DEPARTMENT OF THE AIR FORCE
11TH WING

14 FEB 2001

11 CS/SCS (FOIA)
1000 Air Force Pentagon
Washington DC 20330-1000

John Greenewald, Jr.
[redacted]

Dear Mr. Greenewald

This is response to your August 14, 2000 Freedom of Information Act request for document AD B179793, entitled Recent Accomplishment of the DOD Space Test Program, Final Report (FOIA case 00-1597).

To satisfy your request, our action officers reviewed all material maintained locally by the Directorate of Space and Nuclear Deterrence (SAF/AQS). Because some of the documents contained material that was not releasable, we excluded that material, and prepared the remained for release to you. Material that has not been included for this FOIA request falls under the following exemptions:

1. 5 USC 552 (b)(1) reference (a) relating to classified material and material that when combined with other material, discloses classified information. All classified information removed from the document was currently and appropriately classified.

2. 5 USC 552 (b)(3) reference (a) relating to material not subject to release by statute. The statute covering this material is 10 USC 130, Authority to Withhold Unclassified Technical Data with Military or Space Application.

3. 5 USC 552 (b) (6) relating to personnel information.

You may appeal this decision by writing to the Office of the Secretary of the Air Force within 60 calendar days after the date of this letter. The appeal should include the reasons for reconsideration along with a copy of this letter and be addressed to:

Secretary of the Air Force
Thru: 11 CS/SCS (FOIA)
1000 Air Force Pentagon
Washington DC 20330-1000

Sincerely

DARLEEN A. DRUYUN
Principal Deputy Assistant Secretary
(Acquisition & Management)

Attachment:
1. Requested record

INTERNATIONAL AEROSPACE DIVISION NOTE
IADN 94-1

RECENT ACCOMPLISHMENTS OF THE DOD SPACE TEST PROGRAM

JANUARY 1994

By

[redacted] (b)(6)

Approved by

[redacted]

~~DISTRIBUTION AUTHORIZED~~

~~to U.S. Government agencies only, test and evaluation, January 1994. Other request for this document shall be referred to SAF/AQQX.~~

~~WARNING~~

~~Document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751 et seq.) or Executive Order 12470. Violators of these exports laws are subject to severe criminal penalties.~~

ANSER
Suite 800
1215 Jefferson Davis Highway
Arlington, Virginia 22202

This document reports research sponsored by *SAF/AQ* under *Contract F49620-91-C-0031*, dated 1 May 1991. These results do not necessarily represent Air Force official opinion or policy.

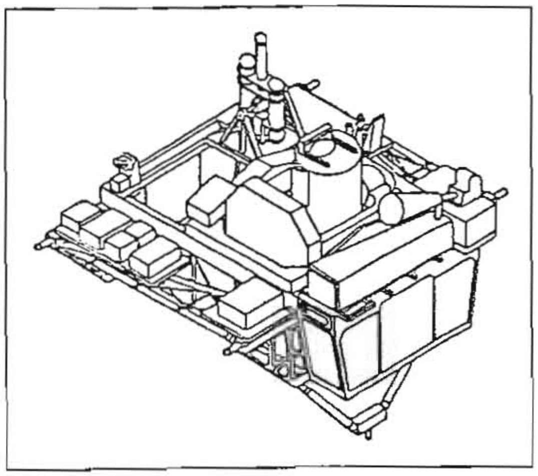
ANSER was established in 1958 as a not-for-profit corporation. We adhere to a policy of accepting only work that affords absolute freedom from conflict of interest, and we scrupulously avoid any alliance that would appear to compromise our objectivity in our work. We do not swerve from our mission of

- Serving the public interest by providing objective analytic and technical products and services of high quality and utility to public agencies on matters of major importance to the Nation
- Working on client-identified problems and helping clients anticipate and identify important issues requiring resolution
- Providing each client with continuity of support over time in distinctly innovative, timely, closely interactive, highly responsive, and efficient ways that best assist the making of sound decisions
- Ensuring that fairness and integrity characterize our dealings with our clients, staff, and the public
- Growing in the number of clients served and services provided in a manner that is compatible with achieving and maintaining excellence in all aspects of our operations for every client.

Our staff knows that producing quality products and services is their responsibility, at every step in the work process. ANSER is committed to achieving the highest standards of excellence.

Space Test Program

RECENT ACCOMPLISHMENTS OF THE DOD SPACE TEST PROGRAM



BY

THOMAS HAGLER
DR. EVA CZAJKOWSKI

4296-1, WK 11-McDP

PREFACE

This division note is an annotated briefing based on a 4-month study ANSER conducted for SAF/AQSL. The purpose of the study was to investigate and document significant accomplishments and benefits from the Department of Defense (DOD) Space Test Program (STP) during the period 1990-1993. A prior ANSER study addressed the period before 1990. The study was performed under the guidance of Maj Dan Cramer, SAF/AQSL.

Figure 1

Space Test Program

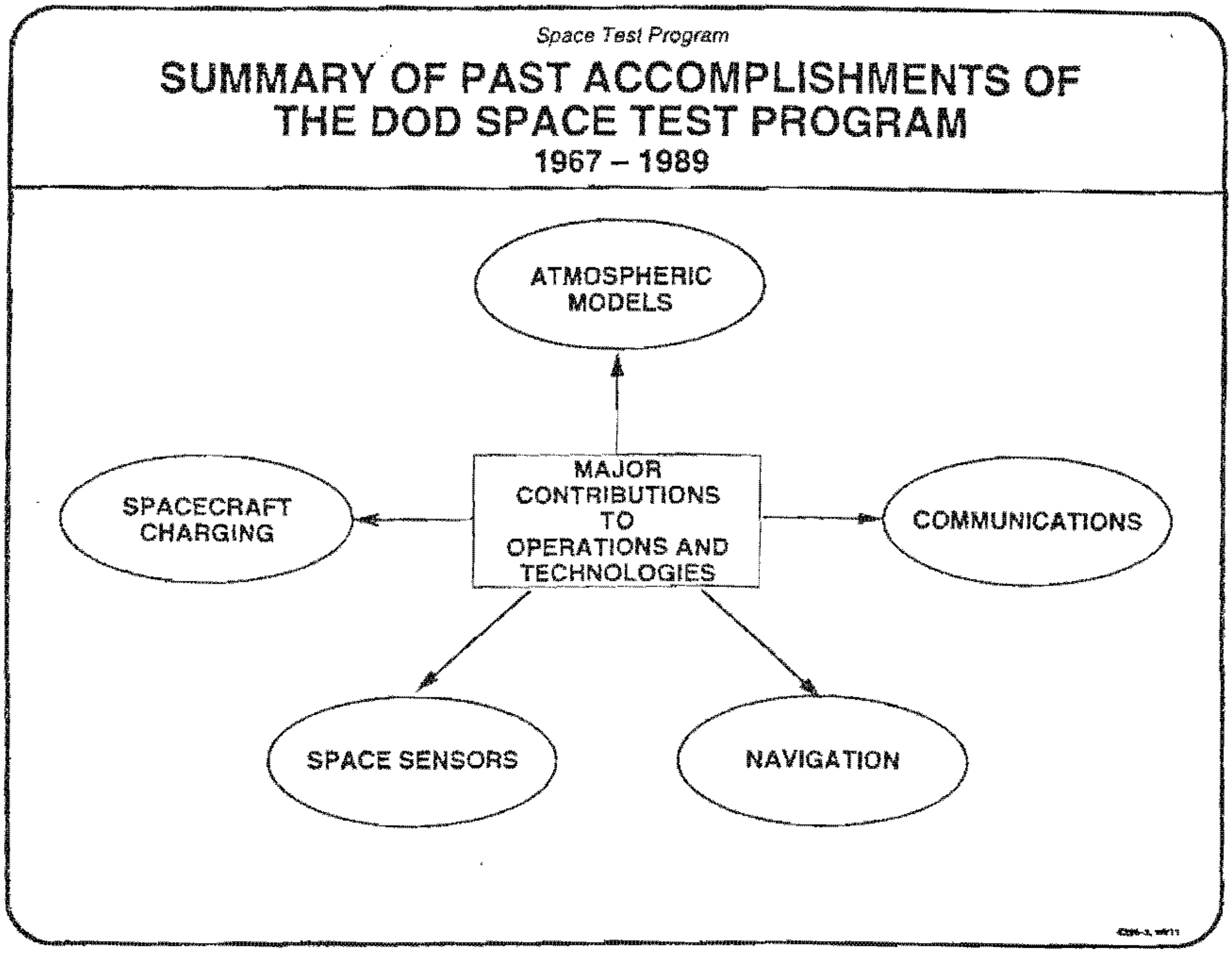
ANSER TASKS

- REVIEW THE EXPERIMENTS CONDUCTED BY THE SPACE TEST PROGRAM FROM 1990 THROUGH 30 JUNE 1993
- DETERMINE EXPERIMENT OBJECTIVES AND SUCCESS IN ACQUIRING DATA
- LOOK FOR SPECIFIC APPLICATIONS OF EXPERIMENT RESULTS TO DOD SYSTEMS AND OPERATIONS

The above chart lists the ANSER tasks in this study.

The initial effort identified specific applications of experiment results to DOD systems and operations. In the case of subsystem development flights or flights of prototype systems, the direct benefit of the flight experiment is often readily evident and established by the system itself. In the case of flights which acquire environmental data, the direct benefit of the data to an operational system is frequently much more difficult to identify since environmental data is usually incorporated into models which, in turn, support space operations.

Figure 2

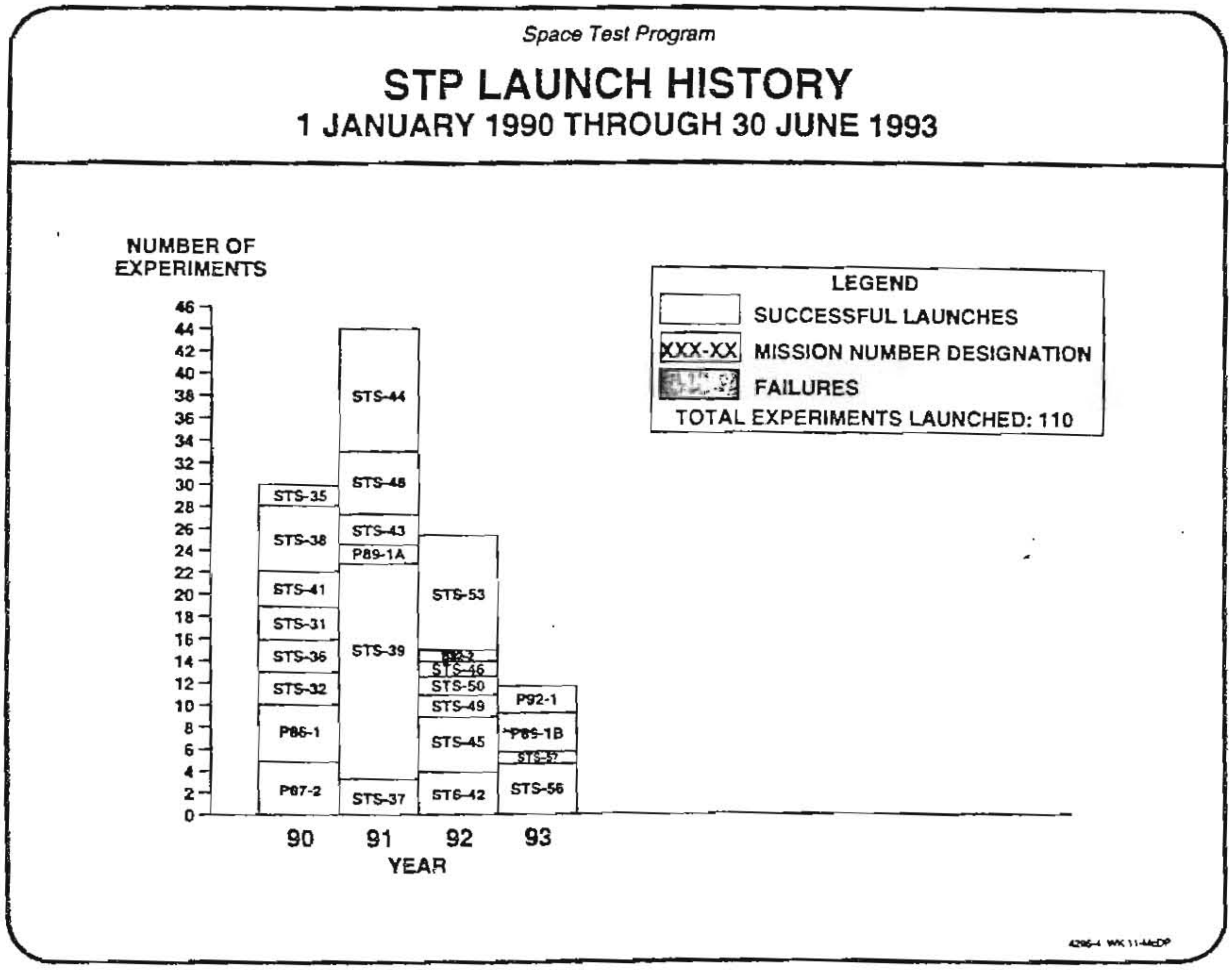


In summary, from its initial flight in 1967 through the end of 1989, STP made significant contributions to many technology areas critical to military operations. The above chart lists five of the major areas to which STP has made major contributions.

In the area of communications, STP flew experiment LES-6 in 1968. This experiment proved the utility of ultra high frequency (UHF) satellite communications for various tactical and strategic scenarios and was the forerunner of current space-based military tactical communications systems. In 1976, STP flew experiments LES-8 and 9. These experiments demonstrated an advanced K-band communications system and were the prototype for the reliable, survivable military communications system currently under development.

II. STP EXPERIMENTS - 1 JANUARY 1990 - 30 JUNE 1993

Figure 3



The subsequent launch history of STP experiments for the period 1 January 1990 through 30 June 1993 is shown on the above chart. The chart indicates missions per calendar year and the number of experiments in each mission. In addition to the successful missions which include 107 experiments, two missions carrying three experiments were lost due to equipment failure. Of the total of 110 experiments launched, 23 experiments were not a part of the STP program but were flown because of the STP space test expertise and as a service for NASA and other DOD activities.

benefits of using military personnel in space for military purposes. Figure 4 lists the major categories of experiments and their inclusive types of experiments which STP has conducted during the period 1 January 1990 - 30 June 1993. Figure 4 also indicates the number of experiments of each type that STP conducted during this same period.

System and subsystem tests of spacecraft components, the first category, are necessary to develop improved components. Such tests are generally directed towards improving component performance or making the component more reliable or more survivable.

Advanced communications tests conducted during this period have demonstrated the feasibility of communicating from space with a ground-based terminal. These tests have also demonstrated a space-based system for store and forward communications. Four experiments have supported communications. Advanced sensor tests evaluated new approaches to a number of space sensors. Three experiments, in this period, supported advanced sensor development. Experiments related to the development of subsystems and components have proof-tested in space a number of components, leading to more reliable and survivable subsystems. An additional nine experiments supported subsystems development. Experiments in space related to space manufacturing are designed to determine whether manufacturing in space can produce a cheaper or better product. During this period, STP carried out its first two space manufacturing experiments. STP also conducted one experiment that provided space objects for calibrating ground radar.

The results of measurements of the space environment, the second category, are more difficult to correlate directly with a beneficial military use. This difficulty in tracking results from measurements of the environment is frequently caused by the fact that experimental results are used in making environmental models or atmospheric standards which, in turn, are used in military operational activities. These models are one of several variables which impact space operations and, therefore, their results are more subjective.

The ionosphere plays a very important role in radio propagation below UHF. Therefore, understanding its properties and behavior is vital to understanding the reliability of many military communications systems. During this period, three STP experiments were flown to measure properties and behavior of the ionosphere.

The Earth's magnetic field is non-uniform and is undergoing continuous change, both ambient and as distorted by solar activity. The variability of this magnetic field directly affects many satellite guidance components. It has a direct impact on both terrestrial and space magnetic related measurement techniques. During this period, STP conducted a very successful experiment which will contribute to revising the world's magnetic model.

The amount and kind of solar radiation striking the Earth widely influences the Earth, its weather, and communications. For example, solar flares can cause worldwide communications blackouts in certain frequency bands. During this period, STP conducted a space experiment to measure isotropic and chemical compositions and energy spectra in solar flare nuclei. This experiment will contribute to the data base for solar flare studies.

Cosmic ray backgrounds are required for proper operation of nuclear detonation detection satellites and estimation of damage to components of spacecraft in orbit for long periods of time. During this period, STP conducted an experiment to characterize the dynamic behavior of the radiation belts. The data will be used to make models and support research related to spacecraft damage in space.

The proper operation of various surveillance satellites requires a thorough knowledge of the frequency spectrum background. During this period, four STP experiments gathered data on Earth and celestial background radiation in the IR and ultraviolet (UV) regions of the spectrum.

The near-Earth environment can be considered to include the regions of cloud formation and the oceans, both major concerns to military operations. During this period, STP carried out three experiments related to cloud formation.

Knowledge of the environment within a spacecraft, whether it be the cargo bay of the Space Shuttle or the experiment compartment on a free-flyer spacecraft, is important in planning for the survival and proper operation of the payload. During this period, STP carried out 37 experiments related to the spacecraft environment.

The third category, man-in-space investigations, includes experiments to detect changes — such as changes in visual acuity — in the human body in space. During this period, eight experiments have been conducted to investigate such changes in man's performance in space. Man-in-space investigations also seek to determine if these are useful military activities which can best be accomplished by a military man in space. During the report period, seven experiments were conducted to determine the utility of military man in space.

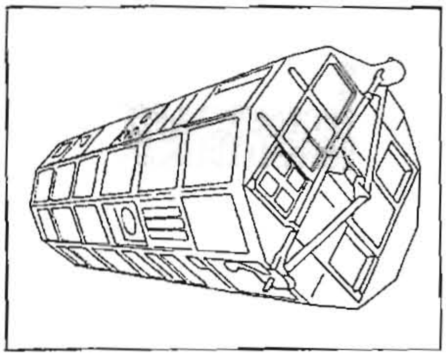
III. 1990-1993 STP HIGHLIGHT MISSIONS

Four specific STP missions have been identified as having a particularly significant impact upon the advancement of space technology. These are: LDEF Recovery, CRRES, AFP-675, and STP-1. Each mission is addressed in detail below.

Figure 5

Space Test Program

1990-1993 STP HIGHLIGHT MISSIONS
LDEF RECOVERY



LONG DURATION EXPOSURE FACILITY (LDEF)

LAUNCHED: 6 APRIL 1984
RECOVERED: 20 JANUARY 1990

STP EXPERIMENT OBJECTIVES:

- AFWL-701 (FIBER OPTICS IN SPACE): TO TEST THE PERFORMANCE OF FIBER OPTIC SYSTEMS IN SPACE
- CRL-258 (TRAPPED PROTON ENERGY SPECTRUM): TO INVESTIGATE SURFACE CHANGES DUE TO EXPOSURE IN SPACE INCLUDING EXPOSURE OF SMALL SAMPLES OF TISSUE
- NRL-702 (HEAVY IONS IN SPACE): TO SURVEY THE SPACE RADIATION ENVIRONMENT
- SD-802 (SPACECRAFT MATERIALS): TO MEASURE THE EFFECTS OF SPACE ON SPACECRAFT MATERIALS AND COATINGS
- AFTAC-201 (SPACE EFFECTS): TO DETERMINE THE SPACE ENVIRONMENTAL EFFECTS ON ELECTRO-OPTICAL SENSOR COMPONENTS

MAJOR ACCOMPLISHMENT

- RECOVERY AND ANALYSIS OF A SPACECRAFT AFTER SIX YEARS IN ORBIT HAS PROVIDED SIGNIFICANT SPACECRAFT DESIGN INFORMATION FOR BOTH INDUSTRY AND GOVERNMENT

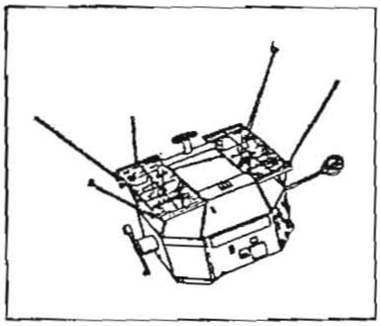
In 1984, NASA launched the Long Duration Exposure Facility (LDEF). The mission plan at the time of launch was for LDEF to remain in orbit for one year and then be recovered by the Space Shuttle. LDEF carried a large number of experiments in experiment trays located on the surface of the spacecraft. The DOD Space Test Program sponsored and managed five of the experiments on LDEF. The objectives of the STP experiments are listed on Figure 5. Generally, the STP experiments were directed toward obtaining data on the performance of electronic components and spacecraft coatings over long periods of time in space.

Due to the loss of the Shuttle Challenger and the subsequent hiatus in Shuttle flights, LDEF was not recovered after one year as planned but remained in orbit for almost six years. This unanticipated extension of the mission provided a bonanza in terms of space effects on spacecraft. Not only did the STP experiments perform well but much additional data was obtained from the analysis of the LDEF spacecraft itself. Through meetings, Aerospace Corporation reports, and informal discussions, STP was able to provide useful information to DOD program managers and contractors regarding the design of spacecraft for long durations in orbit.

Figure 6

Space Test Program

1990-1993 STP HIGHLIGHT MISSIONS CRRES



COMBINED RELEASE AND RADIATION EFFECTS SATELLITE (CRRES)

LAUNCHED: 25 JULY 1990

STP EXPERIMENT OBJECTIVES:

- AFGL-701 (SPACERAD): TO TEST AND SPACE QUALIFY ADVANCED MICROELECTRONICS
- ONR-307 (EPIC): TO CHARACTERIZE THE DYNAMIC BEHAVIOR OF THE RADIATION BELTS
- ONR-604 (SOLAR FLARES II): TO MEASURE COMPOSITION AND ENERGY SPECTRA IN SOLAR FLARE ACCELERATED NUCLEI
- AFAPL-801 (HESP): TO DEMONSTRATE AND EVALUATE IN SPACE A HIGH-EFFICIENCY SOLAR PANEL
- NRL-701 (LASSII): TO STUDY IRREGULARITIES IN THE IONOSPHERE

MAJOR ACCOMPLISHMENTS

- CRRES DEMONSTRATED AND EVALUATED A NEW HIGH-EFFICIENCY SOLAR PANEL. THE EXPERIMENT WILL CONTRIBUTE TO IMPROVED SPACE POWER SYSTEMS
- CRRES TESTED AND SPACE QUALIFIED ADVANCED MICROELECTRONIC COMPONENTS IN SPACE. THIS EXPERIMENT WILL MAKE POSSIBLE IMPROVED MILITARY SPACE SYSTEMS

In 1990, STP launched CRRES, a major joint free-flyer mission with NASA. The spacecraft carried five STP experiments. The objective of each of these experiments is listed on Figure 6. Although all of the STP experiments obtained useful data, two of the experiments are singled out as particularly valuable: demonstration of high-efficiency solar panels and investigation of radiation damage to advanced microelectronics.

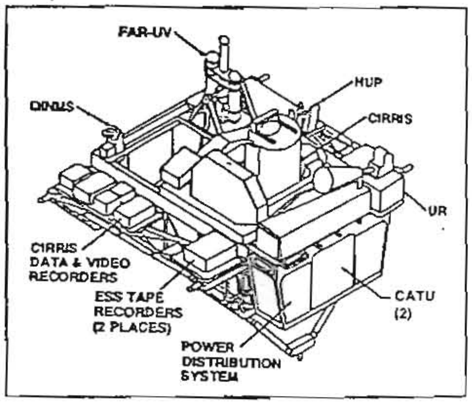
For many years there has been a need to develop an improved space power system. The major improvements needed are better efficiency (power to weight ratio) and less susceptibility to radiation damage in space. One of the prime candidates for such a system has been solar panels composed of gallium arsenide solar cells. The STP experiment on the CRRES mission demonstrated a gallium arsenide solar cell with improved efficiency through the use of a thin film protective cover on the cell. The experiment also demonstrated that gallium arsenide solar cells in space will anneal (i.e., recover) from much of the damage caused by space radiation. These experiments will contribute significantly to the evaluation of gallium arsenide solar cells for future space power systems.

On the CRRES mission, STP also flew an experiment to investigate radiation damage to advanced electronic components in space. The experiment not only measured the radiation environment but also carried sample advanced electronic components in order to directly test them. The data from this experiment have contributed significantly to the data base for the use of advanced electronic components in space.

Figure 7

Space Test Program

1990-1993 STP HIGHLIGHT MISSIONS
AFP-675



AIR FORCE PROGRAM
(AFP)-675

LAUNCHED: 28 APRIL 1991
RECOVERED: 6 MAY 1991

STP EXPERIMENT OBJECTIVES:

- AFGL-201 (CIRRIS): TO MEASURE WITH HIGH PRECISION THE MEDIUM AND LONG WAVELENGTH IR AURORAL AND AIRGLOW BACKGROUND
- NRL-803 (FAR UV): TO OBTAIN IMAGERY AND PHOTOMETRY OF EMISSION PHENOMENA IN FAR UV WAVELENGTHS
- AFGL-801A (HUP): TO ESTABLISH THE VALUE AND VARIABILITY OF THE ATMOSPHERIC BRIGHTNESS IN THE UV WHEN VIEWING THE HORIZON FROM SPACE
- AFGL-804A (QINMS): TO MEASURE CONTAMINATION IN THE VICINITY OF THE CIRRIS INFRARED TELESCOPE
- AFTAC-801 (URA): TO EVALUATE NEW APPROACHES TO THE DEVELOPMENT OF A CLASSIFIED SENSOR SYSTEM

MAJOR ACCOMPLISHMENT

- [redacted] (b)(3)

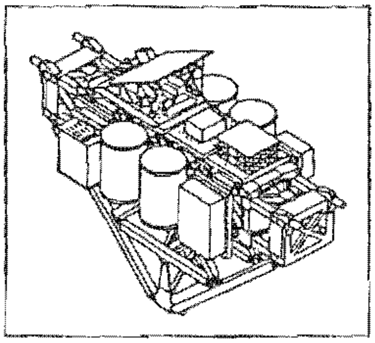
In 1991, STP launched a major space mission in the cargo bay of the Space Shuttle. This mission, named AFP-675, carried five STP experiments. The objective of each of these experiments is listed on Figure 7. Of particular importance is the data obtained by the CIRRIS experiment which measured IR auroral and airglow backgrounds. Since the early 1970s, STP has conducted experiments to determine IR and UV backgrounds in space. The [redacted] in particular, have provided key data for a number [redacted] (b)(3) become more sophisticated, the requirement for more precise background data increases. The high-quality precision data obtained by the CIRRIS experiment will be used to optimize [redacted]

Figure 8

Space Test Program

1990-1993 STP HIGHLIGHT MISSIONS
STP-1

LAUNCHED: 28 APRIL 1991
RECOVERED: 6 MAY 1991



SPACE TEST PAYLOAD
(STP)-1

STP EXPERIMENT OBJECTIVES:

- NRL-904 (UVLIM): TO CHARACTERIZE THE F-2 LAYER OF THE IONOSPHERE BY OBSERVING EUV EMISSIONS AT SHUTTLE ALTITUDES
- SD-602 (ALFE): TO EVALUATE AN ADVANCED LIQUID FUEL SYSTEM
- AFGL-501 (SKIRT): TO MEASURE INFRARED EMISSIONS PRODUCED BY SPACECRAFT OPTICAL SURFACES IN LOW EARTH ORBIT

MAJOR ACCOMPLISHMENT

- THE EXCELLENT DATA OBTAINED FROM THE UVLIM EXPERIMENT WILL BE USED TO BUILD A MAP OF THE IONOSPHERE TO SUPPORT THE DEVELOPMENT AND EVALUATION OF REMOTE SENSING AND SENSORS THAT OPERATE IN THE ULTRAVIOLET RANGE

In 1991, STP flew, in a single flight, approximately 1,000 pounds of experiments in the Space Shuttle cargo bay on a pallet provided by the NASA Goddard Space Flight Center Small Payloads Program. The objective of each of these experiments is listed on Figure 8. The UVLIM experiment made particularly useful measurements of extreme ultraviolet (EUV) emissions at Shuttle altitudes. Over the past several years, a number of experts in space sensors have suggested greater use these sensors which operate in the UV region of the spectrum. The UVLIM experiment has provided the best background data available and has made a significant contribution to a U.S. capability to design and build space sensors which operate in the UV spectrum.

IV. OBSERVATIONS

Figure 9

Space Test Program

OBSERVATIONS

- DURING THIS PERIOD (1 JANUARY 1990 - 30 JUNE 1993) STP HAS CONTINUED TO CARRY OUT A VERY ACTIVE FLIGHT PROGRAM FOR DOD EXPERIMENTERS
- A NUMBER OF THE EXPERIMENTS FLOWN DURING THE REPORT PERIOD OBTAINED DATA OF SIGNIFICANT VALUE TO MILITARY SYSTEMS AND OPERATIONS
- THE FLIGHT OF MISSIONS AFP-675 AND STP-1 WERE MAJOR STEPS FORWARD IN CARRYING OUT THE MISSION ASSIGNED BY DOD TO STP IN 1975 "TO EXPLOIT THE SPACE SHUTTLE AS A MANNED LABORATORY IN SPACE"

Over the past three years, the Space Test Program has produced a prodigious amount of flight tests yielding significant technology advancements, both in the excellence of the experiment and the quality of the data obtained.

The 110 experiments flown during this report period was the largest number flown in a three and one-half year period at any given time during the 30-year history of the Space Test Program.

Experiment results of exceptional value include the data on long duration in space acquired from the LDEF recovery, the demonstration of gallium arsenide solar cells in space from CRRES, and the IR background data obtained from AFP-675.

Although STP has flown experiments in the Space Shuttle for several years, none of these earlier experiments were of the size and sophistication of the experiments on missions AFP-675 and STP-1.

APPENDIX A

PRIMARY DISTRIBUTION LIST FOR

IADN 94-1

IADN 94-1 RECENT ACCOMPLISHMENTS OF THE DOD

SPACE TEST PROGRAM

JANUARY 1994

PRIMARY DISTRIBUTION LIST FOR IADN 94-1

NAME AND ORGANIZATION	NUMBER OF COPIES
SAF/AQS (b)(6) [redacted] 1060 Air Force Pentagon Washington, D.C. 20330-1060	1
SAF/AQSL [redacted] 1060 Air Force Pentagon Washington, D.C. 20330-1060	1 1
HQ USAF/XORR [redacted] 1480 Air Force Pentagon Washington, D.C. 20330-1480	1
Navy Space Systems Group (NRaD 762) [redacted] 2420 Vela Way Los Angeles AFB, CA 90245	1
Chief of Naval Operations [redacted] Department of the Navy The Pentagon (Room 5D569) Washington, D.C. 20350-2000	1
Naval Space Command [redacted] Dahlgren, VA 22448-5170	1
OASA(RDA)/SARD-TC [redacted] 103 Army Pentagon Washington, D.C. 20310-0103	1
HQDA/ODCSOPS (Attn: DAMO-FDW) [redacted] Washington, D.C. 20310-0460	1 1

PRIMARY DISTRIBUTION LIST FOR IADN 94-1 (CONTINUED)

NAME AND ORGANIZATION	NUMBER OF COPIES
HQ AFSPACECOM [redacted] 150 Vandenberg Street Suite 1105 Peterson AFB, CO 80914-4610 (b)(6)	 1
HQ AFMC/STC [redacted] 4375 Chidlaw Road, Suite 6 Wright Patterson AFB, OH 45433-5006	 1 1
SMC/CUL [redacted] Suite 1536A, 160 Skynet Street Los Angeles AFB, CA 90245-4683	 1 1
SMC/CUC [redacted] Suite 1536A, 160 Skynet Street Los Angeles AFB, CA 90245-4683	 1
SMC/CULH, OL-AW/ZR [redacted]	 1 1
NASA/JSC 2101 NASA Road One Houston, TX 77058	
NASA JSC/CB Astronaut Office [redacted] Houston, TX 77058	 1
Office of the Under Secretary of Defense (Acquisition) Missile and Space Systems [Attn: OUSD(A)/S&SS/M&SS] [redacted] 3090 Defense Pentagon (Rm 3E129) Washington, D.C. 20301-3090	 1

PRIMARY DISTRIBUTION LIST FOR IADN 94-1 (CONTINUED)

NAME AND ORGANIZATION	NUMBER OF COPIES
The Aerospace Corporation	
[redacted] (b)(6)	1 1
P.O. Box 92957	
Los Angeles, CA 90009-2957	
The Aerospace Corporation-JSC	
[redacted]	1
NASA JSC/ZR-12	
Houston, TX 77058	
Defense Technical Information Center	1
Attn: DTIC-FDAC	
[redacted]	
Alexandria, VA 22304-6145	
AFSAA-SAI	1
1580 Air Force Pentagon	
Washington, D.C. 20330-1580	
ANSER	
International Aerospace Division	4
Library	4
Masters (International Aerospace Division)	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

ENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	January 1994	FINAL Sept 1993 - January 1994

LE AND SUBTITLE

Recent Accomplishments of the DOD Space Test Program

5. FUNDING NUMBERS

F49620-91-C-0031
PE: FAQ1
PR: SL05
TA: STPS

THOR(S)

[redacted] (b)(6)

RFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

ANSER
Suite 800
1215 Jefferson Davis Highway
Arlington, VA 22202

8. PERFORMING ORGANIZATION REPORT NUMBER

IADN 94-1

ONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

SAF/AQQX
1060 Air Force Pentagon
Washington, DC 20330-1060

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

SUPPLEMENTARY NOTES

. DISTRIBUTION/AVAILABILITY STATEMENT

~~Distribution Limited to U.S. Government agenices only; test and evaluation January 1994. Other requests for this document shall be referred to SAF/AQQX.~~

12b. DISTRIBUTION CODE

ABSTRACT (*Maximum 200 words*)

This Division Note documents a 4-month study which summarizes the accomplishments of the DOD Space Test Program during the period 1 January 1990 - 30 June 1993. The study also describes the benefits to DOD from the Space Test Program during this period.

. SUBJECT TERMS

Space Test Program
Space Testing

15. NUMBER OF PAGES

23

16. PRICE CODE

7. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNCL

N 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102