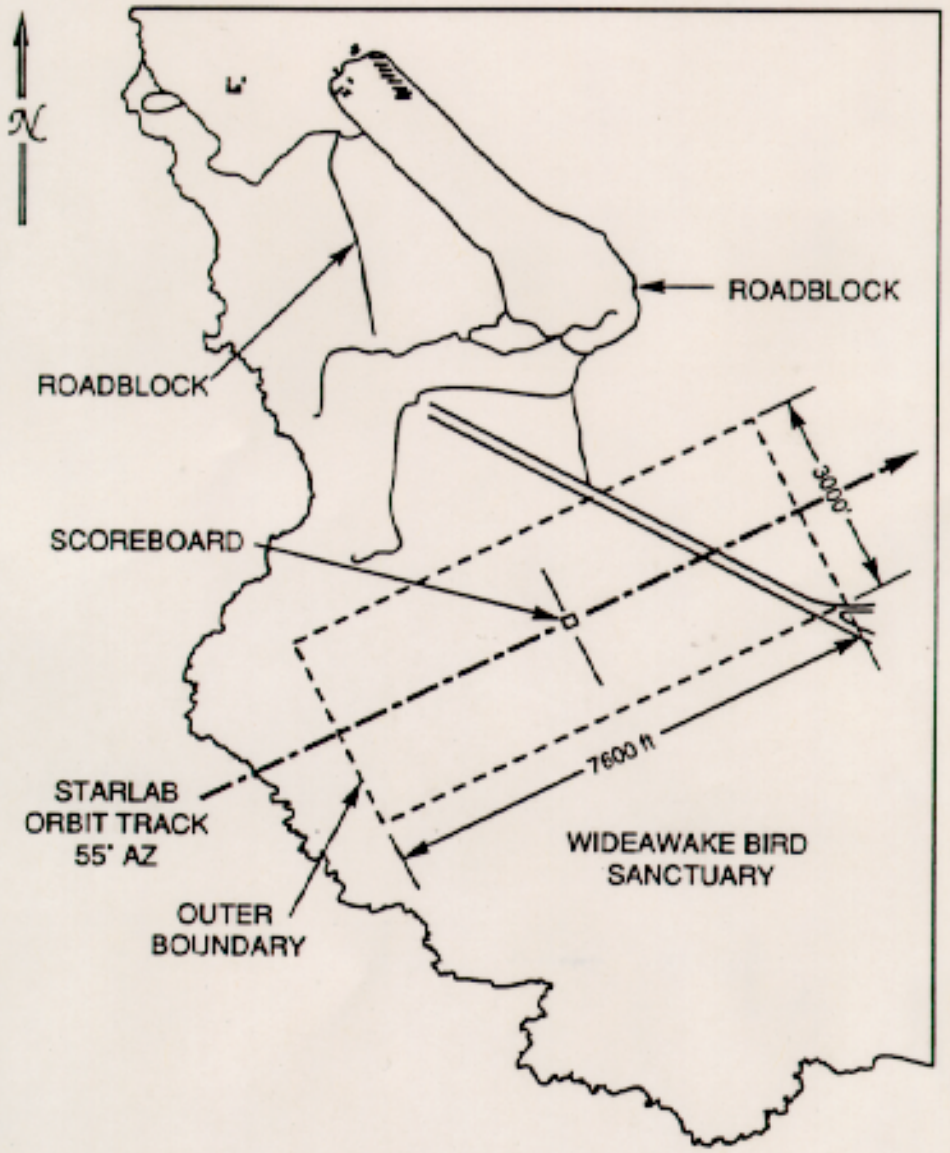

Fig. 7. Boundaries of the Cotar Hill site on Ascension Island.

2.2.3 Alternative sites at Ascension Island

Four alternative sites were identified and evaluated on Ascension Island during a site visit in October 1988. Cross Hill and Pyramid Point (Fig. 4) were eliminated from further consideration and are described briefly below. The West Central and the Cotar Hill locations (Fig.4) are evaluated in more detail in this Environmental Review. The Cotar Hill area is the preferred site. A comparison of the Cotar Hill and West Central is also included in this section.

2.2.3.1 Cross Hill

The Cross Hill area is at the top of a very steep hill [864-ft (263 m)] overlooking Georgetown. The area, which consists of a level 50 x 200 ft (15 x 60 m) parking lot, was developed for a radar installation that is no longer in use. Because of its highly disturbed nature, no plant or animal life is unique to this area. The land has been previously graded for the radar installation, but the size of the cleared area is too small to accommodate the necessary equipment for the ground calibration experiment without further disturbance. Minimum size of the scoreboard layout alone is 125 x 220-ft (40 x 70 m), and additional land would be required for the support facilities. Thus, use of this area is unacceptable, considering that availability of other previously disturbed sites in the area. Also, form a safety standpoint, a malfunction of the Starlab tracking system could result in a laser beam traversing Georgetown, which is only about 1000 yards (560 m) west of the site.

2.2.3.2 Pyramid Point

The Pyramid Point area is a relatively undisturbed lava field about 500 x 2000 yards (460 x 600 m) on the northeast corner of the island. A small portion of the area has already been cleared for other USAF projects and could be expanded for the ground calibration experiment. Vegetation on the site appears to be limited to a few grasses, although no plant surveys have been conducted on the site. Because some grasses on the island are indigenous and rare, most notably *Sporobolus durus***,** a detailed survey of the area would be required prior to any construction activity to determine the possible presence of rare plants. Like the Cross Hill site, however, use of this site is less desirable from an ecological perspective considering the availability of other previously disturbed sites and from a safety perspective in terms of its proximity to Georgetown.

2.2.3.3 Comparison of the Cotar Hill and West Central sites

A detailed description of the existing environment and an evaluation of environmental impacts of developing the Cotar Hill and West Central sites are provided in Sects. 3 and 4. The major similarities and differences between the Cotar Hill and West Central sites can be summarized as follows: (1) Cotar Hill is sufficiently large to accommodate the ground calibration facility, while additional land may be needed at the West Central site. (2) Materials stored at the West Central site would need to be relocated if this site were developed. (3) Both sites are close to Wide-awake airfield and ETR facilities, and access to both sites is generally similar. (4) Neither site is likely to have significant archaeological or historic resources, but consultation with local authorities on the possible presence of such resources will be required before either site is developed. (5) The Cotar Hill site is near a sooty tern rookery and a known population of *Euphoria organdies*, but neither of these potentially sensitive resources would be affected by use of the site for the Starlab engagement. (6) No impacts to aquatic resources would occur at either site. The major advantages of the Cotar Hill site are its size and the fact that it is not presently being used for other purposes. With mitigation recommend in Sect. 2.1.5, development of either site as a ground calibration site is considered to be environmentally acceptable.

3. AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This section describes the environment that could be affected by the proposed construction and operation of the ground calibration site on Ascension Island. The resources that are evaluated include land use, terrestrial and aquatic ecological resources, threatened and endangered species, and cultural resources. A general description of other resources (e.g., air quality) is given as needed to provide adequate background for understanding the evaluation of impacts in Section 4 of this environmental Review document.

3.2 PHYSICAL SETTINGS

Ascension Island is an isolated volcanic peak on the mid-Atlantic ridge eight degrees south of the equator. It is entirely volcanic except for some deposits of beach sand. The nearest land is the island of St. Helena, about 810 statute miles (1300 km) to the south. The island is roughly triangular and covers approximately 38 mi. to the negative 2nd power (98-km 2nd power). Ascension was discovered in 1501 but was not continuously inhabited until 1815 (Packer 1983).

The highest point [2817-ft (860 m)] on the island is the peak on the east-west ridge of Green Mountain (Fig. 4), but about two-thirds of the island is below the 1000-ft (300-m) contour. High cliffs and steep slopes are characteristics of the eastern and southeastern parts of the island. The northwestern part of the island is mainly a gently sloping plain at much lower altitude, and it is only along this part of the coast that large sandy beaches can be found (Duffey 1964). More than half of the island, consisting mainly of the coastal margins and the flat northern area, is covered with lava flows forming an extremely rough terrain.

Although the island is in the tropics, the influence of the southeast trade winds greatly modifies its climate. The steep southeastern slopes of the island cause the moisture-laden winds to rise from sea level to over 2000-ft (600 m) in 2 mi. (3.2 km), so that the ridge of Green Mountain is cool, misty, and frequently capped with clouds. The mean annual rainfall on the mountain is about 27 in. (68 cm) and the high relative humidity reduces evaporation. Georgetown, about 4 mi. (6.4 km) to the northwest, receives only about 5 in. (13 cm) annually. Temperature fluctuates very little from month to month but, like rainfall, varies geographically. The mean daily low and high temperature at Georgetown is 73 to 95 degree (23 to 35degreeC), whereas at Green Mountain t is 60 to 72 degrees (16 to 22 degree) (Duffey 1964).

The main problem for inhabitants of Ascension Island has always been the lack of fresh water. A small dripping spring (Dampier's Drip) at the base of the north side of Green Mountain, Brandreth Wells, and one spring located on the southern slope down Breakneck Valley have been the only natural sources of fresh water and have proved insufficient Catchments and, more recently, desalinization lance have been the primary sources of fresh water.

3.3 LAND USE

The U.S. Army Corps of Engineers constructed Wide-awake Airfield in 1942 to support U.S troops in North Africa. In 1956, the United States and Britain entered into an agreement permitting use of Ascension Island by the United States to provide technical support for aerospace vehicle tests. Wide-awake Airfield was improved and a new base was built. Radar and Communication facilities were set up on many parts of the island. In 1965, NASA constructed a satellite tracking station on the southeast art of the Island. Other facilities on the Island include a British Broadcasting Corporation relay station at English Bay, A British power Station, a British desalinization plant, and a fuel farm that allows oil to be offloaded from tankers anchored in the bay.

As indicated by the climate, much of the island is considered to be desert or semi-desert. Vegetation is sparse, and the volcanic lava and ash are dry and porous with no soil formation. Only Green Mountain has a significant amount of vegetation, and much of this was the result of introductions by man. Green Mountain, frequently covered by clouds, is the only fertile area. The off-base communities raise vegetables, pigs, and sheep for consumption.

The Cotar Hill site is on a 382-ft (116 m) high volcanic cone that has been graded at the top to create a flat area about 350 x 450-ft (107 x 137 m) (Figs. 8 and 9). The site is currently used as a radar site. There is sufficient space [200 x 300-ft (61 x 90 m)] remaining in this disturbed area for the calibration site. The site is located immediately south of the Ascension airfield landing strip and overlooks the aircraft parking lot. A sooty tern rookery (Fig. 10) located southwest of the site is designated as a bird sanctuary (Pan Am World Services, Inc. 1986).

The West Central site is a large level field approximately 250 x 300 ft (75 x 90 m) that is currently noosed as a construction equipment storage yard (Fig. 11). The site is highly disturbed and has patches of plants growing around stride equipment and around the edges.

Fig. 8. View of the Cotar Hill site on Ascension Island.

Fig. 9. Surface features of the Cotar Hill site.

Fig. 10. Sooty tern nesting habitat on Ascension Island.

Fig. 11. View of the West Central site on Ascension Island.

3.4 ECOLOGICAL RESOURCES

3.4.1 Terrestrial Resources

3.4.1.1 Vegetation

Early visitors to Ascension Island unanimously recorded impressions of bareness and sterility; the only place with significant vegetation cover was Green Mountain. Five plant species were noted by nearly all of the early scientific visitors: Euphoria *organdies*, a shrubby endemic species noted in the flat, low-lying desert areas [this species is considered by Packer (1983) to be "one of the worlds rarest plants"]; *Aristida adscensions*, a grass found in lowland areas and covering the sides of Green Mountain; *portulaca oleracea*, a widespread species, common on the island; *ipomoea pes-caprae*, a large creeper found mainly in coastal areas; and *Hedyotis adscensionis*, an endemic rubiaceous shrub, usually seen around Green Mountain (Duffey 1964). Also, several species f ferns, Moses, and lichens are very common at the higher elevations of Green Mountain (Watson 1891). There are no records of indigenous trees.

Another endemic species is a very small tussock grass, *Sporobolus durus*, first collected in 1889 at 1500 ft on the hill known as weather Post (Duffey 1964). This species was reportedly collected again in 1958 at 2000, 2400, and 2500 ft elevations on Green Mountain (Duffey 1964). Cronk (1980), however, believes that the grass referred to by Duffey was not *S. durus*, but *S. caespitosus*. Today, both of these species are considered to be very rare, if not extinct (Cronk 1980, Packer 1983).

3.4.1.2 Fauna

Early scientific visitors to the island frequently described the immense breeding colonies of sea birds, but little reference was made to the land animals except for pests such as rats or goats, which were hunted for food. The terrestrial fauna is still somewhat poorly known, but evidence suggests that man, if not all has introduced most species. Several species were introduced to help control crop pests (starling, thrushes, mynahs, rooks, jackdaws, hedgehogs, and barn owls) or for game (pheasants, partridges, and guinea fowl). Only four species of land birds are now established as residents on the island: cardinals, francolins, waybills, and canaries. Several species of sea birds nest on the island including the sooty tern, blue-faced and brown boobies, the red- and –yellow-billed boatswain birds, the Ascension Island frigatebird, the white love tern, and several species of gannet.

The only "wild" mammals now present on the island include six introduced species: two species of rats, a mouse, rabbit, donkey, and domestic cat. After surviving for hundreds of years, the goat became extinct in the 1940's (Duffey 1964). Cats were probably introduced to control rats, But Island records suggest that it was much more effective at hunting sea birds, introduced game birds, and domestic fowl. Eradication of feral cats is probably the most important wildlife conservation issue on the island but is not related to any of the Starlab project activities.

Two species of reptiles (a small lizard and a gecko) and one amphibian (clawed toad) are also present on the island (Loveridge 1959). The toad is thought to have been introduced during World War II when the species was in demand for diagnostic purposes in medicine (Dufey 1964). Six published accounts of the invertebrate fauna record about 81 species of invertebrates in 12 orders, nearly all of which are species with a wide distribution elsewhere and known to be easily transported from place to place (Duffey 1964).

3.4.2 Cotar Hill

Although the site itself has no vegetation or wildlife habitat present (Fig. 9), a sooty tern rookery is located approximately 1000 yards (914 m) southwest of the base of the hill (Fig. 10), within the tracking path of the shuttle. Terns are present during the nesting season, which is on a 10-month lunar cycle (i.e., every 9.7 calendar months). Information obtained during a site visit indicated that the current size of the rookery is less than one-third its historical size because of perdition by cats. Several dozen individuals of the rare Euphoria organdies, were observed during a site visit in November 1988, approximately 400 yards (365 m) southwest of the site on the slopes of Cotar Hill.

3.4.3 West Central

This site is a large level field that is highly disturbed (Fig. 11). Evidence of sheep and feral donkey grazing were noted during the site visit. No unique ecological characteristics appear to exist at this site.

3.4.4 Aquatic Resources

A significant percentage of the 71 species of shore fishes at Ascension Island are endemic (sabout 16%), with an additional 17% known only from Ascension and the Island of St. Helena. The diversity of species is low for a tropical Island, which probably reflects the isolation of the island and its lack of habitat diversity (Lubbock 1980). Sea turtles and marine mammals are discussed in Sect. 3.4.5.

3.4.5 Threatened and Endangered Species

Section 7 of the endangered Species Act of 1973, as amended does not apply to ascension island [J. Sheppard USFWS, Washington, D.C. personal communication to R. Kroodsma, Oak Ridge National Laboratory (ORNL), Oak Ridge, Tenn., October 5, 1988], and the USFWS does not keep records of threatened and endangered species occurring in this area. However, species listed by the U.S. Fish and Wildlife Service 9USFWS) that have ranges that include Ascension Island and that are protected under the Convention on International trade in Endangered Species of Wild Fauna and Flora are discussed in this section.

Ascension Island is an important nesting area for the Atlantic green sea turtle (*Chelonia mydas mydas).* The green turtle reproduces every 3 to 4 years. The female comes on shore at night and digs an egg chamber (nest) in the sand above the high tide line and deposits an average clutch of 120 eggs per nest. Each female during tbe nesting season of December through May may lay seven of these clutches.

Of 1300 mature female turtles tagged at Ascension Island by 1975, none had been found nesting anywhere else. Once the females have laid their eggs, they return to Brazil, a distance of 2400 to 3100 miles (Mortimer and Carr 1987). These turtles may be a distinct subspecies that depends solely on Ascension Island for nesting habitat (Carr 1975). Turtle nesting has been observed on 32 separate beaches (Mortimer and Carr 1987), but 50% of the nesting occur on three beaches-South West Bay beach, Long Beach, and North East Bay beach (Fig.4).

Historically, the green turtle has been exploited on the island as a main source of meat that was shipped back to England (Packer 1983). The turtles are now very well protected, and the nesting numbers in 1976-1977 were 1650 to 3000 females (Mortimer and Carrr 1987). Ascension Island. Although whales normally prefer the colder waters of high altitudes, they come to warmer waters to breed and calve. Some of the whales that might be present are (*eubalaena glacialis*), sperm (*Physeter catadon*), humpback (*Megaptera novaeangliae*), finback (*Balaenoptera physalus*, and sea (*B. borealis*).

3.5 CULTURAL RESOURCES

The Ascension Island government consists of an Administrator, who is appointed by the Governor of St. Helena. Ascension is known as a "closed island". There are no commercial facilities in the usual sense nor is there an indigenous population. There are three communities on Ascension other than the USAF facility: the British settlement of Georgetown on the western shore, Two boats village near the geographic center of the island, and the British Forces camp at travelers Hill, just south of two Boats.

The island population numbers about 1100. The population is composed primarily of people from St. Helena, South Africa, Britain, and the United States. The local economy is based on the income derived primarily from the British and U.S installations. The USAF installation occupies land on Ascension under terms of an agreement with the Government of the United Kingdom. The basic mission of the installation is to provide technical support for aerospace vehicle tests.

No information on the presence of cultural resources is unlikely to be present. Consultation to identify resources will be undertaken with local authorities prior to the ignition of any construction activities.

4. ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This section evaluates potential environmental impact of constructing and operating the ground calibration site on Ascension Island and identifies mitigate measures that would be implemented to minimize or avoid significant impacts on the environment.

4.2 EFFECTS OF LASERS

4.2.1 Potential Human Health and Safety Concerns

For the purpose of this EA, safety concerns for lasers at AMOS and the Starlab are confined to potential eye or skin injuries from exposure to laser radiation in excess of defined maximum permissible exposure (MPE) limits. Potentially, exposed persons may be on the ground, at sea, or in aircraft.

To illustrate the type of analyses performed for the SWAT and RME and to facilitate the understanding of important points about Starlab laser illumination of the ground surface, simplified calculations are provided in Appendix F of the Starlab Program EA (USAF 1990). The illuminator and marker lasers on Starlab are used as examples. These examples use basic trigonometric relationships in conjunction with safety guidelines and regulations [Air Force Occupational, Safety, and Health Standard (AFOSH) 161-10 (USAF 1980), ANSI (1986), and IRPA (1984)].

An examination of the general nature of laser hazards for laser systems that would be used in the Starlab experiment has been made [see Appendix F (USAF 1990)]. The results suggest that, using generally accepted methods described in IRPA (1984), ANSI (1986), and AFOSH 161-10 (USAF 1980), laser hazards exist for humans in several situations. Because of safety systems and planning, however, no situation has been identified for which the unaided eye would experience an overexposure either at the earth's surface or in aircraft. For example, assuming an 8X light gathering power for a binocular that might be used to view the illuminator laser, a rectangular zone roughly 125x 225 ft (40 x 70 m) centered on the calibration site target exceeds the ANSI MPE for human eye. This target zone would be protected, however, with physical boundaries [i.e., a 6-ft (1.8-m) fence]. Thus, inadvertent intruders would be prohibited from entering the illumination zone. Higher power optical devices could be used just outside the target zone with a result in exceedenences of appropriate standards. The outer boundary of the calibration sites, roughly 3000 x 7600-ft (900 x 2300 m), would be posted with temporary signs and roadblocks to prevent unauthorized entrance. Thus, all persons who might attempt to enter the sites for naked eye or optical aided viewing would be prevented from doing so. Even with the most powerful devices available to the public, viewing the weak "edges" of the footprint outside of the calibration sites would not result in exposure of exceedence levels.

Potential health and environmental effects at ground calibration sites are discussed further in Sect. 4.6. Additional, specific discussions of potential laser hazards and incident scenarios are presented based on the material developed in Appendix F of this document and in detailed safety analyses prepared on the Starlab program [PEP-20 (LMSC) 1989]

Most human experience with light is with conventional light sources that radiate isotropically (i.e., in every direction) or in slightly focused beams (e.g., as in automobile headlights). For traditional beam sources, the light beam spreads out rather rapidly with distance. Hence, a high-beam car headlight can temporarily blind a person even if the person is many feet from the center of the road. Laser light beams do not spread like conventional light sources.

If a viewer (e.g., an amateur astronomer) is not directly in the "footprint" looking "up the beam," the beam is essentially invisible.

The presence of the laser beam may be detected from light scattered when it passes through air containing dust or moisture particles, as observed during laser light shows. With scattered light from these laser beams, one literally sees the path of the laser. The scattered light from the Starlab lasers would be so weak that, even with a high magnification, the intensity would be reduced by factors of thousands to millions from the actual footprint and no eye hazard could exist from this scattered light. Likewise, light potentially reflected from a variety of unintended surfaces (i.e., in the case of misalignment or other error) would be degraded in reflection could be viewed for mor5e than one pulse of 25 nanoseconds and would, therefore, not result in any exceedence of the exposure guidelines.

A detailed accident analysis is contained in the Payload Hazard Report [PEP-20 (LMSC 1989)] entitled "Inadvertent Exposure of Public or Orbiting Satellites to Laser Radiation." The scenario for the calibration sites includes persons using binoculars and postulates three levels of failure. The probability of a person seeing one pulse was estimated to be about 1 x 10^-9. This level of failure is so small and the duration of exposure is so short that the hazard is considered negligible.

4.2.2 Potential Laser Effects on Wildlife

Wildlife could be exposed to a laser beam in three ways: (1) birds could fly through a beam aimed from the shuttle to earth, (2) birds could fly through a beam aimed from earth to the shuttle, or (3) a beam from the shuttle could accidentally wander off the target or be misdirected to areas inhabited by terrestrial or marine wildlife (e.g., nesting areas).

In the most serious case that would result in maximum potential effect, an animal would be within a stationary laser beam, look directly at the laser source with both eyes, and have both eyes in focus on the source (exception the case of birds that can look directly at an object with only one eye). In the most serious case for animals a portion of the laser beam would be focused to a point on each eye's retinal fovea, which is the most important area of the retina for vision. When the light energy of the laser beam is focused to a manner, the energy is concentrated, and damage due to thermal heating of the retina or a photochemical change in the retina is most likely to occur (in the same way that a magnifying glass can be used to focus light energy from the sun to produce a hot spot) (Swope 1969). Damage to the fovea for whatever reason could result in a severe visual handicap. If the eye is not focused on the laser source, the light energy will not be focused to a point on the retina but would be spread out over a larger area of the retina and would not be as likely to cause damage. Also, if the eye is pointed somewhere off to the side rather than directly at the source, any damage to the retina would be outside the fovea and would be less likely to produce severe visual handicap.

Many bird species (hawks, eagles, terns, and swallows) have two foveae in each eye one central fovea for monocular vision and one lateral fovea believed to be important for binocular vision (Sillman 1973, Martin 1985). Because no bird can point both eyes simultaneously, which prevents binocular vision. It is believed, however, that a bird's lateral foveae may be located such that light rays from a source may be focused on both simultaneously, thus allowing binocular vision. If these beliefs lateral foveae could be damaged simultaneously by a powerful laser beam if the bird were within the beam looking with both eyes toward the beam source.

If a bird were to fly through a laser beam pointed from the shuttle to a target on the ground, it would be exposed to the beam probably for no more than 5 to 7 s (depending on the diameter of the beam and the speed at which the bird is flying). It is highly unlikely that the bird would be looking at the laser as it entered the beam because the laser light source on the shuttle (as well as a laser source at an earth-based station) could not be seen or detected prior to entering the beam. Only a bird within the beam that is looking into the exit lens and deep into the apparatus where the laser is located could see the laser light source itself. For a bird outside the laser beam on earth, no point of light due to operation of the laser would be visible on the shuttle. Once a bird is within the laser beam, some time would pass before the bird could detect and focus on the laser source. Therefore, the time of eye exposure would be less than the time it looks for the bird to fly through the beam.

An accidentally misdirected laser beam from the shuttle would have virtually no potential for impact on any moving or stationary individual animal, either on land or in the sea. The light energy would be reduced (i.e., less concentrated) and would be less able to cause injury because the beam's width would increase as it approached the earth's surface. For example, the beam from the red marker laser used in the SWAT experiment would be at least four orders of magnitude below the MPE of 2.5 mW/cm^2 and would have no adverse effect on any exposed animal, either moving or nesting. The reflected beam from the blue laser in the SWAT experiment would be even less powerful than the marker laser and no impact would, therefore, be expected. Exposure to the beam would extremely short due to the rapidly with which the beam would swing past the animal or would be shut off. There would be virtually no opportunity for the animal to look directly at the beam and focus its eyes on the laser.

Although the sensitivity of birds' eyes to bright light is not known, the literature indicates that the visual physiology of birds is generally not greatly different from that of humans. For example, maximum image brightness on the retina is very similar in the diurnal pigeon, the nocturnal Tawny owl, humans, and other mammals, and varies by little more than sixfold across a wide range of other nocturnal and diurnal vertebrate species (Martin 1985). Thus, optical functions (as opposed to cell functions) of the avian eye are apparently incapable of gathering and focusing light to a significantly greater degree than those of the human eye, and the avian retina would not be subjected to significantly greater concentration of light energy and thermal heating. The remaining question is whether the cells and structures of the avian eye are more susceptible to photochemical damage than those of the human eye (i.e., damage caused by chemical changes due to bright light rather than thermal effects). Although information to answer this question is lacking, available literature shows no reason to expect that avian cells involved in vision are much more sensitive than those of humans are.

Evaluation of eye damage to a human viewing a shuttle laser source from within the beam indicates that such damage could occur only in binoculars were being used to look directly up the beam towards the source (Sect. 4.2.1). The objective lenses of the binoculars are larger than the unaided eye, thus presenting greater potential for eye damage. Without the binocular light gathering effect, it is considered highly unlikely that any damage could occur to the eyes of humans, other mammals, or birds exposed to a laser beam from Starlab.

4.3 IMPACTS ON LAND USE

4.3.1 Cotar Hill

Use of Cotar Hill, as a ground calibration site would not significantly affect land use in the area. The site has been previously graded for construction and operation of a radar installation. There is sufficient space [200 ft x 300-ft (60 x 90 m)] remaining in this disturbed area to be used for the calibration equipment; no additional site preparation would be required. The site is on property leased by the USAF and, therefore, access to the area can be controlled by the Air Force. The nearby U.S. Air Base would easily support use of this site; communication and data handing requirements could be met easily without additional land disturbance. Existing housing at the ETR facility would be used for workers involved in installing, operating, and dismantling the ground calibration site; therefore, no additional housing would be needed.

Because Ascension is a “closed island”, containing only U.S and British military personnel and support service (Sect. 3.5), management of people is controlled easily, especially on and in the immediate vicinity of the U.S Air Station. Post signs along the outer boundary of the site an manned road blocks set up during the calibration engagements (Sect 2.1.4) would make viewing of the laser beam by casual observers highly unlikely. The impacts of viewing the laser beam are discussed in Sec. 4.2.1.

The site is located immediately south of the Wide-awake Airfield. Because the calibration experiment would be conducted at night and the shuttle payload specialists to locate the target area would use lights, all nonessential lights in the nearby area would be extinguished during the engagement.

4.3.2 West Central

The West Central site is currently used as a construction equipment storage yard. Use of the site for the ground calibration experiment would require that the construction equipment be stored at some other location, but this should not be a problem because several other already distributed areas leased by the USAF are available. Based on the size of the previously disturbed area a small amount of additional land clearing might be required. This activity, however, would not have any adverse effects on land use in the area. Less than 1 acre (0.4 ha) of land would be within the security fence (Fig. 5), effectively restricting grazing by sheep and feral donkeys. Similar forage is available in nearby areas. The site is located along a normally traveled road and is completely visible from the road. Roadblocks would be set up, however, during the calibration engagements (Sect 2.1.4), making it highly unlikely for someone to be affected by the laser beams.

4.4 IMPACTS ON ECOLOGICAL RESOURCES

4.4.1 Terrestrial Resources

4.4.1.1 Cotar Hill

Use of the Cotar Hill for the ground calibration experiment would not require any site preparation. The site has been cleared previously for installation and operation of a radar installation, and sufficient space remains in this disturbed area to be used for the calibration site. Although no vegetation or wildlife exist on the area where the scoreboard and support facilities would be located, a large sooty tern rookery is located about 1000 yards (900 m) southwest of the base of the hill and in the tracking path of the shuttle. Als, several dozen individuals of *Euphoria organdies*, a very rare plant, occurs about 400 yards (360 m) southwest of the site on the slopes of Cotar Hill. Use of this site would be restricted to that area already disturbed by existing facilities. Limiting construction activities on the already disturbed are at the top of Cotar Hill should not adversely affect either of these ecological resources. Workers would be required to stay within the boundaries of the site to prevent disturbance of these resources. The sooty tern rookery is sufficiently remote from the calibration site that the laser beam would have no effect on the birds. If the laser apparatus were to malfunction and the beam traveled across the rookery, it is highly unlikely that any birds would be adversely affected (Sect. 4.2.2).

4.4.1.2 West Central

Use of the West Central site for the ground calibration experiment is not expected to result in any adverse effect to ecological resources. The site has been highly disturbed by its use as construction equipment storage area, and there is known unique ecological characteristics in the vincity of the site. Even if only a small amount of additional land clearing is required (Sect. 4.3.2), however, a survey would be conducted to confirm the absence of rare plants. No wildlife was observed at this site during the site, visit and none should be affected by the presence of the laser beam (Sect 4.2.2).

4.4.2 Aquatic Resources

Construction of the calibration site and operations during the engagements are not expected to result in any adverse effects on the marine biota. Because there is no freshwater habitat on either of the sites, no impacts on freshwater systems would occur.

4.4.3 Threatened and Endangered Species

The preferred Cotar Hill site and the alternative West Central site are about 4300 and 6600 ft (1300 and 2000m), respectively, from the nearest beach where nesting by sea turtles occurs (Sect. 3.4.5). Construction would have no effect on the shoreline. If the starlab engagement occurs during the sea turtle nesting season, it is unlikely that any hatchlings would be disoriented by lights from the calibration site because of the elevation of the hill above the shoreline and the distance of the site from the beaches. If a misdirected laser beam were to pass over a nesting area during the experiment, the laser would not cause any eye damage to the turtles, even if they were on the nest and looking directly into the beam (Sect. 4.2.2). Likewise, any marine mammals that might be offshore of Ascension Island would experience no adverse effects from inadvertent exposure to lasers.

No other U.S federally listed species is known to occur at Ascension Island (Sect. 3.4.5.). Although no rare plant o animal species are known to be affected by the proposed action, several very rare plants occur in the vicinity of Cotar Hill. ETR would consult with local authorities about possible impacts on protected species before any site preparation work is initiated.

4.5 IMPACTS ON CULTURAL RESOURCES

No impacts on cultural resources are anticipated from use of either site. Historic or archaeological resources are unlikely to be present on either the West Central or Cotar Hill sites due to previous use and disturbance. ETR staff would consult with local authorities to ensure compliance with any local requirements for protecting cultural resources.

4.6 IMPACTS ON HUMAN HEALTH AND SAFTEY

Under operating plans, no human exposure to laser light is likely to occur. However, laser light exposure to humans at Ascension Island could occur as a result of an unplanned situation. Under no circumstance could an overexposure take place for the unaided eye, but if the laser light were to be viewed directly “up the beam” towards the source with 8X binoculars, the MPE could be exceeded by a factor of approximately four.

The planned illumination of the calibration site on Ascension Island by the illuminating laser board the Starlab is limited to a rectangular area about 125 x 225 ft (40 x 70 m) centered on the target. Because this area is not accessible to the general public, an examination was made for occurrences that could result in the light path crossing unrestricted areas. The practical possibilities described in PEP-20 (LMSC 1989) are limited to:

- Premature operation of laser systems
- Inadvertent operation of laser systems
- Malfunction or unplanned operation of laser systems (the laser pointing outside of planned Illumination zone).

Premature or advertent operation of the illuminator laser could occur from electrical failure software/firmware programming error mechanical failure or operator error. In order to ensure lasers would not lase in an unplanned manner controls have been developed for times prior to the engagement and after the engagement.

Prior to an engagement deliberate payload crew actions would be required to open protective enclosure doors turn on the illuminator laser electronics turn on the illuminator laser pump; enable the illuminator laser mechanical shutter to be opened and software command the illuminator to lase. The timing of these events would be controlled by a detailed procedural plan. After an engagement, a software timer closes the shutter and turns off the laser. The payload crew would manually command the shutters closed and turn off electrical power to the laser. Software would also close the laser shutter if the target moved out of the coarse tracker.

To ensure that the illuminator laser would not mispoint outside of the planned illumination zones restrictive provisions have been made. An automatic software shutoff would close the illuminator if the laser mispoints. A backup to this automatic shutoff would be provided so the payload crew could monitor the target on the video monitor showing the coarse tracker. If the target image moved off the coarse tracker the crew could manually close the illuminator laser shutter. The Space Test Objects engagement (Sect. 2.1.3.2) and the ground calibration. Experiments (Sect. 2.1.3.3) would be performed prior to the Starbird engagements in order to determine that the illuminator laser was properly boresighted.

Given the safeguards built into the laser and its pointing system the minor size of the illumination zone and the fact that the laser beams are only hazardous if illumination is directly viewed using optical assistance, the likelihood of harm coming to any individual would be remote.

4.7 CUMULATIVE IMPACTS

No significant adverse cumulative impacts are anticipated from the Starlab program. The only possible cumulative effects from exposure to laser light would be by repeated exposure of the eye or skin to beams of greater intensity than the respective MPEs for these organs. There would be a maximum of three engagements at each of the ground calibration sites. Exposure is precluded by operational parameters.

The development of a ground calibration site on Ascension Island would disturb small areas of land, therefore, add an increment of disturbance to that already created by other USAF activities in these areas. No unique or legally protected species or ecological resources are likely to be significantly affected. The ETR plans to build a new building on the Cotar Hill site on Ascension Island after the Starlab Program is over. Impacts of constructing and operating the ground calibration facilities would be minor and temporary, while the impacts from a new ETR building would be of a more permanent nature. Because a new building would not occupy the whole site and would be built on an area that is already disturbed, the cumulative impacts associated with developing this site are of limited extent and not deemed to be significant, provided there disturbance to the rare plant populations of *euphoria organdies* that occur on the slopes of Cotar Hill and the sooty tern rookery is avoided.

5. CONSULTATION AND COORDINATION

Ascension Island is a protectorate of Great Britain and thereby subject to British Law. ETR will comply with all environmental protection requirements for constructing, operating, and dismantling the ground calibration station on Ascension as required under terms of the treaty between the United States and Great Britain that stipulates conditions for USAF activities on the island. Because the proposed action falls within present activities conducted at ETR and other U.S. facilities on Ascension, it is not anticipated that any new requirements will be identified.

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