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OFFICE OF THE SECRETARY OF THE AIR FORCE

OFFICE OF SPECIAL PROJECTS

PROJECT 770

(STRAWMAN)

DESCRIPTION AND HISTORY

31 DECEMBER 1971

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SECTION I

GENERAL

A. MISSION

The mission for the STRAWMAN Project was to satisfy national ELINT (non-communications emission) requirements for overhead electronic reconnaissance of areas of interest.

B. ELINT REQUIREMENT

The ELINT requirement is divided into two functional categories:

1. ELINT search and technical measurement.

a. Provide data for the early identification of electronic emitters of weapon systems of interest.

b. Provide for technical analysis to determine emitter subsystem performance within the overall system.

c. Provide for the fine-grain measurement of specific emission characteristics as may be necessary to support the design of electronic countermeasures systems.

2. Electronic Order of Battle (EOB) and ELINT surveillance.

a. Provide a continuing capability to obtain the data necessary for accurate EOB information on specified weapon systems from any geographic area to meet both recurring EOB needs and needs resulting from crises or hostilities including the correlation of emissions to weapon systems as well as to specific emitters.

b. Provide a measure of activity levels, interrelationships and usage patterns for specified weapon system emitters for operational intelligence purposes.

c. Provide a continuing worldwide data base for support of warning and indications analysis of areas of interest.

SECTION II

PROJECT PLAN

A. BACKGROUND

The STRAWMAN Project was the last of a long series of stable low altitude ELINT satellites. The earlier efforts were known as the 698BK Program and the MULTI-GROUP/SETTER Project. These efforts were planned to operate from a few days to one month where the STRAWMAN vehicles were initially planned to operate from four to six months. After the operation of the first two STRAWMAN vehicles, the planned life was extended to nine months.

B. PLAN

The original STRAWMAN plan contained five vehicles and only the first three launch dates were firmly identified as July 1968, September 1968, and January 1969. The launch of vehicles four and five were tentatively scheduled at six months and 12 months respectively after vehicle three. However, as the project proceeded through the development phase the schedules were definitized as follows:

a. Production (Government acceptance or DD 250 data)

STRAWMAN	DATE
I (Flight Vehicle 2734)	March 1968
II (Flight Vehicle 2735)	July 1968
III (Flight Vehicle 2736)	November 1968
IV (Flight Vehicle 2737)	March 1969
V (Flight Vehicle 2738)	July 1969

b. Launch

FLIGHT VEHICLE	DATE
2734	July 1968
2735	January 1969
2736	July 1969
2737	January 1970
2738	July 1970

C. MANAGEMENT

1. The Under Secretary of the Air Force as Director, National Reconnaissance Office (DNRO) is responsible for the overall management of the ELINT project.

2. The Director of Special Projects (SAFSP) is responsible to the DNRO for the overall management of the STRAWMAN project.

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c. The Chief Systems Engineer and the Data Handling and Operations Branch are assisted by a staff of personnel from the Aerospace Corporation. This staff is responsible for the overall evaluation of all aspects of the STRAWMAN project and for making appropriate recommendations to the Air Force as to the Technical Direction which should be given to the contractors.

4. Additional support to the STRAWMAN project is provided by other SAFSP Deputy Directors. Their support includes:

a. Procurement of the Thorad booster and required launch services.

b. Procurement and management of the Command Generation and Mission Planning efforts.

c. Procurement of the Agena launch services and selected Agena equipment including the guidance package.

d. Insuring that the Satellite Control Facility (SCF) is adequately configured (equipment, software, personnel, etc.) to support the STRAWMAN project.

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SECTION III

BUDGET

Funds have been provided for the P-770 (STRAWMAN) Program from 1966 through 1972. During the early years of the Program (1966-67), funds were allocated to Signal Intelligence (SIGINT) Programs and were not specifically identified for each project in the ISGINT family. SIGINT included projects such as POPPY, P-11, and STRAWMAN within Program 770. Beginning in FY 1968, funds specifically allocated to STRAWMAN can be segregated from other SIGINT efforts. The following approach has been selected to provide STRAWMAN budgeting history.

a. Actual funding authorizations are provided by fiscal years from September 1967 through 1972. The early years' (1966 through 1967) funds have been estimated by fiscal year. These estimates are considered to be relatively accurate since they are made by individuals who managed the program during the early years. The FY 1968 approved budget has been selected as a typical budget to show individual line items. It was also the largest budget year in the history of the Program.

b. As of 31 December 1971, 0.974 million has been declared excess and identified for reprogramming.

TABLE I

BUDGET APPROVALS BY FY

FY 66		$ 7.000
FY 67		24.000
FY 68		75.000
FY 69		45.555
FY 70		22.698
FY 71		12.362
FY 72		3.432
	Total	$189.829
	Reprogram	.974
		$188.855

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TABLE II

FY 68 STRAWMAN APPROVED BUDGET

SAFSP White (3020)	
Spacecraft	23.476
BTL Guidance	.360
C&C Peculiars	1.400
Booster	5.288
Booster Launch	2.566
Agena	2.200
Agena Launch	2.000
Command Generation	.100
Aerospace	.810
Support Services	.225
Industrial Facilities	.075
Total White	$38.500
SAFSP Black (3020)	
Payloads	18.808
Spacecraft	12.787
MADS	3.800
Mission Planning	1.118
Total Black (3020)	$36.513
SAFSP Black (3600)	.769
	$37.282
TOTAL FY 68 STRAWMAN (770)	$75.782

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SECTION IV

SYSTEM DESCRIPTION

A. BOOSTERS

1. First Stage

a. The first stage vehicle (Thorad) was a long tank Thor SLV-2G/H (70.5 feet in length and eight feet in diameter), boosted by a 170,000 pound thrust main engine supported by two 1,060 pound thrust vernier engines. The liquid propellant consisted of liquid oxygen (oxidizer) and RP-1, a high grade of kerosene (fuel). The liquid engines were augmented by three Thiokol Caster II solid rocket motors that were jettisoned after burnout. The total impulse available from this booster was sufficient to accelerate a 18,000 pound spacecraft to a velocity of 12,500 ft/sec at the time of main engine cut off.

b. The flight control for the first stage was achieved through Western Electric Company (WECO) missile-borne guidance equipment (MBGE) Series 600, installed in the SS-01B forward rack, and a Control Electronics Assembly (CEA) in the SLV-2G/H.

(1) The CEA provided:

(a) SLV-2G/H pitch, roll, and yaw programs.

(b) Spent solid motor jettison signal.

(2) The MBGE (WECO) provided:

(a) SLV-2G/H pitch and yaw steering commands between 124 and 218 seconds after liftoff.

(b) SLV-2G/H main engine cut off and SS-01B sequence timer brake release.

(c) SLV-2G/H vernier engine cut off (WECO) and booster separation.

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(d) SS-01B pitch and yaw steering signals from engine ignition to 5° elevation (referenced to the Ground Guidance Station).

(e) SS-01B velocity meter enable.

The SLV-2G/H was equipped with FM/FM and PDM/FM/FM telemetry systems. Telemetry signals were transmitted via a pair of diametrically opposite blade antennas powered by a ten-watt transmitter.

2. Second Stage

a. The second stage was composed of a SS-01B Agena Space Vehicle (20.6 in. long, 60 in. diameter) permanently mated to a hammer head payload vehicle (80 in. long, 82 in. diameter).

b. The SS-01B propulsion system consisted of a dual burn liquid propellant (Bell Model 8096) rocket engine producing a nominal 16,000 pounds of thrust. The hypergolic propellants were Inhibited Red Fuming Nitric Acid (IRFNA), oxidizer, and Unsymmetrical Dimethyk Hydrazine (UDMH) fuel.

c. The major components of the SS-01B guidance and flight control system and their respective functions were as follows:

(1) Inertial Reference Package (IRP) - the primary attitude-sensing component of the guidance system. It contained three gyros each parallel to a vehicle axes which sensed angular displacement and generated error signals which initiated corrections.

(2) Horizon Sensor - an infrared detector which scanned the earth's horizon from each side of the vehicle. The two sensor heads scanned the space below the vehicle in conical patterns and detected discontinuity in the infrared radiation between earth and space.

(3) Flight Control Electronics Unit - processed attitude error signals from the IRP and developed output signals which energized the proper hydraulic actuators on the engine or pneumatic thrusters.

(4) Velocity Meter - the third sensing element of the guidance system which terminated main engine thrust after achieving predetermined velocity increment.

(5) Sequence Timer - provided one to five simultaneous switch closures at 24 discrete times during its total running time of 6,000 seconds.

d. The pneumatic system maintained vehicle attitude control during the coast phase between first and second burns. At near apogee of the transfer ellipse, the system reoriented the payload vehicle and initiated and terminated second burn which provided the necessary velocity increment to achieve circular orbit. Subsequent to termination of second burn, the system oriented the vehicle to its nose-down orbital attitude. The pneumatic attitude control system continued to maintain vehicle orientation until the twentieth orbit.

[redacted] 50X1

B. PAYLOAD VEHICLE

The payload vehicle includes the space frame structure which houses and supports the payloads, the electrical power subsystem, and the tracking, telemetry, and command (TT&C) subsystem.

1. The electrical power subsystem consisted of a three wing (25 panel)

solar array system, supplemented by three Type 25 (Silver-zinc) primary batteries, two 115V AC 400 cps Type 12B Inverters, two ± 28.3V DC regulated Type 9B Converters, and one Type 15A (115V AC 200 cps) Inverter. The inverters and converters conditioned power for use by the payloads and other vehicle equipment.

a. The solar arrays were designed to provide a minimum of 270 amp-hr/day for all sun incidence angles greater than 15 degrees. For sun incidence angles less than 15 degrees, the power system delivered a minimum of 230 amp-hr/day.

b. The batteries augmented the solar array power during the low sun angles and dark periods and the batteries were charged when the load was less than the solar array output.

2. The STRAWMAN TT&C subsystem includes the command system, the tracking and telemetry system, and the data storage system.

a. STRAWMAN was the first user of the Space Ground Link System (SGLS) which was used for both command and telemetry links and by ground stations to track the vehicle. SGLS is a standard FM telemetry system [redacted] with a standard IRIG FM telemeter for launch/ascent monitoring and a 128 kilobit PCM telemeter system for on-orbit monitoring. The command and tracking signal were multiplexed on a single RF carrier uplink to the vehicle. 50X1

b. Real time commands were processed by the DCP-20 programmer on board the vehicle and appropriate outputs were generated by the programmer to perform vehicle functions. Up to 1024 commands could be stored in the DCP-20 for execution when the vehicle was beyond the range of tracking stations. The DCP-20 controlled all on-orbit functions including payload turn on/off and operating modes.

c. The telemetry and tracking signal were multiplexed into a single RF carrier downlink to the tracking stations. Tracking data was input to SCF on computer for orbit determination and continual update of vehicle ephemeris. Wideband analog data was transmitted to the tracking station via ten watt, six MHz bandwidth transmitters on a separate downlink [redacted] from SGLS. A [redacted] command system was provided to backup the SGLS system, again as a separate uplink from SGLS. Both SGLS uplink and downlink were encrypted, KGR-29 (INSCOE) on the uplink and KGT-28 (GOODSPEED) on the downlink. The backup command system was encrypted with an INSCOE unit. All SGLS, DCP-20, wideband, and encryption equipments were redundant.

50X1

d. Payload wideband data was transmitted either in real time (calibration mode) or as stored data from the Data Storage Unit (DSU). Readout of all data from the DSU, regardless of payload source, was through one of two Type 12 UHF wideband transmitters. The DSU analog output from REAPER or THRESHER payloads recording consisted of pre-detected data with an information bandwidth of 0.5 to 5.5 MHz with reference tones at 46.875 KHz and 6 MHz. The DSU was a magnetic tape recorder incorporating solid state components, two-inch wide magnetic tape, and transverse scanning rotary heads. The .001-inch thick tape was coated on both sides. The two rotary head assemblies enabled recording on each side of the tape. In the "readin" mode, the data was frequency modulated and stored. In the "readout" mode, the rotary head "read" the frequency modulated information. The solid-state electronics within the DSU processed and demodulated the information and presented a signal that was approximately equal to that signal which was readin.

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e. Temporary storage of payload digital data and vehicle status data on board the STRAWMAN vehicle was provided by three Core Storage Units (CSUs). Each CSU was a 1,024,000 bit magnetic core memory divided into four equal stacks (256,000 bits each). Normal vehicle configuration had one CSU assigned to the THRESHER payload, one assigned to the REAPER payload, and the remaining unit assigned for vehicle status telemetry data (status telemetry CSU was time-shared with HARVESTER payload digital data on the STRAWMAN IV vehicle). The capability in vehicle existed to command any CSU to any one of the three input sources or to enable or disable any individual stack in any CSU. Input data control and readout of each CSU was independent of other CSUs and of vehicle configuration. Data rate to the CSU was 250 kilobit/sec and output data rate into the PCM telemetry was 128 kilobit/sec.

C. PAYLOADS

1. THRESHER

The THRESHER payload was one of the primary payloads flown on each STRAWMAN vehicle. These payloads were built by Airborne Instrument Laboratories, Inc., of Long Island, New York. The equipment provided electronic-reconnaissance and technical intelligence collection of radar signals. The THRESHER was capable of handling a large quantity of information and normally brings back hundreds of different intercepts each day. It has provided extensive general search, electronic order of battle, and technical intelligence information. It has a wide variety of modes of operation. It operates in four contigous bands: 124 to 260 MHz, 254 to 541 MHz, 524 to 1,069 MHz, and 1,038 to 2,144 MHz. It was remotely programmed for all or selected parts of these bands and for preselected signal recognition. The normal ground coverage is a 150 mile swath.

The THRESHER used amplitude and phase comparison of first and second order antenna modes to measure azimuth and elevation for location of the signal source. At the same time it also measured signal frequency, amplitude, pulse width, and interval. These measurements were done on a pulse by pulse basis and were furnished as digital words to the one million bit core storage unit. After ground processing, the signal sources were identified and were located to an accuracy of [redacted] There was also an analog pre-detected output which was recorded on the wideband (6 MHz) tape recorder. This was analyzed on the ground to provide detailed technical intelligence such as phase information and interpulse structure or coding. 50X1

2. REAPER

The REAPER payload was one of the primary payloads flown on each STRAWMAN vehicle. These payloads were built by LTV Electrosystems, Garland Division, Dallas, Texas. The REAPER payload was an ELINT receiving and data processing system designed to be operated as part of the STRAWMAN reconnaissance system. REAPER intercepted and output Electronic Order of Battle (EOB) and Technical Intelligence (TI) measurements on electronic signals radiating in the frequency range of 1.8 GHz to 3.3 GHz. The payload measured emitter

[redacted] 25X1 50X1

collection system. This accuracy was achieved with a single [redacted] 25X1 intercept. For that reason, the REAPER has been the primary source of EOB data. Output data consisted of a PCM digital stream which was stored in the STRAWMAN Core Storage Unit (CSU) and a 6 MHz pre-detected output which was recorded on the Data Storage Unit (DSU). Several programmable recognizers (eight on STRAWMAN I - III and 16 on STRAWMAN IV) provided actuating signals to initiate DSU recordings.

3. <u>CONVOY I</u>

The CONVOY I payload was built by Electromagnetic Systems Laboratories, Inc., of Sunnyvale, California, and was carried on STRAWMAN I (Vehicle 2734). The purpose of this equipment was to collect electronic technical intelligence on the Soviet "Dog House" ABM radar. The method used was to search, intercept, and frequency track the radar's lower and upper scan channels: [redacted] The intercepts were pre-detection recorded on the wideband (6 MHz) tape recorder along with internally generated descriptive digital words. The recorded data, after transmission to the ground, was processed and analyzed to determine signal characteristics such as frequency, amplitude, sweep rates, and interpulse information. During the life of the mission, there were more than [redacted] valid recordings of the signal. 25X1

25X1

50X1

[redacted]

5. <u>CONVOY II</u>

The CONVOY II payload was designed and developed by LTV Electrosystems Inc., Garland Division, Dallas, Texas, and was carried on the STRAWMAN II (Vehicle 2735). The CONVOY II collected signals from the large Soviet ABM radars known as [redacted] Dog House, and [redacted] 25X1 (formerly called [redacted] The frequency ranges of these three emitter 25X1 types were covered by five bands: 153 MHz to 163 MHz, covering [redacted] 25X1 [redacted] 380 MHz to 405 MHz and 400 MHz to 425 MHz, covering both beams 25X1 of [redacted] and 853 MHz to 918 MHz and 912 MHz to 977 MHz covering 25X1 the low and high beams of [redacted] Various modes of operation were 25X1 provided to optimize collection of the three target types either singly or in combination. This capability allowed investigation of possible emitter cooperation. Data output from CONVOY II consisted of 2.25 or 5.0 MHz bandwidth pre-detected data (depending on the mode selected) and 48 bit digital words which gave information on the operating mode and internal timer. Both of these types of data were recorded on the STRAWMAN Data Storage Unit (DSU). Recognition functions pre-set to the characteristics of the ABM emitters provided actuation signals for the DSU. The CONVOY system was mounted in the mid-section or "Granary Bay" of the STRAWMAN Payload Vehicle. Power and commands were supplied through the Payload Vehicle.

6. HARVESTER

The HARVESTER payload was built by Electromagnetic Systems Laboratories (ESL) Inc., of Sunnyvale, California. HARVESTER was an add-on payload on STRAWMAN IV (Vehicle 2737) designed to intercept the [redacted] 25X1 [redacted] The HARVESTER concept was to track a known emitter 25X1 location with a steerable high-gain antenna. The mission requirement to intercept low power signals from target emitter side-lobes dictated the system be capable of intercepting signals of approximately 1.6 kilowatts effective-radiated-power. The HARVESTER system consisted of a receiver unit, and antenna assembly containing two high-gain antennas and two omni directional antennas, and redundant antenna control electronics units. The antenna system was stowed for the launch/ascent phase and was deployed during the first orbit. The host STRAWMAN vehicle provided power, commanding, and telemetry as well as a three axis stabilized platform for HARVESTER. Since the vehicle ephemeris and the target locations were known, antenna pointing angles were computed on the ground and the necessary commands to steer the antenna were stored in the STRAWMAN on-board programmer. At the proper time, stored commands were executed to point the antenna at the required location and to continue tracking that point from horizon to NADIR (approximately six minutes). During the tracking period, the payload receiver scanned selected frequency ranges between 2 and 12 GHz. The payload output both digital and analog data for temporary storage in the STRAWMAN data storage units. Digital data included frequency, pulse width, pulse amplitude, and pulse-repetition-interval measurements. Analog data included pre-detected signals (4 MHz bandwidth) and detected video (250 MHz RF bandwidth, 0.5 MHz video bandwidth). The receiver frequency scan was controlled by five programmable sectors adjustable by command. The receiver could also be fixed tuned to any 2 MHz step in the 2 to 12 GHz range. Signals received outside the HARVESTER antenna main beam were inhibited so that only those signals from the designed target area were received. Non-inhibit operation was also selectable by command. HARVESTER had the capability to process both pulse and CW type signals. Analog and digital data stored in the vehicle was readout at an SCF tracking station, and processed at [redacted]

7. [redacted] 50X1

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D. <u>TESTING AND RELIABILITY PHILOSOPHY</u>

1. The STRAWMAN series of vehicles had greater capability and was more complex than its predecessors. It contained more than 125,000 electronic parts (not including 3.4 million ferrite cores). Project requirements dictated a design life of six months or more which in turn required the use of "high reliability" parts, fabrication techniques, quality control and testing procedures, as well as a moderate amount of equipment redundancy. The hi-rel procedures started with the individual parts and were carried through the final system tests. The success of the improvement was demonstrated when it was possible to extend the contractor incentive orbital life of the vehicle from six months to nine months after the first two flights.

2. The orbital vehicle was a hammerhead design, i.e., the nose (payload) section was appreciably larger in diameter than the second stage booster. This caused a higher than normal shock, acoustic, and

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vibration environment during launch. This required higher than normal levels of qualification and acceptance testing of the payload vehicle and equipment.

3. The Thor booster was tested to normal levels. Some of the Agena second stage forward rack equipment had to be tested to higher levels.

4. A qualification (or proof) unit of each subsystem was built and tested to environmental levels beyond those which it would see in use. These tests included ambient operation, shock, vibration, acoustics, vacuum, hot and cold temperatures, electromagnetic interference, and power surges.

5. Each flight component and subsystem underwent a series of acceptance tests which included voltage extremes, vibration, vacuum, hot, and cold temperatures. This was the "hot shake" regime which required that the equipment be operating during all of the environmental tests and that all the tests be completely rerun after any failure rather than the usual repair-and-continue procedure.

6. There were five complete system tests of each payload vehicle at the factory. Two were at ambient conditi ons. Two were in a large thermal-vacuum chamber where actual solar heating and shadow chilling extremes were simulated. Then there was a final system ambient test before shipment. During all of the system tests the vehicle was remote linked to the [redacted] 50X1 50X1

7. Prelaunch tests on the pad at the Western Test Range included the Orbit Simulation Vehicle Test where the Satellite Test Center (command generation by computer) working through the Vandenberg Remote Tracking Station (two-way radio link with the vehicle) commanded and controlled

the vehicle as if it were on-orbit. The telemetry and payload data was sent by the regular communication lines [redacted] 50X1 [redacted] where the normal computer processing was done. Thus, the actual computers, software, ground equipment, vehicle systems, and people were worked together before launch. In addition, the Satellite Test Center conducted an Orbit Simulation Rehearsal before each launch with all of the remote tracking stations which simulated a day of orbital support.

E. AEROSPACE GROUND EQUIPMENT

1. There are two sets of Aerospace Ground Equipment (AGE) which support STRAWMAN vehicles for integrated system tests. One set is located at LMSC, Sunnyvale, in the Bldg 156 factory assembly area and one set is located at the launch pad at the Western Test Range.

2. The AGE units use automated test sequences with inputs formatted on punched tape to duplicate orbital commands and to control signal stimulus. Outputs are routed by communication links to the [redacted] 50X1 [redacted] 50X1 compared to limits, sorted, and key points transmitted back to and displayed at the test areas. A complete test of all subsystems and all conditions can be done in twenty hours. Typically, the orbital simulation test in the thermal-vacuum chamber were performed over a continuous seven day period. Another four to six days were required for a ten-man team to completely review the data.

3. An additional feature at the launch pad is that the operational Satellite Test Center, the Vandenberg Remote Tracking Station, and the [redacted] can operate with the vehicle as if it were on-orbit, making use of the operational software. 50X1

F. OPERATIONS

1. Launch and Ascent

a. Prior to all launches extensive compatibility exercises were conducted between the launch pad, Vandenberg Tracking Station (VTS), the Satellite Test Center (STC), [redacted] and building 156. 50X1
Continuous countdown commenced nine hours prior to launch.

b. Just prior to launch the DCP-20 was enabled and was thereafter continously active. VTS tracked the vehicle during ascent and transmitted the vehicle telemetry to the STC for analysis. The first acquisition was at the Satellite Control Facility Indian Ocean Station where antennas were deployed and verified. The first payload data was recorded immediately following this acquisition. The second contact was Kodiac, Alaska, where solar arrays were deployed and verified. Hawaii was the next acquisition where the first payload data was readout.

2. Commanding and Readout

a. Commanding and telemetry readout of orbiting STRAWMAN vehicles was accomplished by Satellite Control Facility (SCF) tracking stations under the direction of a test controller at the Satellite Test Center (STC), Sunnyvale, California. Continuous 24 hour-per-day SCF support of STRAWMAN on-orbit vehicles has been required since the launch of STRAWMAN I. Tasking of the vehicles was directed by the Satellite Operations Center (SOC) through [redacted] Each STRAWMAN vehicle, in normal 50X1
operation, required more than a thousand command inputs per day, both stored and real time and in turn put out millions of bits of payload and telemetry data each day.

b. At the STC, requirements for stored vehicle commanding were submitted to the Command Generation Group. A command message for each on-orbit vehicle was generated normally once per day by Command Generation.

After two message checks at STC, the command message was transmitted via high speed telephone data lines to the primary and backup tracking stations. Each command message contained the required vehicle operation for one day's activity including payload readin periods and SGLS and wideband transmitter turn-on for tracking station acquisitions.

c. The command message was normally loaded five revs prior to the command becoming effective in the vehicle. If a problem prevented the command message from being stored in the vehicle on the planned rev, the same command message was loaded on one of the remaining four backup revs. To insure all command messages were correctly loaded in the DCP-20 prior to execution of any command, the entire DCP-20 memory was readout and a computer bit-by-bit comparison was made to the command message at STC immediately after loading.

d. There were normally 13 acquisitions per day by the SCF stations. The six SCF stations used to support STRAWMAN were located at New Hampshire, Vandenberg AFB, California, Hawaii, Guam, Kodiac, Alaska, and Thule, Greenland. During a normal station pass, the vehicle transmitters were turned on by command stored in the vehicle programmer just prior to reaching the station radar horizon. Normal checks of signal strength and general vehicle health were made immediately after the vehicle was acquired. If all checks were satisfactory, real time commanding was performed to readout stored PCM (digital) or wideband (analog) data, perform calibrations, or load the programmer. All SCF stations had the capability to readout stored digital data; only New Hampshire, Vandenberg AFB, and Hawaii had the capability to readout wideband data. After the vehicle passed beyond the radar horizon, the digital data was transmitted to the STC via MSORTR, a computer program used to send data over high speed telephone lines. Tapes of payload data recorded at the SCF stations were shipped to the pre-processing center [redacted] for analysis. There were times when the required elapsed time from target intercept to user delivery was six hours of less. It was sometimes accomplished in less than two hours. Special Time-Critical-Reporting (TCR) of digital data was accomplished using the MSORTR or a microwave link between Vandenberg AFB and [redacted]

50X1

3. Organizations and Computers

The following listing of operational functions, operating groups, and the computer used should help to visualize the ground support function:

a. Target list, mission planning and command generation

(1) SP command generation group (at STC)

(2) CDC 3800 computer (at STC)

b. On-Orbit Control, TM mode generation and orbit determination

(1) Field Test Force Director (FTFD) (at STC)

(2) CDC 3800 computer (at STC)

c. Bird buffer-couples STC and RTS computers

(1) CDC 160A computer (at STC)

d. Telemetry, tracking and command

(1) Remote tracking station personnel

(2) Input by and real time print out to FTFD (at STC)

(3) Univac 1230 computer (at RTS)

e. Telemetry decommutation and status analysis

(1) [redacted]

(2) [redacted]

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f. Payload data pre-processing and correlation

(1) [redacted]

(2) [redacted]

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g. Vehicle system tests and analysis

(1) Conducted by systems engineering test group (at Bldg 156)

(2) [redacted]

G. DATA PROCESSING

1. General

a. STRAWMAN data processing activities are performed at a [redacted] 50X1

This processing center processes both vehicle health and status data and payload data to completion, thus encompassing both NRO pre-processing functions and NSA processing functions and resulting in a finished product ready for distribution to consumers.

b. There are two distinct types of payload input data, and, therefore, two distinct chains of processing associated with each payload of the STRAWMAN vehicle. The digital portion of the payload records data by reducing signals observed to a PCM data stream. The analog portion of the payload records data on a wideband (6 MHz) tape in analog form to retain the internal parameter characteristics of signals observed. The analog portion operates only when alarmed by selected signals or pre-determined signal characteristics.

2. Digital Processing

The data processing system accepts the intercept data in SGLS format from the remote tracking stations. This raw data is reformatted for computer use. The computer then unpacks the payload word fields, applies temperature and calibration corrections, converts the data to engineering units and checks the data against parameter limits for error flagging. The data is then correlated with command information, separated by readin bursts, and merged with vehicle attitude and ephemeris information

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resulting in geopositioned pulse sets. These pulse sets are grouped on the basis of frequency, pulse repetition interval, pulse width and location. Pulse groups are then averaged to give single beam representatives of the grouped intercepts. The beam parameters are compared with the ELINT Parameter Limits (EPL) to identify the emitter as a specific type. This process is basically the same for all payloads on the STRAWMAN vehicles.

3. Analog Processing

The wideband analog tape is processed to obtain a directory which identifies each unique readin period represented on the readout tape. This directory is used as an aid for searching the tape during visual/manual analysis. Alternatively, this analog data is also digitized, merged with the directory information and processed in the computer as described above.

4. Processing Improvements

During the lifetime of the STRAWMAN system, data recovery and processing activities resulting in a report to a consumer were reduced from about 60 days to less than 24 hours. This was accomplished by optimizing data transmission methods from the remote tracking stations to the processing facility, by improving acquisition of required support data, and by updating the processing facility methods and equipment.

SECTION V

PROCUREMENT

The procurement of hardware, software, services and facilities for the STRAWMAN project was for the most part accomplished by personnel of Deputy [redacted] with technical assistance from STRAWMAN project officers assigned to [redacted] For the purposes of this report, the procurement effort has been segregated into two parts: Support and Primary. Support procurement is defined as those efforts that do not include the satellite hardware. Primary procurement is defined as those efforts directly related to the design, development, and evaluation of the satellite hardware.

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A. SUPPORT PROCUREMENT

The support procurement required participation by numerous SAFSP and Space and Missile Systems Organization (SAMSO) offices. A summary of major support procurement efforts, the management organizations, and the type of contract is listed as follows:

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SUPPORT SERVICE	MANAGEMENT ORGANIZATION	CONTRACT TYPE
Booster (Thorad)	[redacted]	FPI
Booster, Launch Services		CPIF
Booster, Guidance		FPI
Agena Launch Services		CPIF
Aerospace Support		CPFF
Command Generation		CPFF
Mission Planning		CPFF
Mission Analysis and Data Services (MADS)		CPFF

B. PRIMARY PROCUREMENT

1. The initial procurement (studies) for the STRAWMAN project was accomplished under the active contracts of the earlier project, MULTI-GROUP/SETTER. This procurement is significant relative to the STRAWMAN concept but is considered minor in cost when compared to the total project cost. Therefore, only the four major hardware contracts will be considered in this section. These contracts are:

a. [redacted] a CPIF contract with Lockheed Missiles and Space Company, Inc. (LMSC), Sunnyvale, California, for the Agena booster and most of the spacecraft subsystems, including: 50X1

(1) Analog recorders (DSU)

(2) Digital recorders (CSU)

(3) Communication system (SGLS)

(4) Programmer (DCP-20)

(5) Batteries, Silver Zinc (Type 25)

(6) Solar arrays

(7) Control Gyros (CMG)

b. [redacted], a CPIF contract with Lockheed Missiles and Space Company, Inc. (LMSC), Sunnyvale, California, for the payload vehicle, system integration and test, evaluation of on-orbit performance, and for the following add-on payloads:

(1) Convoy I

(2) [redacted] 50X1

(3) HARVESTER

c. [redacted] a CPIF contract with Airborne Instrument Laboratories, Inc. (AIL), Long Island, New York, for the THRESHER payload and the evaluation of its on-orbit performance.

d. [redacted] a CPIF contract with LTV Electrosystems, Inc., Garland Division, Dallas, Texas, for the REAPER and Convoy II payloads and the evaluation of their on-orbit performance.

2. Each of the primary contracts had a common exhibit for Performance Incentive (PI) which enabled the contractor to earn 15% fee on those costs subject to the PI. The common exhibit makes the STRAWMAN project unique because it was the first project to successfully apply a single complex formula for performance determination to three separate contractors. The STRAWMAN PI has proven to be valid and just in that it accomplished the purpose of obtaining the contractors' maximum effort and provided the government an efficient system at a reasonable price. Also, the STRAWMAN PI has been used as a model for several other SAFSP projects.

3. The significant facts about the primary contracts are listed in the following tables:

TABLE I

CONTRACT NUMBER	LETTER CONTRACT DATE	DEFINITIVE CONTRACT DATE	ORIGINAL CONTRACT TARGET COST	ORIGINAL CONTRACT TARGET FEE
[redacted]	30 Oct 66	2 Feb 68	33,255,939	4,737,477
	1 Aug 66	6 Oct 67	21,052,500	3,134,500
	1 Aug 66	9 Oct 67	19,240,020	2,853,082
	1 Aug 66	9 Oct 67	9,800,000	784,000

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TABLE II

AS OF 1 DECEMBER 1971

CONTRACT NUMBER	TARGET COST	ESTIMATED COST	TARGET FEE	PERFORMANCE FEE EARNED	PERFORMANCE FEE LOST	REMAINING FEE POTENTIAL
[redacted]	$38,145,633	$39,871,345	$4,530,828	$2,117,819	$ 774,041	$1,638,968
	28,464,173	29,942,516	3,423,758	1,447,055	529,733	1,446,970
	24,218,438	26,970,059	3,155,975	1,136,091	1,183,918	835,965
	14,539,830	15,480,203	1,673,649	1,017,000	282,000	379,000

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SECTION VI

STRAWMAN PERFORMANCE

A. ORBIT PARAMETERS

The STRAWMAN vehicles were launched into circular orbits at 275 N.M. altitude and at inclination angles of 75 degrees. This provided a complete orbit each 94.5 minutes or 15.3 revolutions around the earth each day. The ground coverage for target location (and other EOB) purposes was a 150 N.M. width swath so that any point on the equator was covered twice in a 9.4 day closure period and four times of 60° north (and south) latitude in the 9.4 day period. The only parts of the earth not covered were the areas within 825 N.M. of the North and South poles. The orbit was nonsynchronous so that target revisiting was done at continuously changing times of day. The above orbit is in a low drag region so that no makes up power is required to maintain the vehicle in orbit for more than five years.

B. PLANNED LIFE

The original planned life of the STRAWMAN vehicles was six months and the Performance Incentive (PI) (See Section V) of the primary contracts was based upon this plan. After the launch of STRAWMAN II (vehicle 2735), the planned life and consequently the Performance Incentive was changed to nine months.

C. VEHICLE PERFORMANCE

1. STRAWMAN I (Vehicle 2734)

a. Vehicle 2734 was launched from Vandenberg AFB on 5 October 1968. The booster was the standard Thorad and the Agena as modified for the STRAWMAN project. The spacecraft included the Agena, the payload vehicle, which contained STRAWMAN power and TT&C subsystem, and three payloads: THRESHER, REAPER, and CONVOY I.

b. The spacecraft achieved the following orbit:

(1) Apogee - 275.19 N.M.

(2) Perigee - 270.12 N.M.

(3) Inclination - 74.98°

(4) Period - 94.85 Min.

c. The REAPER payload performed in an excellant manner in both the EOB and TI modes throughout the entire flight.

d. The THRESHER payload provided useful EOB data in three of its four bands. In the lowest band (124 to 260 MHz) the data was not usable because the location accuracy was inconsistant and unacceptable. This anomaly was apparently caused by a broken antenna. The TI mode of THRESHER performed within specification.

e. The CONVOY I operated within specification and provided over 150 valid recordings of the signal of interest.

f. All TI data from vehicle 2734 was degraded in part because the analog recorders (DSUs) exhibited two problems.

(1) Start up synchronization could not always be maintained between the tape and the rotary heads. When this occurred the data was noisy.

(2) Oxide from the tape binder would sometimes adhere to the rotary heads during recorder read-out and would produce noisy data.

g. Vehicle 2734 experienced power system failure. After five and one half months of operation one of three batteries failed. The two remaining batteries failed after six and one half months. Subsequently, the vehicle operation was limited to high priority TI tasking and only REAPER EOB tasking.

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h. The operation of vehicle 2734 was terminated after 358 days of operation. The termination was necessary because of the severely degraded power system.

2. <u>STRAWMAN II (Vehicle 2735)</u>

a. Vehicle 2735 was launched from Vandenberg AFB on 31 July 1969. The booster was the standard Thorad and the Agena as modified for the STRAWMAN Project. The spacecraft included the Agena, the payload vehicle, which contained the STRAWMAN power and TT&C subsystems, and four payloads: THRESHER, REAPER, CONVOY II, [redacted] 50X1

b. The spacecraft achieved the following orbit:

(1) Apogee - 295.6 N.M.

(2) Perigee - 260.2 N.M.

(3) Inclination - 75.03°

(4) Period - 94.67 Min.

c. The REAPER payload lost frequency and "Y" phase information. Use of the Partial Scan Mode operation and modified data processing software resulted in the ability for REAPER to locate emitters with an accuracy of one to seven nautical miles.

d. The THRESHER payload provided useful EOB data in Bands 3, 4, and 5 (260 - 2,100 MHz). Band 2 (124 - 260 MHz) data location accuracy was inconsistent. Extensive calibration data was collected on Band 2 and used to apply differential correction factors to the intercept data. The differential corrections to Band 2 data improved the location accuracy but none of the data was shipped to the user.

e. The CONVOY II payload provided good TI data until the DSU 2 failure on day 75. Calibrations of the payload on days 81 and 128 indicated it continued to operate within specification.

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f. The [redacted] payload performed well throughout the entire life of the 2735 vehicle.

g. A malfunction of the solar array ampere-hour meter occurred on day 13. First indications of the problem caused concern about the health of the entire STRAWMAN vehicle power system. After considerable testing and analyses, it was concluded that the power system was performing normally and the problem was reduced to calibration of the amp-hour meter itself.

h. TI data collection with vehicle 2735 was temporarily stopped on day 4 after failure of one analog tape recorder (DSU). A complete loss of TI data occurred after day 75 due to failure of the redundant DSU. Both DSU failures were caused by relays in the control circuits resulting in both tapes being completely severed.

i. Operation of vehicle 2735 was terminated on revolution 11,109, 26 July 1971, after the second battery failed. The vehicle completed 725 days of on-orbit operation.

3. <u>STRAWMAN III (Vehicle 2736)</u>

a. Vehicle 2736 was launched from Vandenberg AFB on 26 August 1970. The booster was the standard Thorad and the Agena as modified for the STRAWMAN Project. The spacecraft included the Agena, the payload vehicle, which contained the STRAWMAN power and TT&C subsystems, and two payloads: THRESHER and REAPER.

b. The spacecraft achieved the following orbit:

(1) Apogee - 273.5 N.M.

(2) Perigee - 270.3 N.M.

(3) Inclination - 75.0°

(4) Period - 94.6 Min.

c. The REAPER payload performed in an excellent manner in both the EOB and TI modes throughout the entire flight.

d. The THRESHER payload performed normally in the EOB mode throughout the entire flight. Normal operation of the THRESHER TI mode using the signal recognizer function was lost on day 1 due to the load enable/disable relay becoming stuck in the load enable position. TI information output of the THRESHER was available if the DSU was placed in the steady state actuate mode. This mode was not used operationally; therefore, no THRESHER TI data was collected during the 2736 mission.

e. The TI data on Vehicle 2736 was excellent until rev 2,764 (24 February 1971) when wideband data out of DSU 1 was noisy. The problem was isolated to side 1 only of DSU 1, therefore only side 2 was used, thereby reducing record time for DSU 1 from 40 minutes to 20 minutes. The redundant unit, DSU 2, was selected on 26 March 1971 and full 40 minute record capability was restored.

f. The STRAWMAN power subsystem was degraded due to failure of one battery on 5 August 1971 (day 344). The second battery failed on 18 October 1971 (day 418). The third battery failed on 14 November 1971 (day 445) leaving only the solar arrays to supply power to the vehicle.

g. Vehicle 2736 is still operating on a "daylight only" basis using the solar array output to supply electrical power (as of 12 January 1972).

4. <u>STRAWMAN IV (Vehicle 2737)</u>

a. Vehicle 2737 was launched for Vandenberg AFB on 16 July 1971. The booster was the standard Thorad and the Agena as modified for the STRAWMAN Project. The spacecraft included the Agena, the payload vehicle, which contained the STRAWMAN power and TT&C subsystems, and five payloads: THRESHER, REAPER, HARVESTER, [redacted] 50X1

b. The spacecraft achieved the following orbit:

(1) Apogee - 286.3 N.M.

(2) Perigee - 270.1 N.M.

(3) Inclination - 74.992°

(4) Period - 94.6 Min.

c. The REAPER payload has performed perfectly in both the EOB and TI modes for the 2737 mission (as of 12 January 1972).

d. The THRESHER payload has performed perfectly in both the EOB and TI modes for the 2737 mission (as of 12 January 1972).

e. The HARVESTER payload performance was limited by two major problems:

(1) The Low Band System (2 to 8 GHz) completely failed. The most probable cause is an open circuit between the antenna and the receiver.

(2) The High Band System (8 to 12 GHz) intercept data was normal but the high band antenna freedom of movement is restricted by a short RF cable. The field-of-view is restricted in the positive roll direction and the antenna boresight alignment changes with antenna movement. The restricted field-of-view reduces the number of targets that could be tasked for any given rev. The change of boresight alignment was compensated for by adding bias correction factors to the antenna steering software.

f. The [redacted] payload performed perfectly for the 2737 mission (as of 12 January 1972). 50X1

[redacted] 50X1

h. Readout of TI data from DSU 1 on rev 519 indicated slow tape movement in the DSU. On rev 521, the redundant unit, DSU 2, was selected and normal TI operation was restored. On 17 November 1971, DSU 2 failed due to a failed control relay in the DSU. DSU 1 was reselected but slow tape movement was observed again. Evaluation of the problem indicated a potential risk to the entire vehicle power system if use of DSU 1 was continued. On 30 November 1971, all TI operation on Vehicle 2737 was terminated due to failure of the wideband DSU recorders.

i. Vehicle 2737 continues to be fully operational in the EOB mode (as of 12 January 1972) for the primary payloads (THRESHER, REAPER). HARVESTER High Band digital data continues to be excellent. [redacted] operation continues to be normal. The vehicle power subsystem and all other vehicle support subsystems are functioning within specification with no indications of problems or end-of-life. 50X1

5. STRAWMAN V (Vehicle 2738)

a. Vehicle 2738 has been manufactured and all testing up through box level has been completed. There has been no systems testing on Vehicle 2738.

b. The Thorad booster and the Agena procured for Vehicle 2738 have been reallocated to other users.

c. All equipment - flight hardware, AGE, STE, qualification units, facilities, and spares - will be declared excess on or about 16 February 1972.

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SECTION VII

DATA COLLECTED

A. TECHNICAL INTELLIGENCE

1. Technical Intelligence (TI) data consisted of wideband pre-detected signals recorded on magnetic tape. The data was recorded during wideband readout of the spacecraft at an SCF tracking station, and then these tapes were shipped to the preprocessing center [redacted] the tapes were checked for data quality, then a "Roadmap" (listing of signal parameters and time) of the data contained on each tape was made. Detailed processing and analysis was performed at [redacted] if required but normally the tape and its associated roadmaps were sent to NSA for detailed data analysis. 50X1 25X1

2. The TI data shipped to NSA for the STRAWMAN vehicles was as follows:

a. STRAWMAN I (2734)

966 DSU readouts - Actual DSU total time is not available; however, typical DSU readouts were five to seven minutes; therefore, an estimate of total DSU time would be about 96 hours of TI data.

b. STRAWMAN II (2735)

272 DSU readouts - Actual DSU total time is not available; however, typical DSU readouts were five to seven minutes; therefore, an estimate of total DSU time would be about 27 hours of TI data.

c. STRAWMAN III (2736)

736 DSU readouts - Actual DSU total time is not available; however, typical DSU readouts were five to seven minutes; therefore, an estimate of total DSU time would be about 73 hours of TI data.

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d. STRAWMAN IV (2737) - as of 1 December 1971

290 DSU readouts - Actual DSU total time is not available; however, typical DSU readouts were five to seven minutes; therefore, an estimate of total DSU time would be about 29 hours of TI data.

B. <u>ELECTRONIC ORDER OF BATTLE</u>

1. Electronic Order of Battle (EOB) data consisted of digital information containing emitter signal parameters and geographical location. Magnetic tapes of the data were recorded during SGLS readout of the spacecraft at an SCF tracking station. These tapes were sent to [redacted] for processing. Normal processing [redacted] included pulse geopositioning per readin, pulse grouping and validation for intercept identification, grouping of intercepts to form beams and correlating the resultant beam information with information contained on the ELINT Parameters List (EPL). The final output (ELK) was a frequency ordered print out of all intercepts and a best guess as to their type and position as compared to the EPL. The data volume of the final output (ELK) was approximately 1/100 of the data collection used for the input to the data processing system. 50X1

2. The EOB data (ELK) shipped to NSA for the STRAWMAN vehicles was as follows:

a. STRAWMAN I (2734)

(1)	REAPER	Total Intercepts	241,283
		Total Pulses	4,348,685
(2)	THRESHER	Total Intercepts	None - Band 2 not operative
		Total Pulses	3,922,698

b. STRAWMAN II (2735)

(1)	REAPER	Total Intercepts	74,491* assume freq.
		Total Pulses	937,942

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(2)	THRESHER	Total Intercepts	163,421**	D.C. not perfected (Band 2 not shipped)
		Total Pulses	396,802	

c. STRAWMAN III (2736)

(1)	REAPER	Total Intercepts Total Pulses	479,203 10,294,905	All data good quality
(2)	THRESHER	Total Intercepts Total Pulses	119,545 6,058,678	All data good quality

d. STRAWMAN IV (2737) - As of 1 December 1971

(1)	REAPER	Total Intercepts Total Pulses	208,484 5,013,044	As of 20 Nov 1971
(2)	THRESHER	Total Intercepts Total Pulses	68,582 7,195,977	As of 18 Nov 1971

(3) HARVESTER (Both Pulse and CW Information)

Digital Pulses	1,856,520	(as of 20 Nov 1971)
Pre-detected Pulses	152,162	(as of 11 Nov 1971)
Detected Video Pulses	635,314	(as of 25 Oct 1971)

Data quality for all payloads was excellent. This data collection rate was higher than any other vehicle operating against ELINT requirements.

C. TIME CRITICAL REPORTING

1. Time Critical Reporting (TRC) was collection of EOB data via the normal STRAWMAN system but readout, ground processing, and transmittal of the data to the user was expedited. Ground processing software and personnel used for TRC were the same as those used for normal EOB data processing except work was accomplished on an around-the-clock (24 hours per day), seven days per week basis rather than the normal work schedule.

2. The TRC Projects supported by STRAWMAN were as follows:

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PROJECT	PURPOSE/AREA OF COVERAGE	STRAWMAN SUPPORT (VEHICLE/DATES)	RESULTS
PENDULUM	North Vietnam, including Laos and Cambodia North Korea	2734 Jan 69 - Jul 69	77 revs. REAPER data. Payload readin to output data (TWX) averaged 15 hours
PENDULUM ECUMENIC SAWBUCK	See Above China Sino/Mongolian and Sino/Soviet Borders	2735 20 May - 15 Jul 70	167 revs. THRESHER and REAPER data. (Times not available)
FLAVOR	United Arab Republic	2736 27 Aug - 2 Sep 70	6 revs. THRESHER and REAPER data. Readin to TWX averaged 6 hrs 59 min.
POTPOURRI (Initially Project ACID TEST)	Warsaw Pact Exercise in East Germany, Poland, Czechoslovakia, and the Baltic Sea	2736 26 Sep - 19 Oct 70	30 revs. THRESHER and REAPER data. Average time: 7 hrs 46 min.
PENDULUM	See Above	2736 19 Nov 70 - 11 Feb 71	
PENDULUM/ ECUMENIC	See Above	11 Feb 71 - 1 Apr 71	96 revs. Average time: 4 hrs 47 min.
TANGIBLE	Navy Fleet Exercise of the coast of Southern California	2736 23 Feb - 3 Mar 71	18 revs total. 10 revs "special" mode to minimize time. Average time (10 revs only) was 1 hr 35 min.
LEMONWOOD	Large Scale Soviet exercise is south-western USSR and the Black Sea	2736 10 Jun - 21 Jun 71	21 revs. Average time: 5 hrs 0 min.
GRANADA	Ocean Surveillance ("Parasite" of other TCR projects in progress)	2736 22 Jun - 15 Nov 71 2737 16 Jul - 15 Nov 71	N/A

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PROJECT	PURPOSE/AREA OF COVERAGE	STRAWMAN SUPPORT (VEHICLE/DATES)	RESULTS
LONGBOAT	Expected Warsaw Pact Exercise in Bulgaria, Rumania, Hungary, Czechoslovakia, USSR, and the Black Sea	2737 9 Aug - 18 Aug 71	25 revs. Average time: 5 hrs 2 min.
"SPECIAL" GRANADA	Soviet Pacific Fleet Exercise in the Far [redacted]	2737 20 Aug - 30 Aug 71	35 revs. Average time: 4 hrs 46 min.
ROPEVAL	Second Navy Fleet Exercise (San Diego to San Francisco to Midway to Hawaii to San Diego)	2736 8 Sep - 17 Sep 71 2737 8 Sep - 17 Sep 71	28 revs. Average time: 2 hrs 48 min. 44 revs. Average time: 2 hrs 14 min.
FLAVOR	See Above	2736 16 Sep - 22 Sep 71 2737 16 Sep - 22 Sep 71	7 revs. Average time: 9 hrs 43 min. 7 revs. Average time: 3 hrs 0 min.
"SPECIAL" GRANADA	See Above	2737 23 Sep - 26 Sep	7 revs. Average time: 9 hrs 7 min.
ABSCOND	NATO Striking Fleet Atlantic Exercise in Norwegian Sea	2736 24 Sep - 4 Oct 71 2737 24 Sep - 4 Oct 71	72 revs. Average time: 8 hrs 14 min. 78 revs. Average time: 4 hrs 57 min.
PALMWOOD	Follow Soviet Naval Group in Atlantic Ocean enroute from the Mediterranean Sea to the Carribbean Sea	2736/2737 18 Oct - 28 Oct 71	69 revs. Average time: 4 hrs 40 min.

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SECTION VIII

PROJECT EFFECTIVENESS

A. ORIGINAL PROJECT CONCEPT

1. Schedule: The STRAWMAN project as originally conceived was to meet the stated mission and ELINT requirements with five spacecraft for the period of July 1968 through July 1970, or a total of 25 months.

2. Price: The exact original project price is not available because of the funding techniques (See Section III) at the time of STRAWMAN conception. However, the negotiated price of the four primary contracts is known (See Section V). These prices total to $94.7 million. Also, we know the actual price for the primary contracts to be $115.5 million.

B. PLANNED vs EXPERIENCED EFFECTIVENESS

In the following paragraphs and diagrams, one will see that the STRAWMAN was extremely effective. This will be shown by comparing the original contract target price to the experienced price and by comparing the expected useful life of the payloads to the actual time they were functional. By referring to the STRAWMAN effectiveness chart, one can see the expected life of a vehicle was six months. The actual life was over 12 months per vehicle. The original plan called for five vehicles to be used to provide mission coverage for two years. Actual coverage was at least four years accomplished by four vehicles. Another observation that can be made is to compare the cost per month for mission coverage. The figures shown are the cost for the four primary contracts and are not total program cost. They can, however, be used to show that coverage cost per month was at least 40% less than originally expected. As mentioned earlier, this was achieved with four vehicles. The fifth was manufactured but was not required to be launched.

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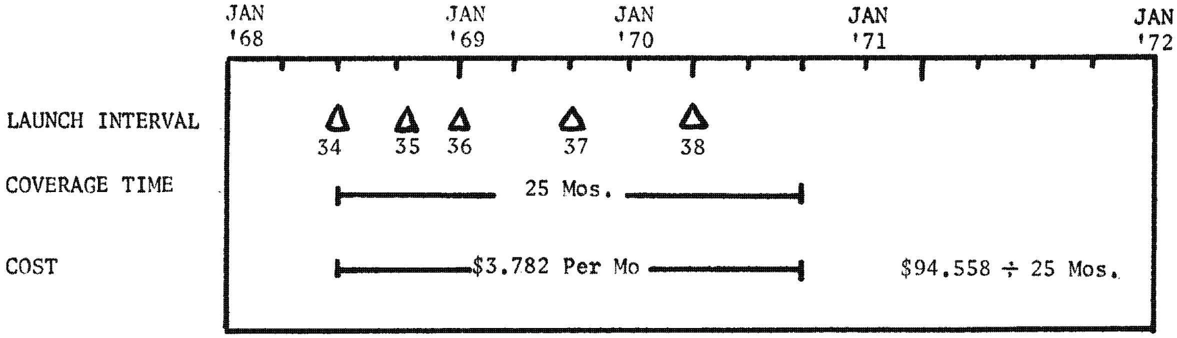
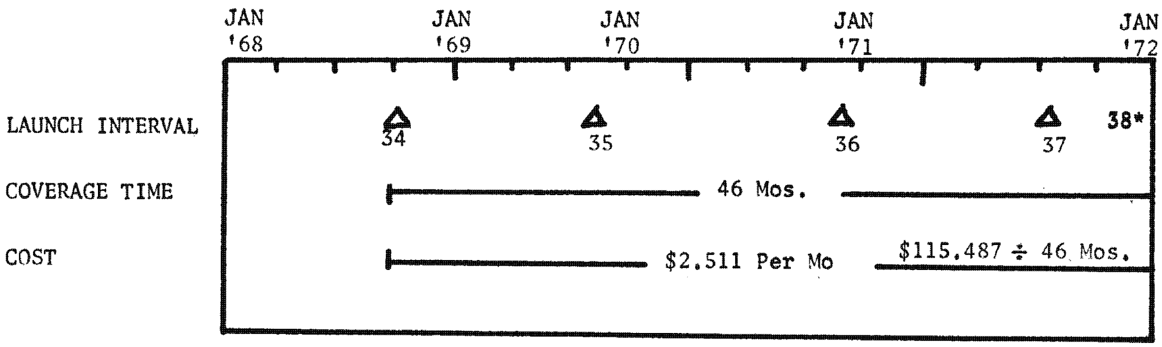
STRAWMAN EFFECTIVENESS

FORCASTED MISSION LIFE AND COST



ACTUAL MISSION LIFE AND COST



*38 Produced Not Required to Launch

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C. SUMMARY

The total all up price of the STRAWMAN project (four vehicles launched only) is approximately $172.855 million. This price includes all costs associated with the support contracts (See Section V) and the special add-on payloads but does not include the manufacturing and initial testing costs of STRAWMAN V (vehicle 2738). Therefore, the average price of the STRAWMAN vehicle, as flown and supported, was $43.213 million.

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