Apr 1st, 8:00 AM

Space Test Program

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ABSTRACT

The Department of Defense Space Test Program is a unique organization dedicated to stimulating space-related technology by providing launch and orbital support for research and development payloads. This paper delineates program management techniques, past accomplishments, and current activities. The benefit to the DOD is discussed.

INTRODUCTION

In large measure the military power of the United States depends upon the possession of space systems which are products of superior technology. To maintain a superior technological base and thereby fully exploit the potential of space, a broadly based research, development, test, and evaluation function is required.

As the military space program matured in the mid-1960s, high management levels in the Department of Defense recognized that the timely development of technology was being hindered by the lack of an on-orbit research and test capability. Basic research of the space environment was being successfully pursued by the Air Force's Office of Aerospace Research (OAR). But the availability of spaceflight support to developmental and pre-operational payloads was largely non-existent. The stimulation of all areas of technological development depended upon an organized capability to select high quality payloads and insure prompt spaceflight support. The embodiment of this capability had to be a low cost, rapidly responsive, flexible program.

In May 1965, the Director of Defense Research and Engineering authorized the establishment of the Space Experiments Support Program (SESP). Tri-service in nature, the Air Force was designated the executive agency. Within Air Force Systems Command (AFSC), a Program Office was established at the Space Systems Division (now the Space and Missile Systems Organization), Los Angeles, California. Originally chartered to support Advanced Development (6.3) and Engineering Development (6.4) payloads, SESP's scope was increased in 1968 to include the Basic Research (6.1) and Exploratory Development (6.2) payloads previously supported by OAR. In June 1971 the program was redesignated the Space Test Program.

The objective of the Space Test Program is the timely spaceflight of DOD research, development, and certain operational payloads. The only limitation on this charter is that the payloads must not be authorized their own means of spaceflight. The Program was never intended to be a launch agency for the large space programs.

To achieve this objective a governing philosophy was established which required the Program to:

- be comprehensive in scope
- select and support the most beneficial payloads
- minimize individual mission costs so as to maximize the number of missions
- minimize the lead-time between payload identification and launch

The management procedures which evolved early in the Program's history are in accordance with this philosophy. Higher management levels have maintained streamlined but effective control, while the Program Office is allowed to exercise decentralized and efficient management techniques. The following sections of this paper will illustrate that the Program is achieving its objective by operating in the manner outlined above.

PROGRAM MANAGEMENT

Space-related Research and Development activities, while predominantly performed in the Air Force, are widely distributed throughout the DOD. To stimulate this broad technological base, the opportunity to participate in the Space Test Program is offered to all DOD and government agencies. Under certain circumstances industry and foreign governments may also obtain the management and technical services of the Program.

As stated in the Introduction, the Space Test Program is a DOD program for which the Air Force is the executive agency. To avoid any debilitating effects of potential differences between the participating organizations, representatives of all payload sponsoring agencies are involved in major program decisions. The Army, Navy, and Air Force are, in essence, voting members at all meetings which approve or prioritize payloads, allocate resources, or determine schedules. A joint Army, Navy and Air Force manual specifies Space Test Program management procedures. Final authority for payload and spaceflight plan approval rests in the Office of the Director of Defense Research and Engineering (ODDR&E).

The most difficult task in the overall management of the program is the selection and prioritization of payloads. Absolutely crucial to effective advancement of technology is the launch of high quality, directly beneficial payloads. The task is complicated by the fact that proposed payloads can originate in any one of dozens of laboratories and organizations. They can fall within any of four categories ranging from basic research to engineering development.

The payload submission and prioritization flow is illustrated in Figure 1. Each sponsoring agency (i.e., Army, Navy, Air Force, ARPA, NASA, etc.) is responsible for insuring that the proposed payload actually requires spaceflight and that funding support to build the payload is available. The sponsoring agency must then prioritize the payloads in accordance with its own internal procedures and submit an integrated list to Hq USAF, Deputy Chief of Staff, Research and Development (DCS/R&D). Within DCS/R&D, the Director of Space with the assistance of the payload sponsors combines the various lists to establish a Master List of Accepted Payloads. Factors utilized in the overall prioritization include:

- Urgency - immediate, near-term, or far-term usage
- Mission Orientation - operational, subsystem development, general research
- Programmatic - essential, important, secondary to sponsoring program's goals

This Master List is approved by ODDR&E prior to transmittal to Hq SAMSO/DYE for detailing flight planning.

With 60-70 payloads in the program at any given time, the process of approving and prioritizing payloads represents a major effort. It has been efficiently and successfully conducted at the various levels by assigning the task to knowledgeable individuals and small cooperative groups. Large standing committees inundated with paperwork are not utilized.

Upon receipt of the Master List of Accepted Payloads, the Planning Function of the Space Test Program prepares Spaceflight Plans delineating performance, schedules, and costs for a variety of missions. Once a Spaceflight Plan is approved, the detailed planning, procurement, and engineering activities which follow are solely the

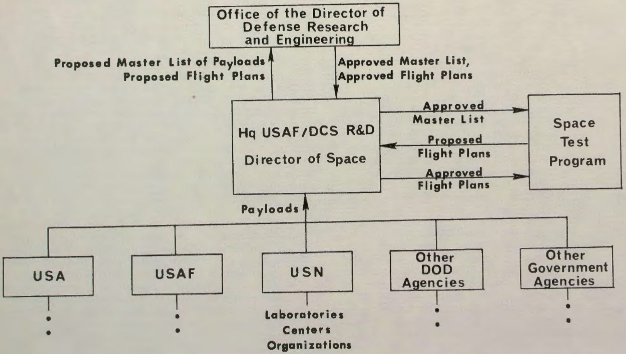

Figure 1

Payload Submission and Spaceflight Plan Approval Flow responsibility of the Space Test Program Office. Located at the Space and Missile Systems Organization (SAMSO) in Los Angeles, it is the overall DOD management agency with complete authority to plan, organize, and direct the progress of each launch. It does so by funding and procuring boosters, spacecraft, and payload integration. It also obtains launch and orbital support as required.

The Space Test Program is also the overall DOD management agency for the assignment of payloads to secondary (excess) capability on launch vehicles and spacecraft of other DOD programs. It is also the central agency for requesting secondary payload space on NASA programs. In performing this function, the Program Office maintains current information on the secondary payload capabilities of all DOD and NASA programs.

Due to the large number and variety of the payloads flown, the Program is not expected to manage payload development. A vast increase in personnel, monetary resources, technical support, and management control would be required. Each payload agency is responsible for the design, fabrication, and test of their hardware. They are required to fully fund and manage these activities without extensive Space Test Program involvement.

A detailed discussion of the methods used to minimize individual mission cost and lead-time is beyond the scope of this paper. However, the major guidelines can be presented. The Program has been successful in controlling cost and schedule by:

- utilizing previously flight-proven/ flight-qualified hardware
- utilizing low-cost launch vehicle systems
- rigorously negotiating payload "desirements" until well defined "requirements" are established
- procuring competitively (if appropriate)

Such control is largely achieved in the mission planning phase. A process is used which is actually the reverse of the classical approach of defining requirements and then estimating costs. The Planning Function utilizes projections of outyear funding and knowledge of the missions to be flown to determine the resources which can be allocated to any particular mission. Extensive knowledge of spacecraft and launch vehicle capabilities and costs is then used to establish the maximum capabilities those resources can procure. Payload "desirements" can generally be negotiated consistent with these capabilities without degrading the payload objectives.

In essence the Space Test Program controls cost and schedule by firmly establishing requirements and by knowing, before initiating procurement activity, how much a mission will cost. Subsequent to contract award a small, dedicated project team assures effective management. The payload agencies are liable for increases in Space Test Program costs due to changes in payload requirements or late delivery. The last feature assures that the payload agencies adequately define their requirements. It also assures that they closely manage their activities.

PAST ACCOMPLISHMENTS

On 29 June 1967, five months after contractual goahead, a Thor/Burner II lifted off from Vandenberg AFS carrying an Army satellite and a Navy satellite. Successful injection into a 2100 NM orbit by the specially developed apogee insertion system marked the completion of the first primary Space Test Program mission. Slightly over a month later, a classified Air Force satellite was launched carrying three additional payloads representing the first secondary Space Test Program mission. The Program's complete launch history is presented in Table 1.

In the late 1960s, the majority of the payloads submitted by the various participating organizations were self-contained satellites. The Space Test Program's function was largely integrating these diverse satellites into a composite payload. The secondary mission being flown also involved self-contained satellites. By 1970, however, there was a marked change in the type of payload being submitted. The small basic research black-box and satellite were being replaced by the much larger, more complex, highly developmental payload. The Program's budget was sharply increased to $16M per year to permit the procurement of spacecraft necessary to support these payloads. To illustrate this transition the payloads and capabilities of Flights P70-2, P71-2, S71-3, and P72-1 will be presented in greater detail.

P70-2: This flight was the last primary mission to predominantly support research-related payloads. Cannonball II was an 810 lb, 26 inch diameter sphere, built by the AF Cambridge Research Laboratory (AFCRL). Together with Musketball, also built by AFCRL, it investigated atmospheric density in the region of 70-150 NM. Cannonball II was integrated on the forward section of an OV1 Propulsion Module (OV1-20) and placed into a 72 x 1064 NM orbit. Mustketball was integrated with the forward structure of OV1-21 and was placed into a 75 x 483 NM orbit. The use of two OV1 Propulsion Modules permitted the insertion of payloads to three different orbits. Reference Figure 2.

The 75 x 1050 NM nominal orbit was ideal for the investigation of high energy protons and other particles. Batteries, telemetry equipment, thermal control surfaces, and a stabilization boom were added to the OV1-20 Propulsion Module to provide 8 days of mission life for AFCRL's Energetic Proton Analyzer and Particle Energy and Flux payloads.

The other payloads assigned to the mission all required a 400-500 NM orbit. Therefore, an apogee kick motor was added to the OV1-21 Propulsion Module. After circularization the Grid Sphere Drag payload built by the AF Avionics Laboratory was separated. Three inflatable 7 foot spheres were utilized to investigate the transition point from free molecular to laminar flow. The Propulsion Module was then reoriented and the canister containing the Army's Lincoln Calibration Sphere was jettisoned. This sphere was placed in orbit to provide a radar calibration target with a known signature.

Subsequent to the separation of these self-contained payloads a stabilization boom was deployed and the Propulsion Module spun-up. Primary batteries and a real-time telemetry system provided support to three other payloads. Two booms, each 60 ft in length, were deployed from the Navy's ELF/VLF Antenna Effects payload to investigate the propagation characteristics of signals in this region. A Velocity Mass Spectrometer and an Atmospheric Neutral Composition Payload were also supported.

The mission was launched by an Atlas F booster. The OV1 Propulsion Modules and all associated payload and mission integration functions were provided by General Dynamics/Convair Astronautics. Excluding payloads and data reduction, the total mission cost was $5.5M. The mission was launched 13 months after contract award.

P71-2: This flight represents the most complex spacecraft launched to date by the Space Test Program. The Agena vehicle was utilized as a three-axis, earth-oriented spacecraft. Control moment gyros, a power system, and a complex telemetry system were added to support four payloads. Ref Fig 3. AF Aero Propulsion Flexible Solar Array and a mechanically cooled SAMSO Celestial IR Telescope were integrated into the forward structural rack. The 32 ft x 5 ft, sun-tracking array, provided 1.5 KW of power for use by the IR Telescope. Ionospheric Particle Interactions were thoroughly investigated by an Office of Naval Research payload containing 21 different sensors. The fourth payload, Command and Control Interfaces, was submitted by the National Security Agency.

Still operating after 18 months on orbit, this mission has provided a wealth of information. The feasibility of large flexible arrays has been demonstrated. Nearly a complete map of celestial IR sources has been obtained. The vast quantity of data collected by the Navy's particle sensors will lead to improved understanding of the ionospheric disturbances which cause communication black-outs. A significant bonus was realized when this payload measured the large solar flare which occurred last August. At that point in time the spacecraft and payloads were 5 months past their nominal life.

Lockheed Missiles and Space Company modified the Agena and integrated the payloads in an 18-month period. The total mission costs, exclusive of payloads, was $17.4M.

S71-3: This secondary mission is typical of the capabilities available to payloads incorporated on spacecraft of other DOD programs. Two AFCRL payloads were integrated into the aft rack of an Agena. The Cold Cathode Ion Gauge was mounted on a boom to insure an unobstructed view forward along the velocity vector. Two instruments provided nadir and zenith view angles for the Nightglow Photometer.

The numerous orbits of data obtained by these payloads will further the understanding of atmospheric composition and phenomena. The integration of these payloads into the Agena's power, telemetry, and command systems was completed in 5 months at a cost of $139K.

P72-1: This flight marks the departure of the Program from the practice of utilizing the upper stage as the spacecraft. The requirements of previous missions had resulted in the cost effective modification of Burner II's, OV1 Propulsion Modules, and Agenas. The requirements of the P72-1 payloads and the changing stable of launch vehicles mitigated against this approach. A separable spacecraft, as well as the upper stage, was competitively procured. Reference Figure 4.

Integrated within the spacecraft were four payloads. The Advanced Research Project Agency's Gamma Spectrometers required a spinning spacecraft to permit complete measurement of the gamma ray background. This method of stabilization was also well suited to the Extreme UV Radiation and Low Altitude Particle payloads built by Naval Research Laboratories and AFCRL respectively. Completing the payload complement within the spacecraft were groupings of Thermal Control Coating provided by the AF Materials Laboratory. Supported by one of the largest tape recorder storage capacities ever built into a spacecraft these payloads have produced a massive amount of data in the first five months of operation.

Mounted atop the spacecraft was a 4 ft diameter, 10 ft long, 450 lb cylinder. This Radar Calibration Target submitted by the Army's Advanced Ballistic Missile Defense Agency was separated from the spacecraft while still under control of the Burner II upper stage. A reorientation maneuver was required prior to spin-up and separation of the spacecraft.

The mission was launched on an Atlas F booster. The Boeing Company provided the Burner II, the separable spacecraft, and the integration of the Radar Calibration Target under a 19-month contract. The total mission cost, exclusive of payloads, was $9.3M.

The characteristics of these missions, as well as others outlined in Table 1, should make apparent the breadth of support capabilities the Space Test Program can provide. Payloads weighing 0.5 lb, requiring 1 W of power, and outputting 8 bps of data have been integrated with payloads weighing hundreds of pounds, requiring 500 W of power, and outputting 256 kbps of data. These payloads have been approved, prioritized, and flown based solely upon the benefit derived by the DOD. The flexible but rigorous manner in which the Program plans, procures, and manages its missions has insured timely and cost effective support.

The large number of flights under contract or in the procurement process is a further indication that the Program is satisfying its goal of stimulating technological development.

CURRENT ACTIVITIES

The Space Test Program flights which are currently under contract or in the procurement process are outlined in Table 2. These flights are the result of intensive planning and procurement activities during 1971 and 1972. Similar to past flights, the spacecraft and orbital transfer systems being utilized were configured with regard to both payload requirements and cost constraints. A brief discussion of these current flights will serve to identify the most recent trends in the Program and outline future capabilities.

S73-5, S73-6, S74-2: The Small Secondary Satellite (S3) Project represents the development of a major secondary mission capability. Three similar satellites will be launched "piggy-back".

A solid rocket motor is incorporated in each of the three satellites. After separation from the host vehicle, each satellite will spin-up, coast an appropriate period, and ignite the solid rocket motor. By varying the size of the motor, widely different orbits will be obtained.

Including the solid rocket motor each satellite weighs approximately 580 lbs. Seventeen different research-related payloads provided by Air Force and Navy laboratories will be supported. Seventy-one different instruments and packages will be furnished to the Boeing Company for integration.

The first satellite will be available for launch 16 months after contract award. Including the cost associated with incorporating these satellites on the host vehicle, the total S3 Project is currently estimated at $9.5 million. Each satellite is costing approximately $2.7 million.

S73-7: Similar to the S3 Satellites this flight will be launched by another program. However, the payload is itself a self-contained satellite. The hardware being procured for this mission is a dual burn orbital transfer system. Once the 430 x 430 NM orbit is achieved the transfer system will be despun and the ARPA Calibration Satellite separated.

P72-2: Flight P72-1 marked the first use of a completely separable satellite. Flight P72-2 represents the first use of an Integrated Spacecraft, that is, one in which the propulsive capabilities of an upper stage are incorporated in the spacecraft. At the time this mission was being planned it was recognized that the full performance of a Burner II upper stage would not be utilized. Consequently, the attendant cost and complexity were not warranted. Since the spacecraft had to have a rigid stabilization system for other reasons, a small solid rocket motor was added to perform the injection function.

The spacecraft makes maximum use of flight-proven equipment, although the overall configuration is new. Three-axis, earth-oriented stabilization is provided for the four payloads. The SAMSO Radiometer-20 payload will measure the earth's background. An accompanying SAMSO Ultraviolet Radiometer will investigate the UV characteristics of the earth's horizon. Wideband Radio propagation measurements will be performed by a Defense Nuclear Agency payload. The Office of Naval Research will provide a Preliminary Aerosol Monitor, the forerunner of far more sophisticated instrumentation. Reference Figure 5.

To be built by North American Rockwell in a 20-month period, this Integrated Spacecraft is estimated to cost $8.3M. The total mission cost, including the Atlas F booster but excluding the payloads, is $13.2M.

P73-3: This flight will place a Navy Navigation Technology Satellite (NTS-1) into a 7500 NM, 145° orbit. NTS-1 represents the first mission of a cooperative AF/Navy effort to develop the Defense Navigation Satellite System. The Payload Transfer System and supporting mission integration analyses will be provided under a 11 month contract soon to be awarded. The Atlas F will be utilized as the booster. Reference Figure 6.

P74-1: This flight will be the first Space Test Program utilization of a Titan IIIC launch vehicle since 1968. Two Air Force Lincoln Experimental Satellites (LES 8/9) and two Navy Solar Activity and Forecasting Satellites (SOLRAD 11 A/B) will be integrated into a composite payload system. Although the hardware being procured is largely structural in nature, many supporting analyses must be performed. This integration effort will be performed during a 19 month contract by TRW Systems, Inc. Reference Figure 7.

LES 8/9 are experimental communication satellites intended to demonstrate advanced communication techniques. They will be placed in a synchronous altitude, 23° orbit. The SOLRAD 11 A/B satellites will be transferred out to a 69,000 NM orbit to insure undisturbed monitoring of solar activity. When separated 180 degrees in this orbit, nearly continuous real-time monitoring of solar activity will be possible.

These flights comprise those which will be launched in CY 73 and CY 74. Several CY 75 and CY 76 missions are in the preliminary planning phases. However, they lack sufficient definition to be included in this paper. A launch rate of 1-2 primary missions and 2-3 secondary missions per year is expected in the mid and late 1970s. Planning for use of the Space Transportation System (STS) has been initiated but the impact of the STS upon the Program's operations will not be established for several years.

BENEFIT TO DOD

The benefits of the Space Test Program to the DOD have been as varied as the payloads which have been flown. The area of investigation for each of the payloads is indicated in Tables 1 and 2. Some have been research-oriented and obtained data which will not be immediately utilized by existing programs. However, the majority of the Program's funding has been allocated to developmental or nearly operational payloads. These payloads have either obtained design data for the next generation of systems or actually tested these systems.

The payloads and the data obtained must also be considered within the much broader context of their mission applications. Very significant contributions have been made to each of the following missions:

- Ballistic Missile Defense
- Communications
- Geodetic Mapping
- Navigation
- Orbit Prediction
- Space Environment Investigation
- Space Object Identification
- Spacecraft Subsystem Development

A further indication of the scope of the Space Test Program is the number of participating payload agencies. Within the major agencies listed below, payloads have been accepted and flown from more than 20 different laboratories, commands, and organizations.

Advanced Research Projects Agency (ARPA)

Defense Nuclear Agency (DNA)

National Security Agency (NSA)

United States Air Force (USAF)

United States Army (USA)

United States Navy (USN)

Discussions relative to flight opportunities have been held with NASA and the French Government; however, no payloads have yet been flown from these agencies.

A less tangible benefit to the DOD has been the manner in which the Program's governing philosophy was developed and implemented. Management of the overall Program is a different task involving many organizations. The large number of successful launches has demonstrated that direct communication, streamlined procedures, and a projectized approach can result in effective and responsive management of a complicated Program. These launches have also demonstrated that by utilizing cost criteria, particularly during the mission planning phases, costs can be controlled. Without actually labeling it such, the Program has consistently used a "design to cost" approach. This combination of streamlined-management and cost-conscious philosophies has enabled the Program to provide broad support with modest resources. The Program is a continuing example of the success such philosophies can achieve.

CONCLUSIONS

The Space Test Program has achieved its goal of providing an on-orbit research and test capability. Since its first launch in June 1967, the Program has steadily grown in technical expertise, management capability, and funding resources. Today it has the capability to plan, integrate, and launch a wide variety of missions. Past and current launches have supported advanced payloads from numerous DOD agencies. Provided with adequate funding support and managed consistent with existing philosophies, the Space Test Program will remain a primary force in the stimulation of space-related technology.

ACKNOWLEDGEMENT

The missions discussed in this paper represent the cooperative efforts of numerous individuals within both the DOD and the aerospace industry. Each mission has been unique; each has had its peculiar set of problems. The success of the Space Test Program is a measure of the dedication and competence these individuals have repeatedly displayed.

ILLUSTRATIONS

TABLE 1

SPACE TEST PROGRAM

PAST LAUNCHES

Flight Number	Launch Date	Launch Vehicle	Payload Agency	Payload Title	Orbit (NM)	Area Investigated
P67-1	29 Jun 67	Thor/Burner II	USA	Sequential Collation of Range (SECOR)	2079 x 2156, 90°	Geodesy
			USN	Charged Particle and Auroral Measurements - AURORA	2086 x 2163, 90°	Space Environment
S67-3	7 Aug 67	Thorad/Agena	USAF	Radiometer 12	102 x 194, 90°	Earth Background
			USAF	Radiometer 15		Earth Background
			USAF	Solar X-ray		Solar Effects
S68-2 (Unsuccessful: Booster failure)	8 May 68	NASA/Thorad Agena	USA	Sequential Collation of Range (SECOR)	590 x 590, 100°	Geodesy
P68-1 (Unsuccessful: Payload Fairing failure)	16 Aug 68	Atlas/Burner II	USA	Radar Calibration Target (RADCAT)	400 x 400, 91°	Radar Calibration
			USA	Lincoln Calibration (LCS-3)	400 x 400, 91°	Radar Calibration
			USAF	Ultra-Violet Radiometer (UVR)	400 x 400, 91°	Earth Background
			USAF	Radiometer 18	400 x 400, 91°	Earth Background
			USN	Ionospheric RF Propagation Studies - ORBIS CAL I	85 x 400, 91°	Ionospheric Effects
			USAF	Grid Drag Sphere	400 x 400, 91°	Atmospheric Density
			USA	Sequential Collation of Range (SECOR)	2100 x 2100, 91°	Geodesy
			USA	Sequential Collation of Range (SECOR)	2100 x 2100, 91°	Geodesy
			USN	Geodetic and Gravitational Measurements - LIDOS	600 x 2400, 91°	Geodesy
			USAF	Orbital Space Vacuum Friction Experiment	400 x 400, 91°	Material Properties
P67-2	26 Sep 68	Titan IIIC	USAF	Lincoln Experimental Satellite (LES-6)	Sync, 3°	Advanced Communications Techniques
			USAF	Sync Radiation Monitoring Sat: OV2-5	Sync, 3°	Space Environment
			USAF	Solar Particle Monitoring Sat: OV5-2	95 x 19300, 26°	Space Environment
			USAF	Zero G Liquid Heat Transfer: OV5-4	Sync, 3°	Orbital Thermodynamics

TABLE 1 (Cont.)

SPACE TEST PROGRAM

PAST LAUNCHES

Flight Number	Launch Date	Launch Vehicle	Payload Agency	Payload Title	Orbit (NM)	Area Investigated
P69-1	17 Mar 69	Atlas F/Tri OV1	USAF, USN	Auroral and Atmospheric Studies Satellite: OV1-17	217 x 253, 99°	Space Environment
			USAF, USN	Auroral Effects Measurements Satellite: OV1-18	254 x 319, 99°	Space Environment
			USAF	Radiation Belt Particle Monitoring Satellite: OV1-19	254 x 3160, 105°	Space Environment
			USN	Ionospheric RF Propagation Studies: ORBIS-CAL II	100 x 226, 99°	Ionospheric Effects
S69-2	14 Apr 69	NASA Thorad/Agena	USA	Sequential Collation of Range (SECOR)	580 x 605, 107°	Geodesy
S68-3	23 May 69	Titan IIIC	USAF	VLF Plasma Wave Detector: OV5-5	9334 x 61,051, 33°	Space Environment
			USAF	Solar Flare Particle and X-Ray Satellite: OV5-6	9254 x 61,046, 33°	Space Environment
			USAF	Solar Flare Particle and X-Ray Satellite: OV5-9	9320 x 60,982, 33°	Space Environment
S69-4	30 Sep 69	Thorad/Agena	USN	Radar Calibration Cone/Cylinder	488 x 505, 71°	Radar Calibration
S70-3	8 Apr 70	NASA Thorad/Agena	USA	TOPO-A	575 x 600, 107°	Geodesy
S70-4	16 Feb 71	Thor/Burner II	USN	Radar Calibration and Drag Spheres	421 x 447, 101°	Radar Calibration, Atmospheric Density
P70-1	8 Jun 71	Thor/Burner II	USAF	Celestial IR Measurements-1	311 x 298, 90°	Celestial Background
			USAF	Spacecraft Attitude Sensing Devices	311 x 298, 90°	Attitude Subsystem Development
P70-2	7 Aug 71	Atlas F/Dual OV1	USAF	Low Alt. Den. Sat. - Cannonball II	72 x 1064, 92°	Atmospheric Density
			USAF	Energetic Proton Analyzer (OV1-20)	72 x 1060, 92°	Space Environment
			USAF	Particle Energy and Flux (OV1-20)	72 x 1060, 92°	Space Environment
			USAF	Radar Tracked Density Satellite - Musketball	75 x 483, 88°	Atmospheric Density
			USA	Lincoln Calibration Sphere (LCS-4)	430 x 500, 88°	Radar Calibration

TABLE 1 (Cont.)

SPACE TEST PROGRAM

PAST LAUNCHES

Flight Number	Launch Date	Launch Vehicle	Payload Agency	Payload Title	Orbit (NM)	Area Investigated
P70-2 Continued			USAF	Grid Sphere Drag	426 x 499, 88°	Atmospheric Density
			USN	ELF/VLF Antenna Impedance and Plasma Effects (OV1-21)	432 x 498, 88°	ELF/VLF Signal Propagation
			USAF	Atmospheric Neutral Composition (OV1-21)	432 x 498, 88°	Atmospheric Composition
			USAF	Velocity Mass Spectrometer (OV1-21)	432 x 498, 88°	Atmospheric Composition
P71-2	17 Oct 71	Thorad/Agena	USAF	Celestial Mapping Program	432 x 434, 93°	Celestial Background
			USAF	Flexible Solar Array	432 x 434, 93°	Power Subsystem Development
			USN	Ionospheric Effects of Energetic Part. Interaction	432 x 434, 93°	Ionospheric Effects
			NSA	Command and Control Interfaces	432 x 434, 93°	Comm. Subsystem Development
S71-3	19 Apr 72	Thorad/Agena	USAF	Cold Cathode Ion Gauge	Low Earth, Polar	Atmospheric Density
			USAF	Nightglow Photometer	Low Earth, Polar	Atmospheric Physics
S71-5	25 May 72	Thorad/Agena	USAF	Ionization Density Gauge	Low Earth, Polar	Atmospheric Density
			USAF	Mapping of Atmos. Density and Composition	Low Earth, Polar	Atmospheric Density
P72-1	2 Oct 72	Atlas F/Burner II	ARPA	Gamma Spectrometer	399 x 411, 98°	Space Environment
			USN	Extreme UV Ionospheric Radiation	399 x 411, 98°	Atmospheric Physics
			USAF	Flux and Spectra of Low Altitude Particles	399 x 411, 98°	Space Environment
			USAF	Thermal Control Coatings	399 x 411, 98°	Material Properties
			USA	Radar Calibration Target (RADCAT)	395 x 406, 98°	Radar Calibration

P - Primary Mission

S - Secondary Mission

Total Number of Flights: 17

Total Number of Payloads: 55

TABLE 2

SPACE TEST PROGRAM

CURRENT ACTIVITIES

Flight Number	Launch Date	Launch Vehicle	Payload Agency	Payload Title	Orbit (NM)	Area Investigated
S73-7	4 Qtr CY 73	-	ARPA	ARPA Calibration Satellite	430 x 430, Polar	Infra-Red Calibration
S73-5	1 Qtr CY 74	-	USAF	Low Altitude Density	85 x 2000, Polar	Atmospheric Density
			USAF	Thermospheric Composition Studies	85 x 2000, Polar	Atmospheric Density
			USAF	Atmospheric Heating Sources	85 x 2000, Polar	Atmospheric Density
P73-3	1 Qtr CY 74	Atlas F	USN	Navigation Technology Satellite (NTS-1)	7500 x 7500, 125°	Navigation Techniques
S73-6	2 Qtr CY 74	-	USAF	Piezoelectric Accelerometer	130 x 500, Polar	Atmospheric Density
			USAF	Ionization Density Gauge	130 x 500, Polar	Atmospheric Density
			USAF	Atmospheric Variation Environment Studies	130 x 500, Polar	Atmospheric Density
			USAF	Dynamics of Polar Atmosphere and Ionosphere	130 x 500, Polar	Atmospheric Density
			USAF	Localized Atmospheric Density Variations	130 x 500, Polar	Atmospheric Density
			USAF	Low Altitude Trapped Part. Environment	130 x 500, Polar	Space Environment
			USAF	Auroral Zone Particles and Fields	130 x 500, Polar	Space Environment
P72-2	2 Qtr CY 74	Atlas F	USAF	Radiometers - 20 A/B	400 x 400, 98°	Earth Background
			DNA	Trans-Ionospheric Effects on Wideband Radio Signals	400 x 400, 98°	RF Signal Propagation
			USAF	Ultra-Violet Radiometer UVR	400 x 400, 98°	Earth Background
			USN	Preliminary Aerosol Monitor	400 x 400, 98°	Atmospheric Composition
P74-1	3 Qtr CY 74	Titan IIIC	USAF	Lincoln Experimental Satellites (LES 8/9)	Sync Alt, 23°	Advanced Communication Techniques
			USN	Solar Activity and Forecasting Satellites: SOLRAD 11 A/B	69,000 x 69,000, 23°	Solar Activities

TABLE 2 (Cont.)

SPACE TEST PROGRAM

CURRENT ACTIVITIES

Flight Number	Launch Date	Launch Vehicle	Payload Agency	Payload Title	Orbit (NM)	Area Investigated
S74-2	3 Qtr CY 74	-	USAF	Trapped Proton Monitoring	130 x 4750, Polar	Space Environment
			USAF	Low Energy Particle Spectrometer	130 x 4750, Polar	Space Environment
			USN	Electric Field Measurements in a Polar Orbit	130 x 4750, Polar	Space Environment
			USAF	Electric Fields - Ion Drift	130 x 4750, Polar	Space Environment
			USAF	Energetic Electron Environment	130 x 4750, Polar	Space Environment
			USAF	Magnetosphere H_2H_e Ion Abundances	130 x 4750, Polar	Space Environment
			USAF	ELF/VLF Antenna and Propagation	130 x 4750, Polar	ELF/VLF Signal Propagation

P - Primary Mission

S - Secondary Mission

Number of Flights under Contract: 7

Number of Payloads to be Flown : 25

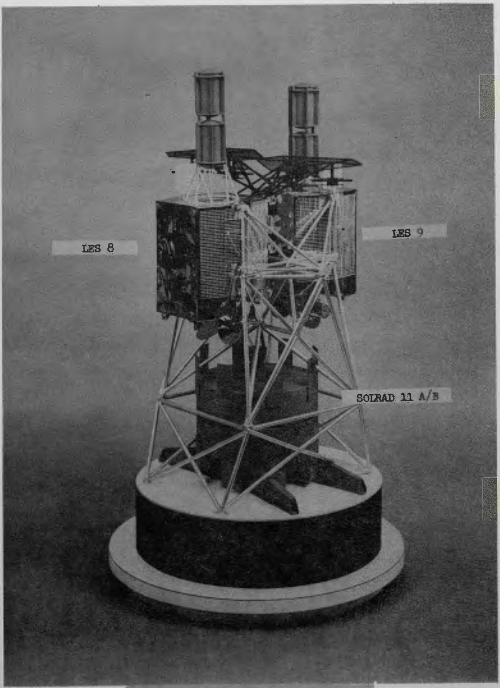

Figure 7

MODEL OF FLIGHT P74-1 CONFIGURATION

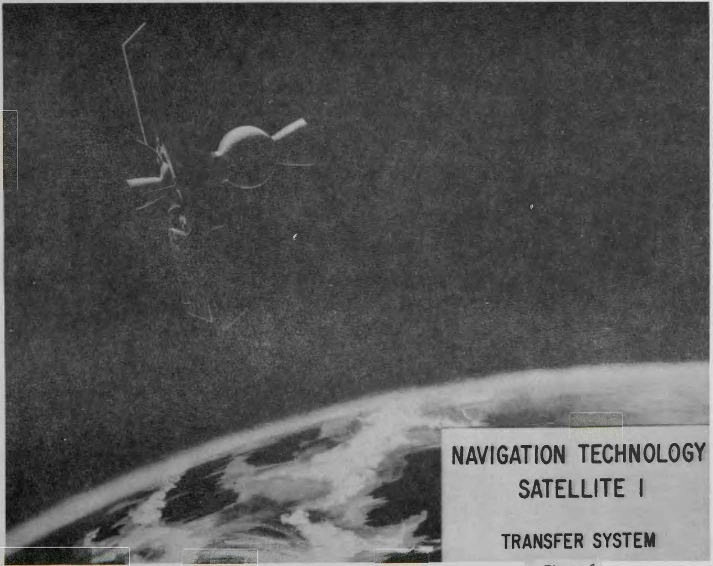

Figure 6

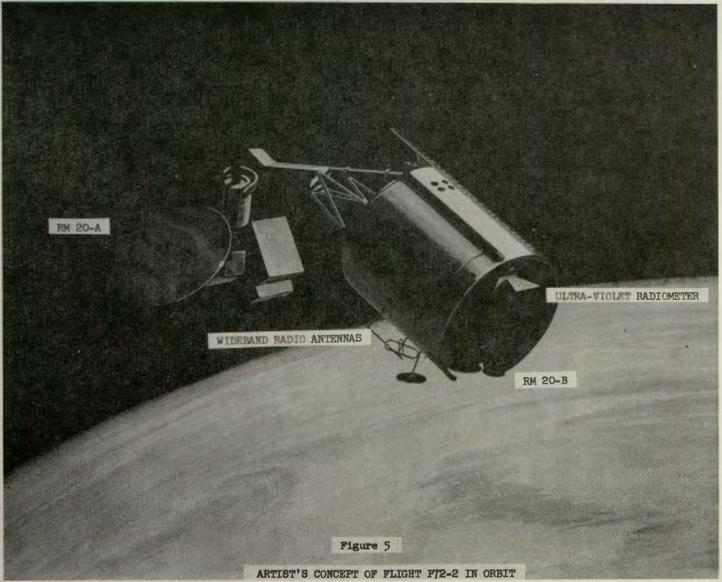

Figure 5

ARTIST'S CONCEPT OF FLIGHT F72-2 IN ORBIT

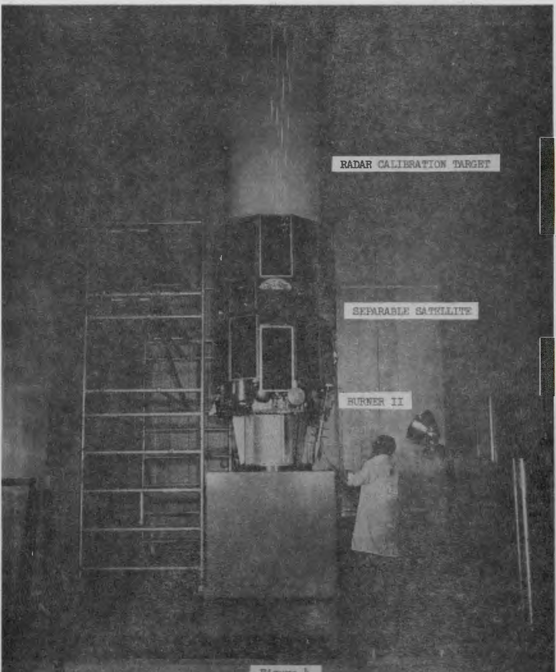

Figure 4

FLIGHT F72-1 CONFIGURATION ON SPIN TABLE

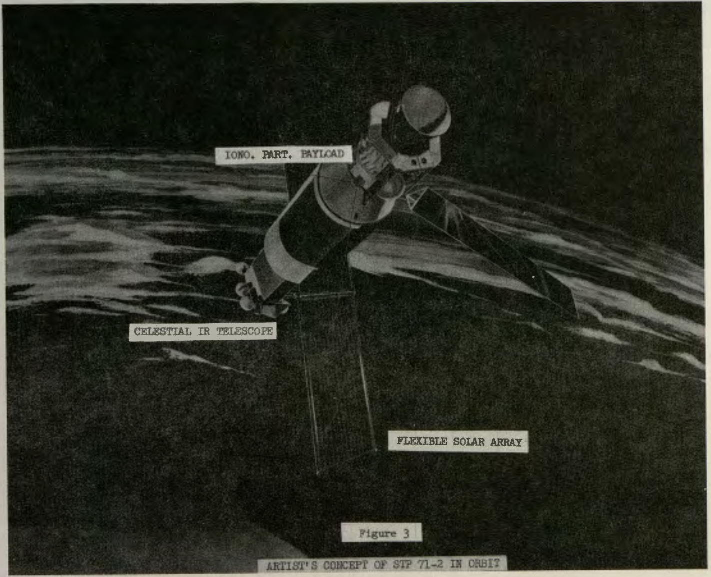

Figure 3

ARTIST'S CONCEPT OF STP 71-2 IN ORBIT

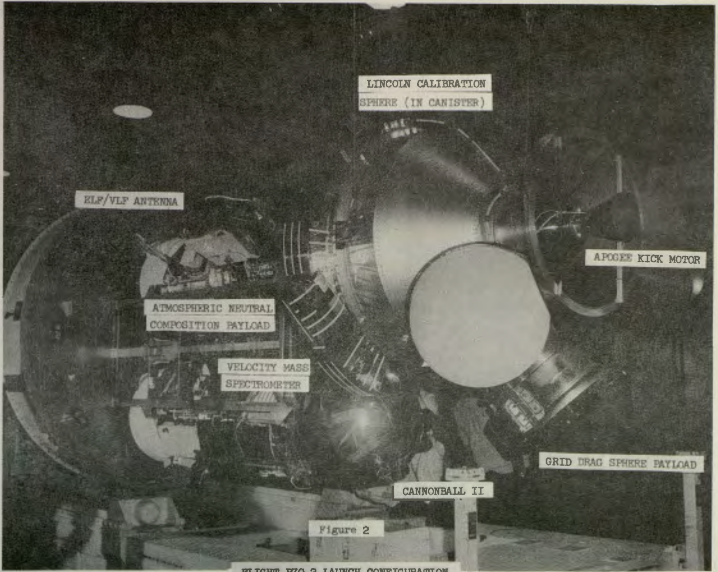

Figure 2

FLIGHT P70-2 LAUNCH CONFIGURATION