~~TOP SECRET~~

DEPARTMENT OF THE AIR FORCE
DIRECTORATE OF SPECIAL PROJECTS (OSAF)
AF UNIT POST OFFICE, LOS ANGELES, CALIFORNIA 90045

BYE-70792-67

29 August 1967

REPLY TO
ATTN OF: SP-1

SUBJECT: Summary Analysis of Program 206 (GAMBIT)

TO: Director, NRO (Dr. Flax)

1. On completion of Program 206 (GAMBIT), I asked [redacted] to undertake a summary analysis of the overall program. This report is his work. I believe that you will find it interesting, including all of the appendices as well as the summary discussion.

2. With the exception of one Agena failure and one Atlas failure, both of which resulted in no orbit being attained, all of the mission catastrophic failures and most of the other serious failures were in GE equipment. Some payload difficulties existed throughout the program lifetime but no payload difficulty seriously affected the accomplishment of the primary objectives of any mission. Note that, although only four payloads clearly exceeded (bettered) the specification on resolution, 11 more were at the very threshold of bettering it, as may be seen from the graph on resolution versus flight number in Attachment 2.

3. On an overall basis, considering all SAFSP contracts on the program, including our estimate of final figures as explained in the report, the principal contractors earned the following fee as a percent of actual cost (obviously a higher percent of the original target costs where actuals exceeded target, lower where actuals were under target):

GE	5.6%
LMSC.....	7.4%
EK.....	7.7%

4. The new incentive applied to 19 of the last 20 vehicles of the GE -580 contract; 15 of these vehicles were flown, of which 14 were generally successful, with an average performance score of 86.3%.

5. The difficulties encountered in this program are not necessary characteristics of this business. As an illustration, we have drawn

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HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

heavily on this experience in laying out and proceeding with Program 110 (GAMBIT-3). It is a much more complex system, and the comparison of the first seven flights with the GAMBIT experience illustrates the degree to which we have been successful in this regard.

JOHN L. MARTIN, JR
Brigadier General, USAF
Director

1 Atch
Analysis of Gambit Project
24 Aug 67 w/5 Atch

TOP SECRET

DEPARTMENT OF THE AIR FORCE
DIRECTORATE OF SPECIAL PROJECTS (OSAF)
AF UNIT POST OFFICE, LOS ANGELES, CALIFORNIA 90045

BYE-70792-67

24 AUG 1967

REPLY TO
ATTN OF: SP-2

SUBJECT: Analysis of GAMBIT Project

TO: SP-1 (Gen Martin)

1. Purpose and Scope

a. This paper analyzes the effectiveness of the recently completed GAMBIT (206) project, which launched 38 missions, all but two of which achieved orbit. One of the 36 orbiting missions was not recovered.

b. The following parameters are addressed: intelligence, operations, technical, procurement, and cost.

c. The Quarterly Program Review as of 31 Dec 1966 (BYE 66207-67) contained a summary comparison of GAMBIT operations in calendar years 1965 and 1966. Portions of the data on which that comparison was based were in error, and are superseded by correct data in this analysis.

d. This basic paper summarizes the results of the analysis. The attachments contain details in narrative, tabular and chart form.

2. Intelligence

a. Photographs of [redacted] intelligence targets were recovered during the life of the GAMBIT project. Not all of these were useable because of cloud cover or degraded resolution. The total number of targets photographed as used in this analysis does not distinguish between target priorities, mono versus stereo, or resolution obtained.

b. GAMBIT provided the intelligence community with the first high resolution (2-3 ft) satellite photography of denied areas. The community has stated that the intelligence value of this photography was extremely high.

c. There was steady growth in the capability of the GAMBIT system to obtain photography, as seen in the following table of calendar year averages.

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Targets Photographed

CY	Per Flight	Per Day	Per Rev
63	[redacted]		
64			
65			
66			
67			

d. The contract specification for GAMBIT ground resolution was 2 to 3 ft (135 lines/mm). The total take of any single mission contained photographs with a variety of resolutions because of flight and ground conditions. Considering only the best resolution obtained on any flights, the results of the 36 missions achieving orbit may be tabulated as follows:

Resolution	Number of Flights	%
[redacted]	4	11.1
2 to 3 ft	21	58.3
3 to 10 ft	3	8.3
Worse than 10 ft	7	19.5
Not recovered	1	2.8
TOTAL	36	100%

e. Thus, 69.4% of all flights obtained some photography that was within specification, 27.8% obtained photography worse than specification and 2.8% obtained no photography.

3. Operations

a. The system was originally designed for a nominal 5-day life,

but operations began with shorter planned orbital lifetimes. The first 5-day mission was No. 17, nearly two years after No. 1. Lifetimes were extended to 6 days by mission No. 26 and to 8 days by mission No. 30. The 36 flights achieving orbit had the following orbital lives:

Days	Number of Flights
8	7
7	2
6	4
5	4
4	8
3	1
2	5
1	5
Total	36

b. Of 36 recovery attempts, 35 capsules were successfully recovered by air. On mission No. 13, which had flown 4 days (67 revs), the recovery vehicle separated but there was no retrofire. The capsule impacted in the ocean and was lost.

c. The 36 orbiting vehicles accomplished a total of 2,716 operational revs (before RV separation) or a total of 169.745 operational days. Of these, 136.445 operational days (80.4%) were acceptable, i.e., days in which the satellite operated so as to permit a mission which could achieve 75% of the planned reconnaissance. On the other 19.6% of the days, system anomalies degraded performance.

d. The first three flights were planned in the "hitch-up" mode, wherein the Agena stage did not separate from the OCV. Only nadir photography was possible.

4. Technical

a. Major problems encountered in development, test, production and operation can be categorized into the following divisions:

(1) Deficient handling, selection, testing and quality control of parts and components.

(2) Inadequate design

b. Changes in procedures, 100% selection of piece parts, additional testing and emphasis on quality control solved most of the deficiencies in parts and component failures. Some of the most significant of these were

(1) Redesign of harness connections and potting procedures eliminated a rash of early electrical problems where connecting pins were bent or pulled loose.

(2) In analyzing a DC powe r supply problem several black boxes were opened which disclosed faulty wiring, contamination and lack of thorough inspection. This disclosure resulted in increased emphasis on quality control, but also prompted a new series of thermal vacuum and shake tests in order to identify possible failures prior to launch. In addition identical tests were instituted at the factory and at Vandenberg to disclose failures occurring during shipment.

(3) A serious battery problem occurred which was traced to a change in design not accompanied by a necessary change in procedure. The battery exploded damaging critical flight components. A vent line to the vehicle's exterior was added to minimize recurrence, and battery checkout and fill procedures were updated.

(4) A series of servo failures on the crab and stereo systems were traced to improper handling of parts; lead screws were cut down to fit without reanodizing, allowing contaminants to build up when operated on orbit.

c. The possibility of the command system issuing false commands when triggered by voltage transients was never completely solved. Logic circuits were "hardwired" into the vehicles that prevented the operation of simultaneous commands which together would be catastrophic.

(1) The inability of the horizon sensor to discriminate between sky and very cold earth areas resulted in loss of stability. This started

a development cycle on a new sensor, some models of which were flown on the Agena for testing. However, because of cost and long lead times, a procedure was adopted to turn off the sensors and go inertial over those cold earth masses. Further development was discontinued.

(2) Impingement of cold gas from the roll nozzles resulted in a forward thrust to the vehicle destroying accurate position knowledge. The nozzles were moved back for one flight and studies were made as to moving them outward from the vehicle. Instead, we were able to calculate the added thrust for each roll accurately enough to discontinue further development.

(3) One capsule loss because of anomaly in ejection programmer led to a design of redundant wiring within the recovery vehicle.

(4) Electro-magnetic interference throughout the vehicle resulted in a series of changes. A power amplifier was removed from the telemetry transmitters, but signal strength remained sufficient for operation. The 6-volt power supply was filtered and refiltered many times to reduce interference with the command system. This problem was never really solved. Interference in the horizon sensor system from the Rate Attitude Gyros and the stabilization amplifiers started a study in elimination of the RAGS. This turned out to be too difficult and a replacement system was not available, so the gain was reduced along with a reduction in sensitivity of the sensors.

(5) Beginning with the second flight, failures persisted with the environmental door. The original pneumatic actuator was eventually backed up by an electric motor. Then the pneumatic system was discarded in favor of an all-electric system with a pyro backup to guarantee a fail-open condition. The first flight of the electric system failed because of a switch relay - which was then changed to a magnetic type.

(6) An outer shield separation failure because of a buildup of tolerances and a change in design of a pyro by the vendor resulted in a new, stronger pyro and some design changes in the separation mechanism.

(7) Polystyrene capacitors were eliminated from the primary camera drive system and from the supply torque motor after a number of failures. The wrong type of lubricant resulted in variable running rates for the platen drive motor.

(8) Degradation in results was traced to thermal effects on the primary and stereo mirrors. A new design resulted in segmented potting of the mirrors to the casing. Also the temperature specifications were changed during optical testing at the factory and at the launch base.

(9) Some servo failures were caused by arcing between relay contacts and case. This was corrected by modifying the design, purchasing new relays, and reinspecting decoders.

d. Although it is believed (erroneously) in some quarters that once a space project becomes operational, the quantity of technical changes decreases significantly, the GAMBIT experience was to the contrary, and in this respect was typical of all reconnaissance satellite effort. It was necessary to introduce technical changes throughout the entire life of the GAMBIT project for two reasons: to correct design deficiencies which usually resulted in on-orbit anomalies and to improve the operational effectiveness of the system. As an illustration of these changes, Atch 6 shows the Contract Change Notifications (CCN) history of GE-580, the contract on which the last 20 OCVs were procured. The originally negotiated price of [redacted] was increased by the technical changes (and also to a slight degree by a cost overrun) to [redacted] a growth of 73% over the three year period of performance. These changes were all necessary, and in fact were the means by which the operational performance was improved significantly during the later stages of the project.

5. Procurement

a. Of the total dollar cost of the GAMBIT project, nearly [redacted] was incurred on SAFSP contracts and the remaining [redacted] on SSD and CIA contracts.

b. The SAFSP contracts were of the following types:

	Total	White	Black
CPFF	10	8	2
CPIF	14	12	2
FFP	5	4	1
L/C (terminated)	1	1	0
	30	25	5

c. The most significant procurement development on the GAMBIT project was the introduction of a new incentive structure devised by Gen Martin. Previous structures, written at a time when cost was the principal concern and the effect of GE workmanship problems on flight performance was not yet apparent, had emphasized cost at the expense of performance. Under the new structure, the only way the contractor could earn fee was by successful in-flight performance. There were only negative incentives on cost and schedule, to insure responsible financial and production effort by the contractor. (Atch 4 describes the structure.)

d. Cost experience on the major contracts was:

(1) Eastman:

While CPFF, over-ran [redacted] (6.7%)

While CPIF, under-ran [redacted] (4.2%)

(2) GE:

-76	(CPFF)	over-ran	(7.3%)
-155	(CPIF)	over-ran	(3.8%)
-432	(CPIF)	over-ran	(7.1%)
-580	(CPIF	over-ran	(26.2%)
-7705	(CPFF)	over-ran	(.9%)
-2106	(CPIF)	broke even	

[redacted]

(3) LMSC:

-92	(CPFF)	Over-ran	[redacted]	(2.8%)
-506	(CPIF)	under-ran		(3.9%)
-670	(CPIF)	under-ran		(7.3%)

e. Schedule experience showed that GE consistently lost fee on schedule, and only [redacted] gained fee in this parameter. Since the OCV was the pacing component in the system, GE schedule delays impacted on the launch dates.

f. Performance experience showed fee gain by all contractors except on GE -155 (smallest GE contract for 4 OCVs) which lost [redacted] on performance. Contracts having the old performance incentive showed small fee gains for performance. The only contract with the new performance incentive (GE-580) showed a fee gain of [redacted] for the performance parameter (of a possible gain of [redacted]; however, cost and schedule penalties resulted in a net fee loss.

g. Of all the GAMBIT contractors, GE posed the greatest workload by far in contract administration. Agreements reached at top management level were disseminated to lower levels slowly and/or with varying accuracies of interpretation. Positions taken during negotiations were more often intractable, resulting in discontinuance of negotiations. There were frequent disputes concerning whether directed work was within contract scope, and a growing tendency to request new contractual coverage for all minor directions from the SAFSP project office. These, combined with other examples too numerous to mention here, reflected unfavorably on GE's capability to manage the project. This is confirmed by Gen Martin's letters to DNRO in 1965 (BYE 40317-65 and BYE 40329-65) in which the poor GE performance was documented.

6. Cost

a. As of 30 June 1967 the GAMBIT project had cost [redacted] Final contract settlements over the next few years will cause minor changes in this amount.

b. The [redacted] includes the [redacted] cost of hardware purchased for GAMBIT but reallocated by DNRO without reimbursement to other SAFSP projects. [redacted]

c. The non-recurring costs for development, industrial facilities, and one-time support totalled [redacted] or 24.3% of the total program cost. Two-thirds of the development cost was for development of the satellite vehicle by GE, and 18% was for development of the payload by EKC.

d. Determination of unit costs is difficult because of overlapping contract periods and fiscal year accounting. It is possible to make a fairly accurate division of the recurring costs into two groups: those associated with the first 10 flights and those associated with the last 28 flights. On this basis the unit costs of a GAMBIT flight averaged [redacted] for the first 10 and [redacted] for the last 28.

e. On a more arbitrary basis, the recurring costs were allocated to the vehicles flown in each calendar year, i.e., the cost of the four flights in CY 1963 was determined to be [redacted], etc. This allocation gives the following comparisons [redacted]

	63	64	65	66	67
Average Cost per flight	[redacted]				
Average Cost per day in orbit					
Average Cost per target photographed					

f. It is perhaps more meaningful after a project is completed to lump all costs (recurring and non-recurring) into one total and then determine the above averages. This gives [redacted]

Average Cost per flight	[redacted]
Average Cost per day in orbit	
Average Cost per target photographed	

7. Summary

The GAMBIT project can be said to have been highly successful in that:

a. It produced the first high resolution satellite photography and thus filled the gap created by the cessation of U-2 flights following the Powers incident.

b. Its record of successful launches, orbits and recoveries far surpassed the records of earlier systems, especially during comparable periods of the initial four years.

c. It advanced the state of the art to the point where a follow-on larger system could be developed and flown so successfully that GAMBIT could be phased out.

d. The record of cost control showed a steady decrease in cost of days in orbit and cost of targets photographed.

e. Specific technical, procurement and cost problems successfully resolved during the GAMBIT project improved the capability of SAFSP, and indeed the NRO, to prosecute other satellite projects.

[redacted]

[redacted] Colonel, USAF
Vice Director

5 Atch
1. Proj history and list of flts
2. Graphs
3. Flt anomalies
4. Procurement Data
5. Cost Data

Attachment 1

Project History

1. A detailed historical record of the GAMBIT project is contained in the official SAFSP history being compiled by Mr Robert Perry. Volumes completed to date are on file in SP-3. Following is a summary of a few key points.

2. GAMBIT was the first NRO satellite project to produce reconnaissance photographs with high (2-3 ft) ground resolution. (The CORONA project, which began earlier and is still operating, produces photography of 8-15 ft resolution. In the SAMOS series, the one E-1 flight achieved about 100 ft resolution, the one E-5 camera flight (LANYARD) achieved 7-12 ft resolution, and no photography was recovered from the five E-6 flights.)

3. The photography produced by GAMBIT has been extremely valuable to the intelligence community.

4. GAMBIT has been managed entirely by SAFSP, which office had complete responsibility for development, production and operation of all system components. This contrasts with CORONA, where the CIA has responsibility for the sensor subsystem. For cover purposes, GAMBIT was overtly placed under ostensible SSD management until Dec 1962, when the overt assignment was changed to SAFSP; however, SAFSP covertly had the complete management responsibility from the outset.

5. There were a number of overt designators used throughout the life of the GAMBIT project:

Sep 1961	Exemplar
Dec 1961	Cue Ball and 483A
Feb 1962	698AL
Aug 1962	206

6. After earlier SAFSP parametric work had established feasibility, official GAMBIT go-ahead was given in Sep 1961. The first flight was launched 12 Jul 1963 and the thirty-eighth and final flight was launched

4 June 1967. The first three flights were flown in the "Hitch-up" mode, wherein the Agena stage was not separated, but orbited attached to the Orbital Control Vehicle (OCV). In the remaining thirty-five flights, the Agena was programmed to separate and the OCV was the orbiting vehicle.

7. Principal components and their manufacturers were:

Payload	EKC
OCV	GE
RV	GE
Agena Stage	LMSC
Atlas Booster	GDA
S/I Camera	Itek
Horizon Sensor	Barnes

8. During the life of the project there were these changes in key personnel:

a. DNRO:

Sep 1961 - Mar 1963	Dr J V Charyk	(Initial Development)
Mar 1963 - Sep 1965	Dr B McMillan	(Final Dev and 22 Flights)
Sep 1965 - Jun 1967	Dr A H Flax	(16 Flights)

b. Director of Special Projects:

Sep 1961 - Jun 1965	Gen R E Greer	(Dev and 19 Flights)
Jul 1965 - Jun 1967	Gen J L Martin Jr	(19 Flights)

c. Project Director:

Sep 1961 - Dec 1962	Col Q Riepe	(Initial Development)
Dec 1962 - Aug 1966	Col W G King Jr	(Final Dev and 31 Flights)
Sep 1966 - Jun 1967	[redacted]	(7 Flights)

9. The following pages contain a list of the thirty-eight GAMBIT launches.

List of GAMBIT Flights

Sequence	OCV#	Launch Date	Orbit	Orbital Revs	Days on Orbit: Total	Days on Orbit: Acceptable	Targets Photographed	Best Ground Resolution (ft)	Recovery
1	951	12 Jul 63	Yes	18	1.125	.50	[redacted]	3.5	Yes
2	952	6 Sep 63	Yes	34	2.125	2.125		2.5	Yes
3	953	25 Oct 63	Yes	34	2.125	2.125		3.0	Yes
4	954	18 Dec 63	Yes	18	1.125	0		N/A	Yes
5	955	25 Feb 64	Yes	34	2.125	0		N/A	Yes
6	956	11 Mar 64	Yes	51	3.188	3.188		3.0	Yes
7	957	23 Apr 64	Yes	66	4.125	4.125		2.5	Yes
8	958	19 May 64	Yes	34	2.125	1.0		2.0	Yes
9	959	6 Jul 64	Yes	34	2.125	0		50.0	Yes
10	960	14 Aug 64	Yes	66	4.125	1.0		7.0	Yes
11	962	23 Sep 64	Yes	67	4.188	4.188		7.0	Yes
12	961	8 Oct 64	No	0	0	0		N/A	N/A
13	963	23 Oct 64	Yes	67	4.188	0		N/A	No
14	964	4 Dec 64	Yes	16	1.0	.5		2.1	Yes
15	965	23 Jan 65	Yes	67	4.188	4.188		2.0 (b)	Yes
16	966	12 Mar 65	Yes	67	4.188	4.188		2.4	Yes
17	967	28 Apr 65	Yes	83	5.188	5.188		2.0	Yes
18	968	27 May 65	Yes	83	5.188	5.188		2.0	Yes

List of GAMBIT Flights
(cont'd)

Sequence	OCV#	Launch Date	Orbit	Orbital Revs	Days on Orbit Total	Days on Orbit Acceptable	Targets Photographed	Best Ground Resolution (ft)	Recovery
19	969	25 Jun 65	Yes	18	1.125	0		N/A	Yes
20	970	12 Jul 65	No	0	0	0		N/A	N/A
21	971	3 Aug 65	Yes	67	4.188	0		N/A	Yes
22	972	30 Sep 65	Yes	67	4.188	4.188			Yes
23	973	8 Nov 65	Yes	18	1.125	.25		N/A (c)	Yes
24	974	19 Jan 66	Yes	83	5.188	5.188		2.0	Yes
25	975	15 Feb 66	Yes	84	5.250	5.250		2.0	Yes
26	976	18 Mar 66	Yes	99	6.188	5.250		2.0	Yes
27	977	19 Apr 66	Yes	98	6.125	6.125		2.0	Yes
28	978	14 May 66	Yes	99	6.188	6.188		2.0	Yes
29	979	3 Jun 66	Yes	99	6.188	6.188		2.3	Yes
30	980	12 Jul 66	Yes	131	8.188	5.50		2.5	Yes
31	981	16 Aug 66	Yes	130	8.125	6.75		2.0	Yes
32	982	16 Sep 66	Yes	115	7.188	7.188		2.0	Yes
33	983	12 Oct 66	Yes	131	8.188	8.188			Yes
34	984	2 Nov 66	Yes	115	7.188	0		N/A	Yes
35	985	5 Dec 66	Yes	131	8.188	8.188		2.5	Yes

List of GAMBIT Flights
(cont'd)

Sequence	OCV#	Launch Date	Orbit	Orbital Revs	Days on Orbit Total	Days on Orbit Acceptable	Targets Photographed	Best Ground Resolution (ft)	Recovery
36	986	2 Feb 67	Yes	131	8.188	8.188	[redacted]	2.2	Yes
37	987	22 May 67	Yes	131	8.188	8.188		[redacted]	Yes
38	988	4 Jun 67	Yes	130	8.125	8.125			Yes
	TOTALS			2,716	169.745	136.445			

Notes:

(a) Targets shown for flights 1 and 14 are cloud free targets photographed and do not include other targets photographed.

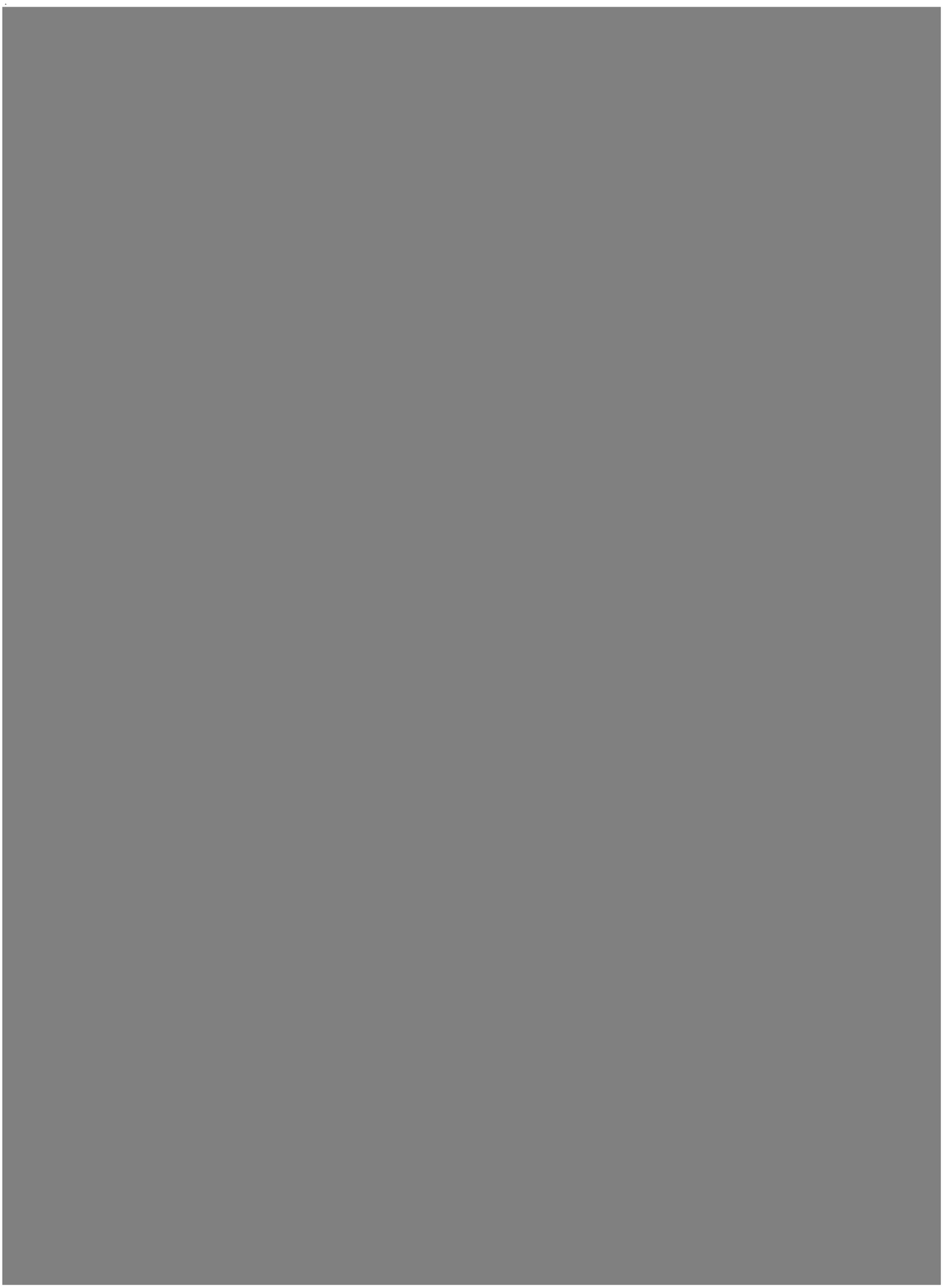
(b) Resolution on flight 15 was 2.0 ft on day 1 but degraded to 10 ft on day 4.

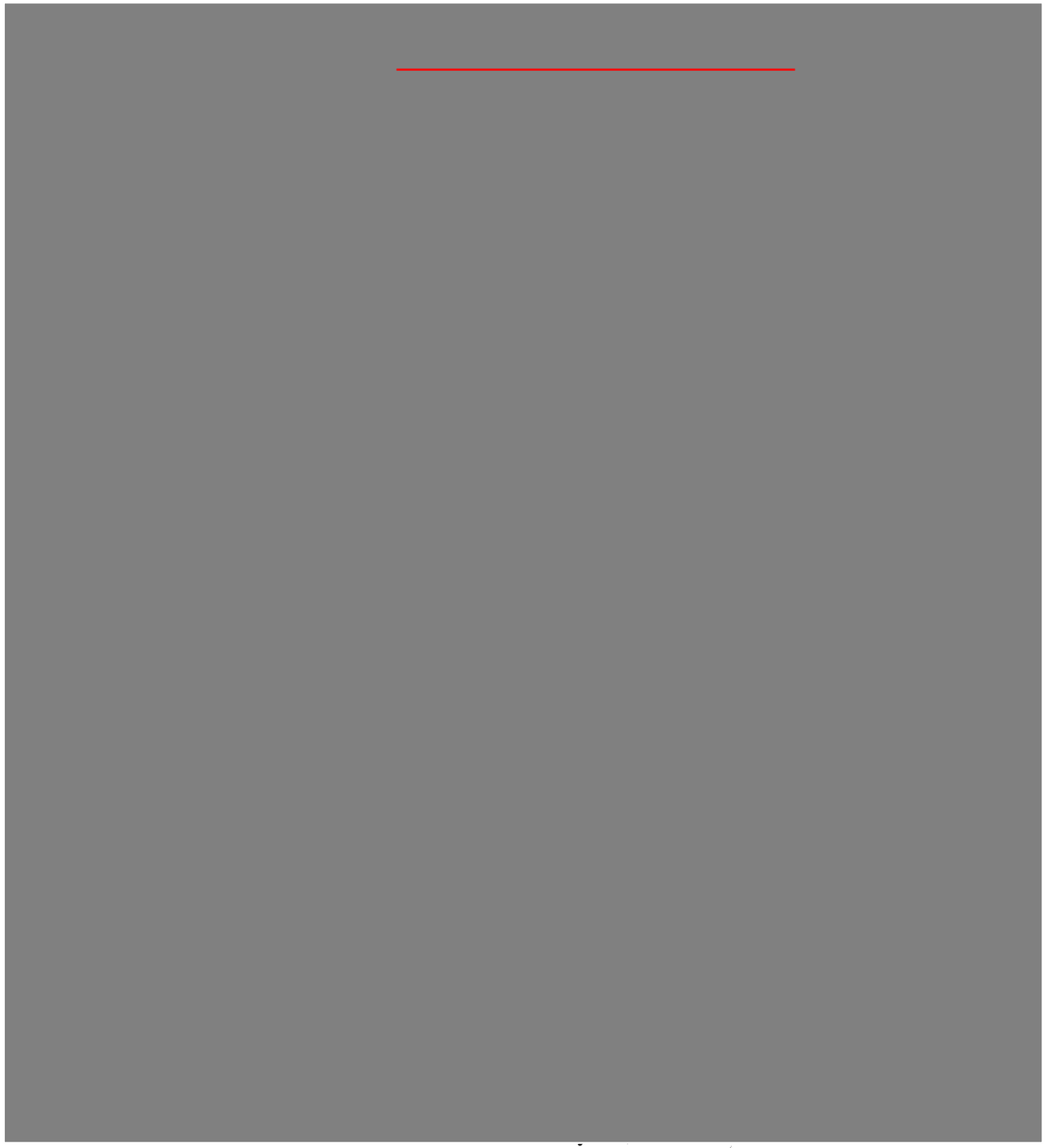
(c) Resolution on flight 23 was so poor it was not measurable.

Attachment #2

Graphs

1. Total targets photographed, by mission.
2. Average targets photographed, by calendar year.
3. Orbital Life by mission, actual vs planned.
4. Acceptable Life by mission, actual vs planned.
5. Ground Resolution, actual (best) vs specified.
6. Costs, per flight, per day and per target.





SPECIAL HANDLING

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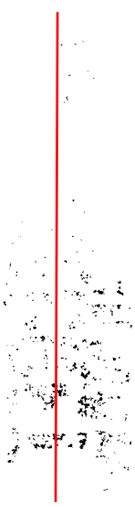
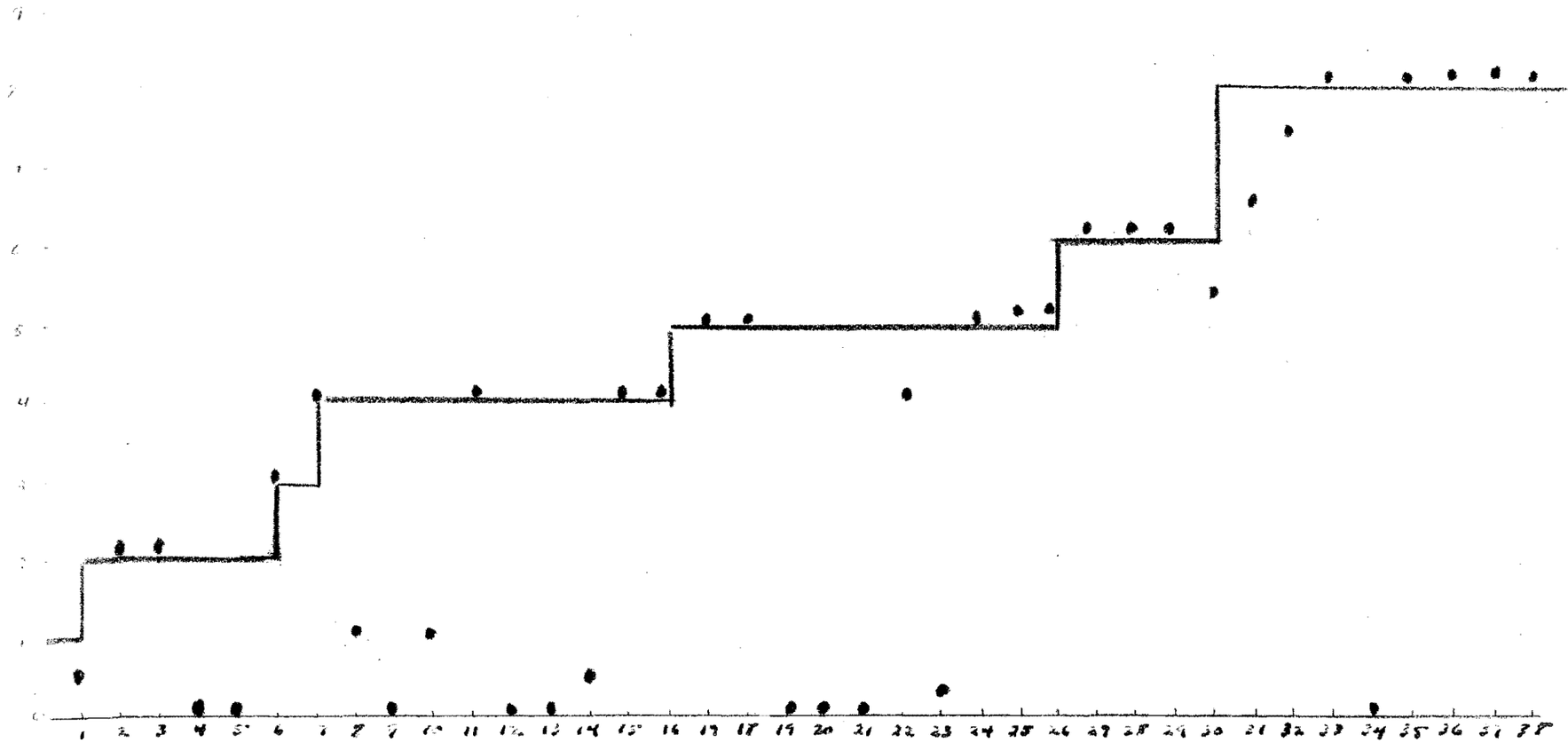
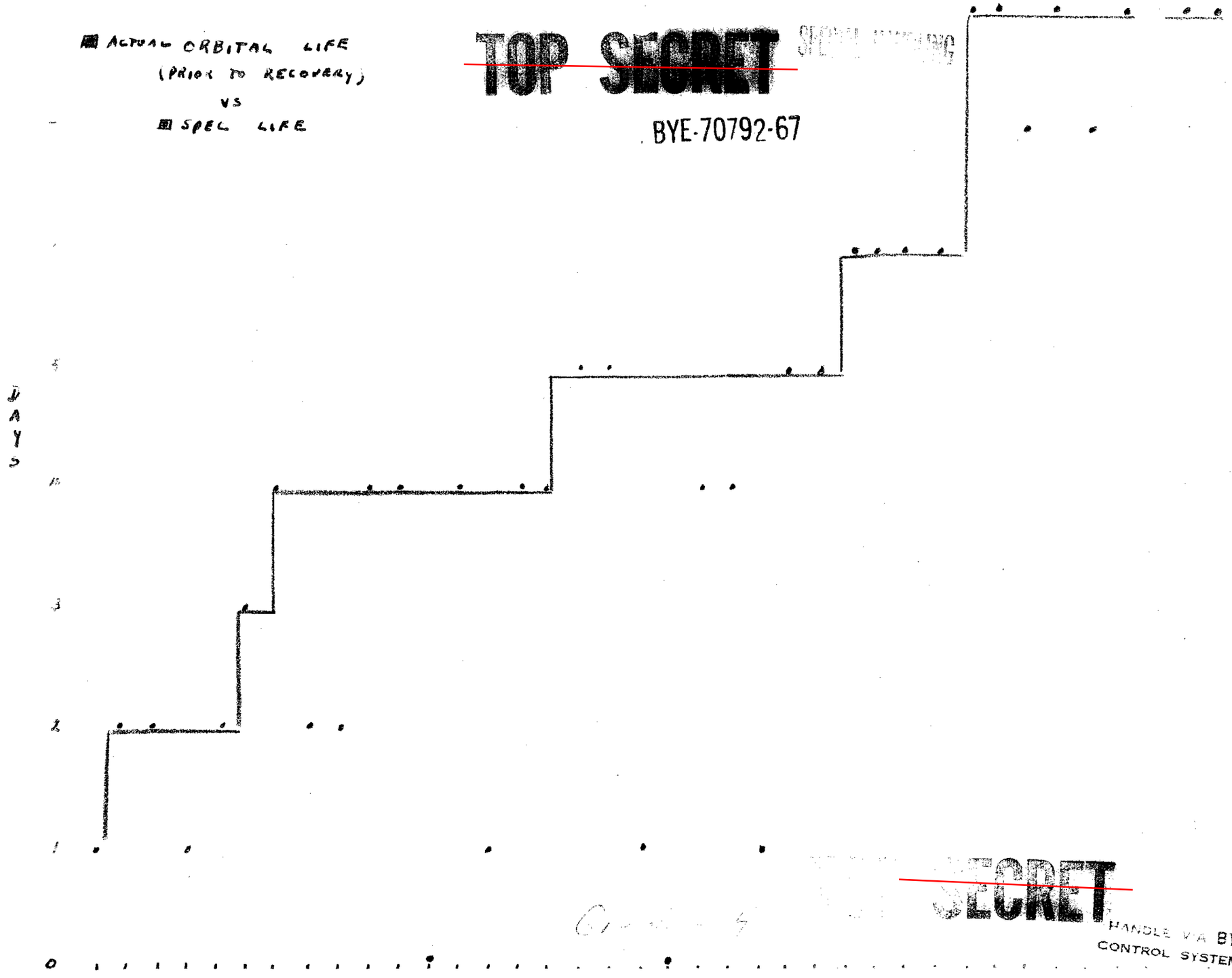


■ ACTUAL ACCEPTABLE DAYS ON ORBIT
VS
■ PLANNED DAYS



BYE-70792-67

■ ACTUAL ORBITAL LIFE
(PRIOR TO RECOVERY)
VS
■ SPEC LIFE



[redacted]

Attachment #3

GAMBIT Flight Anomalies

Vehicle	Days on Orbit Total	Days on Orbit Acceptable	Principal Anomalies
951	1.1	.5	Agena gas depletion, vehicle unstable.
952	2.1	2.1	Same
953	2.1	2.1	None
954	1.1	0	RAGS package overheat and loss of rate. Vehicle unstable. OCV did not deboost.
955	2.1	0	Excessive yaw through rev 16. Environmental door did not open on rev 22.
956	3.1	3.1	Excessive settling times
957	4.1	4.1	Bad component in horizon sensor mixer box caused pitch bias equal to 4 miles in-track error beginning rev 42.
958	2.1	1.0	Unstable in all three axes from rev 16. Horizon sensor could not discriminate over Antarctic.
959	2.1	0	Same
960	4.1	0	Slit misalignment and improper temperature correction caused out-of-focus condition. Unable to load programmer after rev 19.
962	4.1	4.1	Improper temperature correction caused out-of-focus condition.
961	0	0	No orbit. Agena engine failure.
963	4.1	0	No retrofire on RV. Capsule lost.
964	1.0	.5	Loss of power to stabilization system on rev 9. Vehicle unstable.

GAMBIT Flight Anomalies
(cont'd)

Vehicle	Days on Orbit Total	Acceptable	Principal Anomalies
965	4.1	4.1	Payload temperature anomalies. Stereo mirror stuck forward.
966	4.1	4.1	Stereo mirror stuck in 0 degree on rev 16. Mono photography only.
967	5.1	5.1	Primary door actuator.
968	5.1	5.1	Same
969	1.1	0	Power supply malfunction during ascent.
970	0	0	No orbit. Booster failure.
971	4.1	0	DC/DC power converter failed. Vehicle unstable.
972	4.1	4.1	High gas consumption. Roll maneuvers restricted on day 4.
973	1.1	.25	High gas consumption caused early mission termination.
974	5.1	5.1	Stereo mirror failed to drive to proper angle beginning rev 25.
975	5.2	5.2	Crab servo mechanism failed to move from zero. Stellar shutter malfunctioned.
976	6.1	5.2	S/I camera intermittent between revs 40 and 59. No commanding attempted after rev 71.
977	6.1	6.1	Slit position commanding anomaly. Slow platen drive motor.
978	6.1	6.1	Torque motor failure
979	6.1	6.1	Stabilization system performed improperly.
980	8.1	5.5	Vehicle clock malfunctioned, resulted in 58 degree pitch down, pressurization of the orbit propellant tanks and driving platen to full forward position.

GAMBIT Flight Anomalies
(cont'd)

Vehicle	Days on Orbit Total	Acceptable	Principal Anomalies
981	8.1	6.7	Stereo mirror stuck 0 degrees on rev 9, resulting in mono only
982	7.1	7.1	High gas consumption
983	8.1	8.1	Low thrust roll control valve leaked intermittently.
984	7.1	0	Outside hatch failed to jettison, preventing main camera photography.
985	8.1	8.1	Excessive time for roll at low rate.
986	8.1	8.1	Software selected wrong slit on revs 7 through 25. Primary stored command system inoperative on rev 126.
987 *	8.1	8.1	None
988 *	8.1	8.1	None

* Although both of these flights achieved planned performance, GE did not earn the maximum fee on the performance portion of the incentive structure [redacted] per flight) for the following reasons. Prior to these flights, GE completed an analysis of component vibration data obtained on previous flights, from which they concluded that some components on these two vehicles would probably exceed the vibration levels for which they had been qualified originally. Accordingly, GE considered that some adjustment should be made in the fee structure for these two vehicles. The government contracting officer proposed to score each of these two flights at the average performance score awarded on the previous 13 flights [redacted] per flight), or to fly them under the full incentive provisions, with the provision that the same option would have to apply to both flights and would have to be elected prior to the first of these two flights. GE accepted the option of the average performance score, with the result

that these two flights earned a total performance fee of [redacted] as opposed to [redacted] that would have otherwise been earned by the actual performance of the vehicles. The government contracting officer's rationale in accepting the apparent risk of guaranteeing GE a performance fee prior to flying either of these vehicles was based on the following considerations:

a. Both vehicles at the time of the settlement on the average performance option had already been completely manufactured and shipped to the launch base, this manufacturing cycle having been carried out under the full terms of the incentive contract. Thus, the incentive had already had all possible effect on the quality of these two vehicles, except for the actual launch activities, all of which were under detailed supervision of experienced Air Force personnel at Vandenberg AFB.

b. These two vehicles had had all previously established improvements carried out completely in the above manufacturing process. Therefore, they had a higher probability of successful operation than any of the preceding 13 flights.

Attachment 4

Procurement Data

GENERAL

1. SAFSP contracted for the payloads, Orbital Control Vehicles (OCVs), Agena peculiars, Recovery Vehicles (RVs), horizon sensors, mission planning and miscellaneous support effort.

2. SSD contracted for the Atlas boosters and launch service, standard Agena and launch services, satellite control, aerospace MTS and miscellaneous support effort. Funds for these items were released to SSD by SAFSP.

3. CIA contracted for the S/I cameras, film, roll joints, and certain RV parts. Funds for these items were released to CIA by the NRO comptroller at SAFSP request.

4. The SAFSP contracting was accomplished by an [redacted] procurement division collocated with the GAMBIT project office. Division chiefs were:

[redacted]	Sep 1961 - May 1965
	Jun 1965 - Jun 1967

INCENTIVES

5. Several types of incentive structure were used. Following is a narrative description of them, showing actual results obtained:

General Electric

a. Contract -76 (white) and [redacted] (black) covered development and production of the first six OCVs and RVs.

(1) -76 began as CPFF, but a performance incentive was introduced on the last two flights. Under this incentive, 100 possible points could be

earned during orbit and recovery and 70 points was par. At par the contractor received target fee, at above par he earned additional fee up to a maximum increase of [redacted] per flight, and below par he lost fee up to the same maximum. Of the two flights, one earned maximum fee and one lost maximum fee, thus canceling each other. The cost overrun was 7.5%, but since there was no cost incentive, this did not penalize GE. Final fee situation was (% is of actual cost):

	[redacted]
Target fee	
Maximum possible fee	
Actual fee	

(2) [redacted] was CPFF throughout, with a fixed fee of [redacted] (6.4%). There was a small overrun of less than 1%.

b. There followed a series of four follow-on white contracts and one black contract with a life covering the lives of all four white contracts.

(1) -155 (white) produced four OCVs. It had the same performance incentive as -76, but added a negative schedule incentive penalizing GE [redacted] per week up to a maximum penalty of [redacted] as well as a cost incentive under which GE could earn or lose 7.871% respectively of underruns or overruns up to a maximum gain/loss of [redacted]. Actual results were losses on all three parameters:

	[redacted]
Performance	
Schedule	
Cost	
Total	

Final fee situation was (% is of actual cost)

	[redacted]
Target fee	
Maximum possible fee	
Actual fee	

(2) -432 (white) produced 12 OCVs. It had the same general performance incentive, except that the par was higher and the maximum gain/loss per flight was [redacted] The negative schedule incentive was [redacted]

per week penalty up to a maximum penalty of [redacted] The cost incentive had graduated sharing ratios with maximum gain/loss of [redacted]. Actual results were:

Performance	[redacted]	gain
Schedule		loss
Cost		loss
Net		loss

Final fee situation was (% is of actual cost):

Target fee	[redacted]
Maximum possible fee	
Actual fee	

(3) -580 (white) produced 20 OCVs, of which 16 were flown. The incentive structure was changed significantly effective with the second of these 20 OCVs.

(a) For the first OCV, the performance incentive was generally the same as -432, except that the par was higher and the maximum gain/loss per flight was [redacted] There was a savings clause that where final score was lower than par the score would be adjusted to equal the average of previous flights on this contract but not lower than par. The negative schedule incentive was [redacted] per week penalty up to a maximum penalty of [redacted] The cost incentive was generally the same as on -432 except that the maximum gain/loss was [redacted]

(b) Effective with the second of the 20 OCVs, the incentive structure changed. The performance incentive was based on a list of critical events and on the ratio of the number of revs until the first critical event occurs to the number of planned revs. GE could earn an additional 7.5% above target fee of 7.5% for having no critical events during all the planned revs, and lose fee progressively because of critical events down to the point where there was no fee if a critical event occurred at 50% of the planned revs. There was a savings clause under which SAFSP could unilaterally award a higher fee if the intelligence obtained indicated a higher % of mission achievement. Maximum gain/loss per flight on performance was [redacted] for OCVs 2 through 11 and [redacted] for OCVs 12

through 20 (8-day birds). (The last four birds were not flown and were awarded average performance fees of [redacted] each.) Schedule incentive was negative only, with penalties of [redacted] per day up to a maximum penalty of [redacted]. Cost incentives were negative only, with sharing ratio of 80/20 up to [redacted] overrun and 70/30 thereafter, up to a maximum penalty of [redacted]

(c) Pending completion of contract termination, we estimate the following results:

Performance	[redacted]
Schedule	
Cost	
Net	

(d) Final fee situation is estimated to be (% is of actual cost):

Target fee	[redacted]
Maximum possible fee	
Actual fee	

(4) [redacted] was to have produced three OCVs. This was issued as a letter contract which was negotiated but terminated before the definitive contract was executed. The OCVs were in various stages of completion at the time of termination. [redacted] was to have had the same incentive structure as [redacted], but since it was terminated from letter contract status there was no incentive operation. Actual fee paid was [redacted] as set by the terminating contracting officer. This is 7.6% of actual cost.

(5) [redacted] was a black contract covering mission - revealing aspects of the production of all but the first six OCVs and RVs. It had incentives on two elements:

(a) Performance. The incentive was on how well GE integrated the CIA-furnished S/I cameras. GE could earn points on the following formula:

$$\frac{100 \times \text{no. pairs of acceptable photos obtained}}{95\% \text{ of no. pairs available at liftoff}}$$

The maximum fee gain/loss per flight was [redacted] Pending completion of contract termination, we estimate the contractor will earn about [redacted] on performance.

(b) Cost. The contractor could lose or earn 20% of overruns or underruns up to a maximum gain/loss of [redacted] Pending completion of contract termination, we estimate no gain or loss on cost.

(c) Estimated final fee position (% of actual cost):

Target fee	[redacted]	(7.5%)
Maximum possible fee		(12.5%)
Actual fee		(7.6%)

Eastman Kodak

(6) All the GAMBIT payload development and the production of 45 payloads [redacted] was done on black contract [redacted].

(a) The contract began as CPFF in Oct 1960 and was converted to CPIF in May 1964 effective with the 23d payload. At the time of conversion we recognized a cost overrun of [redacted] (6.7%) and in effect started over again from scratch on the CPIF basis.

(b) From payload no. 23 on, the incentive was on cost only, with fee gain/loss of 3% of target cost without dollar limit (up to 15% of cost). Pending completion of contract termination, we estimate EKC will earn a fee gain of [redacted]

(c) Final fee situation will thus be (% is of actual cost):

Target fee	[redacted]	(7.3%)
Maximum possible fee		(15%)
Actual fee		(7.8%)

Lockheed

(7) White contract -92 called out development work and the peculiarization of 10 Agenas as GAMBIT stages. It was CPFF, with a fixed fee of [redacted]

(8) White contract -506 was a CPIF follow-on for peculiarization of 12 Agenas, with incentives on cost only. LMSC earned a fee gain of [redacted] Final fee situation was (% is of actual cost):

Target fee	[redacted]	(7.0%)
Maximum possible fee		(8.8%)
Actual fee		(7.4%)

(9) White contract -670 was a CPIF follow-on for peculiarization of 13 Agenas, with incentives on performance and cost. LMSC earned fee gains of [redacted] on performance and [redacted] on cost for a total gain of [redacted]. Final fee situation was (% is of actual cost):

Target fee	[redacted]	(4.9%)
Maximum possible fee		(11.2%)
Actual fee		(7.8%)

(10) White contract -874 was a CPIF follow-on for peculiarization of 6 Agenas, with incentives on performance and cost. Pending completion of contract termination, we estimate LMSC will earn a fee gain of [redacted] on performance and break even on cost, with the following final fee situation (% is of actual cost):

Target fee	[redacted]	(5.2%)
Maximum possible fee		(11.2%)
Actual fee		(7.8%)

(11) None of the above LMSC CPIF contracts contained the new incentive structure described for GE [redacted].

Barnes

(12) White contract -666 was a CPIF contract for production of 17 model 155 sensors, with incentives on schedule and cost. The contract was terminated, and there was no fee gain/loss because of the incentives. Actual fee paid was [redacted] as set by the terminating contracting officer.

(13) White contract -840 was a CPIF contract for production of 20 model 151 sensors, with incentives on cost and schedule. Pending

completion of contract termination, we estimate the following results:

Schedule	[redacted]	gain
Cost		gain
Total		gain

Final fee position will thus be (% is of actual cost):

Target fee	[redacted]	(3.5%)
Maximum possible fee		(8.4%)
Actual fee		(7.6%)

TRW

(14) White contract -841 was a CPIF contract for mission planning software, with incentive on cost only. This was a follow-on to earlier CPFF and FFP contracts. The contractor broke even on cost. The actual fee was thus the target fee of [redacted] which was 8.2% of actual cost.

(15) White contract -1014 was a CPIF follow-on contract to -841, but provided mission planning for both GAMBIT and G-3. The contract is still active. We estimate the GAMBIT portion of the work will break even on cost, and that the actual fee for GAMBIT will be the target fee of [redacted] which is 4.5% of cost.

6. Listings

The following pages contain listings of SAFSP contracts for GAMBIT and a summary of results of those which had incentive features.

List of SAFSP GAMBIT Contracts

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Number	Type	Secur	With	For	Life	Final Price	Fee Earned (% of actual cost)
PAYLOAD							
[redacted]	CPFF for 22 then CPIF	Black	EKC	Dev and Production of 45 payloads	Oct 60-Jul 67	[redacted]	(7.8%)
OCV							
-76	CPFF	White	GE	Dev, Prod and Launch of 6 OCV	Dec 61-May 64		(6.3%)
-155	CPIF	White	GE	Prod and Launch of 5 OCV	May 62-Sep 64		(5.8%)
-432	CPIF	White	GE	Prod and Launch of 11 OCV	Apr 63-Sep 65		(7.1%)
-580	CPIF	White	GE	Prod and Inch of 20 OCV(part.term)	Mar 64-Jun 67		(2.7%)
-988	L/C	White	GE	Prod and Inch of 3 OCV (term)	Mar 66-Mar 67		(7.6%)
[redacted]	CPFF	Black	GE	Mission Revealing work on 10 SVs	Dec 60-Sep 64		(6.4%)
	CPIF	Black	GE	Same, plus Incentives on Integration of 32 GFE S/I Cameras	Oct 63-Jun 67		(7.6%)
AGENA PECULIARS							
-92	CPFF	White	LMSC	10 Vehicles	Mar 62-Jun 64		(7.0%)
-506	CPIF	White	LMSC	12 Vehicles	Feb 64-Jun 65		(7.4%)
-670	CPIF	White	LMSC	13 Vehicles	Apr 65-Oct 66		(7.8%)
-874	CPIF	White	LMSC	6 Vehicles	Apr 66-Jun 67		(7.8%)
HORIZON SENSOR							
-503	CPFF	White	Barnes	Sensor Development	Nov 63-Apr 64		(7.6%)
-666	CPIF	White	Barnes	17 Model 155 Sensors	Sep 64-Nov 65		(7.0%)
-840	CPIF	White	Barnes	20 Model 151 Sensors	Apr 65-May 66		(7.6%)
-160	CPFF	White	EKC	1 Prototype and 4 Flight Models	May 62-Dec 64		(5.8%)

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List of SAFSP GAMBIT Contracts (Cont)

Number	Type	Secur	With	For	Life	Final Price	Fee Earned (% of actual cost)
SOFTWARE							
-145	CPFF	White	STL	Mission Planning	Apr 62-Jun 64		(7.2%)
-622	FFP	White	STL	Mission Planning	Jul 64-Jun 65		
-841	CPIF	White	TRW	Mission Planning	Jul 65-Apr 66		(8.2%)
-1014	CPIF	White	TRW	Mission Planning	Apr 66-Apr 67		(10.9%)
MISCELLANEOUS							
-438	CPFF	White	GE	Pad Modification	Aug 63-Oct 63		
-749	FFP	White	AVCO	Angle Detector	Feb 65-Nov 65		
-757	FFP	White	Philco	Spiral Decay Study	Feb 65-Jan 66		
-895	FFP	White		D C Power Supply Failure Analysis	Sep 65-Nov 65		
-0014	CPFF	White	GE	Command Gen and Software	Dec 66-current		(8.2%)
	FFP	Black	LMSC	Cutter/Sealer and Parts	Oct 64-Nov 65		
	CPFF	Black	GE	Command Generation	Jul 65-Dec 66		(7.3%)
-533	CPIF	White	GE	Engineering Study	Jan 64-Jun 64		(7.0%)
-665	CPFF	White	EKC	VAFB support	12 Oct 64-curr		(8.4%)
RELATED WORK (Funded by GAMBIT)							
-790	CPIF	White	STL	Mission Optimization	20 Apr 65-20 Apr 66		(8.2%)
-573	CPFF	White		Low Altitude Study	9 Mar 64-27 Jul 64		(7.1%)

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Overall Fee Earnings

Principal SAFSP Contractors on Total GAMBIT Work

Contractor	No. of Contracts	Actual Cost ($ mil)	Actual Fee ($ mil)	Actual Fee (% of Actual Cost)
GE	10	[redacted]	[redacted]	5.6
EKC	3			7.7
LMSC	4			7.4
STL/TRW	4			9.2
Barnes	3			7.1
[redacted]	1			7.1
	26			6.1 (average)

Note: Above dollar figures represent all SAFSP GAMBIT contracts except five small FFP contracts.

Results of Incentive Features on GAMBIT Contracts

Contract	Fee Gain (Loss) for: Performance	Schedule	Cost	Net Fee Gain (Loss)	Resultant Fee Earned	% of Actual Cost
GE -155						5.8
GE -432						7.1
GE -533						7.0
GE -580						2.7
GE -2106						7.6
EKC						7.8
LMSC -506						7.4
LMSC -670						7.8
LMSC -874						7.8
Barnes -666						7.0
Barnes -840						7.6
TRW -841						8.2
TRW -1014						4.5

* Estimated

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Attachment #5

COST DATA

1. The total program of [redacted] includes the following:

a. Thirty-eight satellite vehicles launched plus two complete for storage and two complete except for systems test. Additional parts for three systems are included. The cost does not include the long term storage of the excess hardware.

b. Forty payloads excluding a possible underrun of [redacted] recoverable in FY 1968 or 1969.

c. Forty-five Atlas boosters and launch services for thirty-eight launches. Five boosters have been reallocated to [redacted] but costed against GAMBIT. These have been removed from the unit cost recapitulation shown on the page referred to in paragraph 2.b., below. The launch services cost includes maintenance of capability at WTR until 30 June 1967.

d. Forty-five Agenas and launch services for thirty-eight launches. Five Agenas have been allocated to [redacted] and the costs have been treated the same as the Atlas costs, above. Forty sets of Agena peculiar equipment were procured.

e. Aerospace, mission planning, and general support costs include effort through 30 June 1967.

2. The following pages show:

a. GAMBIT cost summary by FY with line items as in monthly Financial Status Reports.

b. Non-recurring investment summary, unit cost for the development phase of 10 launches, and unit cost for the remaining units. Each line item shows the inclusive equivalent units.

c. Development cost by fiscal year. This information relates directly to that referred to in 2.a., above.

d. Flight cost per calendar year. This summary shows the cost in the calendar year of the flight and does not consider long lead funding.

GAMBIT COST SUMMARY

	FY 62	FY 63	FY 64	FY 65	FY 66	FY 67	TOTAL
WHITE							
Spacecraft							
Atlas							
Atlas Launch							
Agena							
Agena Peculiars							
Agena Launch							
Satellite Control							
Mission Planning							
Aerospace							
Industrial Facilities							
General Support							
Subtotal							
BLACK							
Spacecraft							
Command Generation							
Payload							
Subtotal							
G R A N D T O T A L							

Attachment 5a

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[redacted]

GAMBIT NON-RECURRING AND RECURRING

PER UNIT COST SUMMARY

	Non-Recurring	Recurring for Systems 1-1 1-10	Recurring for Remaining Systems (1)	TOTAL
Satellite Vehicle	[redacted]			
Satellite Control				
Payload				
Agena Peculiars				
Atlas				
Atlas Launch				
Agena				
Agena Launch				
Aerospace				
Mission Planning				
Industrial Facilities				
General Support				

(1) Number in parenthesis shows the inclusive numbers of equivalent systems.

(2) [redacted] does not include 5 Atlas vehicles [redacted] and 5 Agena vehicles [redacted] reallocated to [redacted]

Attachment 5b

SPECIAL HANDLING

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NON-RECURRING INVESTMENT FY SUMMARY

	FY 62	FY 63	FY 64	FY 65	FY 66	TOTAL
Spacecraft						
Payload						
Satellite Control Peculiars						
Agena Peculiars						
General Support						
Industrial Fac.						
Total						

SPECIAL HANDLING

~~SECRET~~

Attachment 5c

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	CY 63	CY 64	CY 65	CY 66	CY 67	Cost of Residual Units Not Flown	Cost of Transfer To Other Project
Satellite Vehicle							
Satellite Cont. Pec.							
Payload							
Agena Peculiars							
Atlas							
Atlas Launch							
Agena							
Agena Launch							
Aerospace							
Mission Planning							
General Support							
Total							

The totals by CY plus cost of residual units plus non-recurring of [redacted] reconciles to the program of [redacted]

Attachment 5d

[redacted]

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Attachment #6

CCN History of GE Contract [redacted]

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~~(S)~~ NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

[redacted]

- I think you will find this interesting

dff

THE NRO STAFF

19 September 1967

Yes.
JJ

MEMORANDUM FOR DR. FLAX

SUBJECT: Summary Report of GAMBIT Program

STATEMENT OF THE PROBLEM

General Martin has submitted a summary of the GAMBIT program.

DISCUSSION

The highlights of the report are as follows:

General Martin's cover letter points out that:

(1) Most of the serious failures were associated with the GE equipment.

(2) The overall fee of 5.6% for GE versus the LMSC and EK fees of 7.4% and 7.7% reflects the GE problems.

(3) Four missions had ground resolutions [redacted] and 11 had resolutions approaching or equal to 2 feet.

[redacted] analysis summarizes the growth in capability as the system matured, the technical problems encountered, and the procurement aspects such as the incentive fee structure and costs.

Attachment #1 consists of a short project history.

Attachment #2 consists of 6 graphs:

Graph 1 - Targets per mission

Graph 2 - Average targets per mission by calendar year

Graph 3 - Acceptable versus planned days on orbit

Robert J. Flax
Dr. Carter

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Graph 4 - Days prior to recovery versus planned days on orbit

Graph 5 - Actual (best) ground resolution by flight

Graph 6 - Costs per flight, per day, and per target

Attachment #3 is a summary of flight anomalies. A footnote concerning the last two missions explains that even though the missions had no major problems, GE did not get the maximum performance incentive for these flights because prior to the flights GE accepted the Government contracting officer's offer to score the flights at the average score awarded on the previous 13 flights.

Attachment #4 is primarily an analysis of the effect of the incentive contracts.

Attachment #5 tabulates the total costs.

Attachment #6 is the CCN history of GE Contract [redacted] which illustrates [redacted] comment (in paragraph 4d of his report) that the quantity of technical changes do not decrease as a space project becomes operational.

RECOMMENDATION

That you take note of this report.

~~Albert Johnson~~
ALBERT W. JOHNSON
Major, USAF