COPY 75

National Aeronautics and Space Administration

BUDGET ESTIMATES

BUREAU OF THE BUDGET SUBMISSION

FISCAL YEAR 1966

Volume I

SUMMARY OF FISCAL ANALYSIS
RESEARCH AND DEVELOPMENT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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NASA PROGRAM SUMMARY

FISCAL YEAR	64	65	66	67	68	69
Research & Development	3909	4364	4815	4528	4024	3323
Construction of Facilities	715	263	133	135	100	100
Administrative Operations	496	623	615	600	610	620
TOTAL	5120	5250	5563	5263	4734	4043

ESTIMATED EXPENDITURES

ESTIMATED FY 1965.....	$5,100
ESTIMATED FY 1966, WITH NEW STARTS.....	$5,769
ESTIMATED FY 1966, ON-GOING.....	$5,686

AUTHORIZATION LANGUAGE

(Information to be provided later)

APPROPRIATION LANGUAGE - GENERAL PROVISIONS

(To be provided later)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 1966 ESTIMATES
SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY PROGRAM

	FY 1964	FY 1965	FY 1966	
Manned Space Flight	2,646,752	3,035,800	3,294,300	
Gemini	418,900	308,400	242,100	
Apollo	2,206,652	2,701,400	3,026,200	
Advanced Missions	21,200	26,000	26,000	
Space Science and Applications	747,136	745,372	862,000	
Geophysics and Astronomy	146,957	133,400	180,200	1/
Lunar and planetary exploration	203,100	208,000	202,600	2/
Manned space science	5,620	11,800	32,400	
Sustaining university program	40,000	46,000	60,000	
Launch vehicle development	125,100	107,900	106,500	
Bioscience	20,691	27,800	30,000	3/
Meteorological satellites	62,930	30,800	49,300	
Communication satellites	8,760	9,700	4,300	
Advanced technological satellites	17,192	26,700	30,100	
Launch vehicle procurement	116,786	143,272	166,600	
Advanced Research and Technology	318,562	315,828	380,000	
Basic Research	22,198	21,500	25,000	
Space vehicle systems	45,714	40,528	40,700	
Electronic systems	28,700	26,880	34,400	
Human factor systems	13,200	13,320	18,000	
Nuclear-electric systems	44,963	44,400	46,500	
Nuclear rockets	80,537	57,000	61,000	
Chemical propulsion	46,000	62,100	76,900	
Space power	14,000	13,300	15,500	
Aeronautics	21,795	36,800	62,000	4/
Tracking and Data Acquisition	194,347	261,800	273,500	

	FY 1964	FY 1965	FY 1966
Technology Utilization	3,500	4,750	5,000
TOTAL PLAN	3,908,936	4,363,550	4,814,800

1/ Includes New Start:

AOSO	25.6

2/ Includes New Start:

Voyager	43.0
Spacecraft	43.0

3/ Includes New Starts:

Planetary Quarantine	1.0
Automated Biolab	1.0
	2.0

4/ Includes New Starts:

B-70	20.0
Hypersonic Ramjet	7.8
	27.8

OMSF PROJECTS

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Gemini	418.9	308.4	242.1	41.6	-	-
Spacecraft	280.5	165.3	122.7	19.1	-	-
Launch Vehicles	122.7	115.4	88.6	8.5	-	-
Support	15.7	27.7	30.8	14.0	-	-
Apollo	2206.7	2701.4	3026.2	2887.1	2510.8	1929.5
Spacecraft	877.6	998.6	1135.0	1094.7	876.3	624.0
Saturn I	187.1	68.4	4.4	-	-	-
Saturn IB	146.9	251.1	266.7	227.3	167.2	96.9
Saturn V	690.9	1031.6	1236.5	1187.3	1109.9	897.9
Engine Development	166.0	149.4	140.7	121.5	94.7	68.7
Mission Control System	47.5	38.5	36.4	35.7	35.1	34.9
Apollo Space Ops.	3.7	23.4	41.0	49.6	56.6	36.1
Launch Ops. Support	19.4	30.1	53.6	57.0	57.0	57.0
Launch Instrumentation	8.5	10.4	12.9	15.0	15.0	15.0
Systems Engineering	28.8	46.0	46.0	46.0	46.0	46.0
Supporting Development	30.3	53.9	53.0	53.0	53.0	53.0
Advanced Mission Studies	21.2	26.0	26.0	26.0	26.0	26.0
TOTAL	2646.8	3035.8	3294.3	2954.7	2536.8	1955.5

OSSA PROJECTS

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Supporting University Program	40.0	46.0	60.0	60.0	60.0	60.0
Training Grants	19.8	25.0	30.0	-	-	-
Facilities Grants	12.0	10.0	12.0	-	-	-
Research Grants	8.2	11.0	18.0	-	-	-
Geophysics & Astronomy	147.0	133.4	180.2	207.7	220.9	205.0
SR&T	16.0	15.9	18.0	19.0	20.0	21.0
OSO (A-H)	13.8	9.9	11.4	11.4	6.8	2.9
OAO (A-J)	35.6	31.4	32.3	36.0	41.0	45.0
AOSO (A-D)	6.2	7.4	25.6	33.7	28.3	20.8
OGO (A-K)	42.9	30.2	32.5	33.0	49.1	46.7
Explorers	15.5	22.0	26.9	31.0	27.1	22.5
Sounding Rockets	17.0	16.0	18.0	19.0	20.0	20.0
Advanced Studies	-	.6	2.0	2.0	2.0	3.0
Data Analysis	-	-	4.0	7.0	9.0	11.0
Pioneer (E-K)	-	-	9.5	15.6	17.6	12.1
Lunar & Planetary	203.1	208.0	202.6	279.6	243.5	206.0
SR&T	17.3	20.0	19.5	17.0	18.0	19.0
Advanced Studies	1.8	2.0	2.0	4.0	4.0	4.0
Ranger (1-5, A-D)	30.6	16.5	1.0	-	-	-
Surveyor Lander (A-Q)	70.7	76.0	82.6	83.0	73.0	35.0
Mariner Mars 66 (Canc.)	7.0	2.0	-	-	-	-
Mariner Mars 64 (C-D)	42.1	19.0	3.5	.5	-	-
Voyager	-	8.0	43.0	105.0	130.0	140.0
Pioneer (A-D)	13.6	14.7	12.0	9.1	1.5	-
Lunar Orbiter (A-J)	20.0	41.8	39.0	61.0	17.0	8.0
SFOF	-	8.0	-	-	-	-

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
			(in millions)			
Bioscience	20.7	27.8	30.0	32.0	34.0	35.0
SRT	12.2	11.8	12.0	13.0	14.0	15.0
Biosatellite (A-F)	8.5	16.0	16.0	4.0	-	-
Automated Biological Lab.	-	-	1.0	10.0	15.0	15.0
Planetary Quarantine	-	-	1.0	5.0	5.0	5.0
Manned Space Science	5.6	11.8	32.4	35.0	35.0	35.0
SRT	1.4	3.8	9.4	-	-	-
Manned Satellite Science	1.8	.6	8.0	-	-	-
Manned Lunar Science	2.4	7.4	15.0	-	-	-
Communications Satellites	8.8	9.7	4.3	3.7	2.1	2.0
SRT	1.9	2.3	3.0	3.0	2.0	2.0
Echo 1-2	1.7	.2	-	-	-	-
Relay 1-2	2.6	1.2	.4	.1	-	-
Syncom 1-3	2.6	1.0	.9	.6	.1	-
EGGE	-	5.0	-	-	-	-
Advanced Technological Satellite	17.2	26.7	30.1	19.9	11.7	9.9
SRT	1.8	1.7	2.0	2.0	3.0	3.0
ATS 1, 2 & 3 (A-E)	15.4	25.0	28.1	17.9	8.7	6.9
Meteorological Satellites	62.9	30.8	49.3	48.2	46.7	48.5
SRT	7.5	7.1	10.6	11.0	11.5	12.0
Tiros/TOS A-K & B/U	11.5	4.1	4.8	3.6	2.0	1.5
Nimbus A-F and B/U	41.7	16.0	26.9	25.2	25.0	25.0
Meteorological Soundings	2.2	2.4	3.0	3.0	3.0	5.0
Meteorology Flight Exper.	-	1.2	4.0	5.4	5.2	5.0

	(in millions)					
	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Launch Vehicle Development	125.1	107.9	106.5	76.2	48.4	45.0
SRT	1.7	4.5	5.0	6.0	6.0	6.0
Advanced Studies	.2	-	3.0	4.0	4.0	4.0
Centaur Development	108.1	89.4	59.6	30.5	3.2	-
FLOX	1.9	2.6	-	-	-	-
Operational Vehicle Support	13.2	11.4	38.9	35.7	35.2	35.0
Vehicle Procurement	116.8	143.3	166.6	168.7	145.0	58.6
Scout	8.1	10.0	7.7	9.6	7.2	6.0
Centaur	32.0	47.8	50.4	48.1	32.2	2.6
Delta	26.7	31.4	32.0	33.2	36.3	12.1
Agena	48.2	53.1	76.5	77.8	69.3	37.9
Atlas	1.8	1.0	-	-	-	-
OSSA Total	747.1	745.4	862.0	931.0	847.3	705.0

OART PROJECTS

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
OFFICE OF ADVANCED RESEARCH & TECHNOLOGY						
Nuclear Electric	45.0	44.4	46.5	43.8	45.1	46.5
SRT	25.7	24.4	25.5	26.8	28.1	29.5
SNAP-8 Development	15.5	17.0	16.0	12.0	9.0	6.0
SERT	3.5	3.0	5.0	5.0	8.0	11.0
Small Nuclear Electric Propulsion Flight Projects	.3					
Nuclear Rockets	80.6	57.0	61.0	65.2	69.4	73.1
SRT (Systems)	.5	1.0	1.0	1.1	1.1	1.1
SRT (Propulsion)	21.4	21.0	22.0	23.1	24.3	25.5
NRDS Operations	.7	.7	1.0	4.0	7.0	9.5
NERVA	49.5	34.3	37.0	37.0	37.0	37.0
RIFT	6.8					
KIWI	1.7					
Space Power	14.0	13.3	15.5	16.3	17.1	17.9
SRT	14.0	13.3	15.5	16.3	17.1	17.9
Space Vehicle Systems	45.7	40.5	40.7	38.3	35.5	33.8
SRT	24.6	24.5	26.8	28.1	29.5	31.0
Small Space Veh.Flt.Projs.	2.3	1.4	4.8	4.2	4.0	2.8
Scout Reentry Heating	.3	.7	6.1	5.3	1.8	
Meteoroid Sat.(S-55c & S-55d)		.2				
FIRE	7.0	2.8	.5			
Saturn Launch Met. Exp.	10.3	9.4	1.5			
Lifting Body Flt. Program	1.2	1.5	1.0	.7	.2	
Electronics Systems	28.7	26.9	34.4	35.1	36.1	38.2
SRT	26.4	23.9	30.0	31.5	33.1	34.7
Small Elec.Sys.Flt.Projs.	2.3	3.0	4.4	3.6	3.0	3.5

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Aeronautics	21.8	36.8	62.0	60.6	43.9	38.1
SRT	9.2	8.3	8.3	8.7	9.2	9.6
X-15 Research Aircraft	.9	1.4	.9	.9	.9	.4
Supersonic Transport	8.8	22.0	22.0	22.0	23.0	25.0
V/STOL	2.9	2.0	3.0	2.5	2.5	2.5
Hypersonic Ramjet Exp.	-	3.1	7.8	10.5	8.3	.6
B-70	-	-	20.0	16.0	-	-
Human Factor Systems	13.2	13.3	18.0	18.8	19.6	20.5
SRT	13.2	11.8	16.0	16.8	17.6	18.5
Small Biotech.Flt. Projects		1.5	2.0	2.0	2.0	2.0
Chemical Propulsion	46.0	62.1	76.9	78.8	82.6	98.5
SRT	22.0	25.1	31.0	32.6	34.2	35.9
M-1 Engine Development	24.0	24.0	25.9	26.2	28.4	42.6
Large Solid Motor Dem.	-	13.0	20.0	20.0	20.0	20.0
Research	22.2	21.5	25.0	26.2	27.6	28.9
SRT	22.2	21.5	25.0	26.2	27.6	28.9
TOTAL, OART	317.2	315.8	380.0	383.1	376.9	395.5

TRACKING & DATA ACQUISITION PROGRAM

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
TDA SRT	12.9	13.5	14.5	15.0	16.0	17.0
Networks OPS	78.5	94.7	129.0	164.0	172.0	175.0
Equipment & Components	102.3	153.6	130.0	75.0	70.0	70.0
TOTAL OTDA	193.6	261.8	273.5	254.0	258.0	262.0

OTUPP PROGRAM

Identification & Dissemination	2.6	3.85	4.0	4.0	4.0	4.0
Socio-Economic Studies	.9	.9	1.0	1.0	1.0	1.0
TOTAL OTUPP	3.5	4.75	5.0	5.0	5.0	5.0
TOTAL NASA	3,908.9	4,363.6	4,814.8	4,527.8	4,024.0	3,323.0

FY 1966 SUMMARY OF CONSTRUCTION OF FACILITIES PROJECTS

BY INSTALLATION

	(000)
OFFICE OF MANNED SPACE FLIGHT INSTALLATIONS	
John F. Kennedy Space Center, NASA	$8,791.9
Manned Spacecraft Center	9,958.8
Marshall Space Flight Center	8,365.1
Michoud Plant	300.0
Mississippi Test Facility	2,121.0
OFFICE OF SPACE SCIENCE AND APPLICATIONS INSTALLATIONS	
Goddard Space Flight Center	6,710.0
Wallops Station	1,048.0
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY INSTALLATIONS	
Ames Research Center	7,324.2
Electronics Research Center	13,691.3
Langley Research Center	13,501.0
Lewis Research Center	17,317.0
VARIOUS LOCATIONS	33,871.7
FACILITY PLANNING AND DESIGN	10,000.0
TOTAL	133,000.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FY 1966 BUDGET ESTIMATES

Administrative Operations
(Thousands of dollars)

	Personnel Costs	FY 1965 Limitation Travel	Other (Excl ADP)	ADP (Lease, Pur. & Maint)	TOTAL
Supporting Activities	31,974	2,600	22,812	21,430	78,816
Manned Space Flight Centers	155,700	9,300	78,400	27,943	271,343
Advanced Research & Technology Centers	125,471	4,200	32,129	13,202	175,002
Space Science and Applications Centers	45,850	2,800	18,090	31,625	98,365
TOTAL	358,995	18,900	151,431	94,200	623,526
		FY 1966			
Supporting Activities	33,168	2,640	26,091	73	61,972
Manned Space Flight Centers	164,666	9,800	85,963	11,259	271,688
Advanced Research & Technology Centers	129,900	4,600	37,500	11,259	183,259
Space Science and Applications Centers	47,300	3,500	21,700	25,581	98,081
TOTAL	375,034	20,540	171,254	48,172	615,000

Personnel

FY 1964	32,499 (actual)
FY 1965	33,800 (plan)
FY 1966	34,100 (plan)

SUMMARY of FY 1966 NEW PROJECTS

	(in millions)			
	FY 1966	FY 1967	FY 1968	FY 1969
Advanced Orbiting Solar Observatory	25.6	33.7	28.3	$20.8
Voyager	45.0	128.0	184.0	235.0
Spacecraft	(43.0)	(105.0)	(130.0)	(140.0)
Automated Biolab & Planetary Quarrantine	(2.0)	(15.0)	(20.0)	(20.0)
Saturn/Centaur	(-)	(8.0)	(34.0)	(75.0)
B-70 Flight Tests	20.0	16.0	-	-
Hypersonic Ramjet	7.8	10.5	8.3	.6
Total R&D	98.4	188.2	220.6	256.4
New CoF	67.0			
New AO (computer purchases)	25.0			
Total	190.4			

ADVANCES AND REIMBURSEMENTS

(This information will be provided later)

RESEARCH AND DEVELOPMENT
LAUNCH VEHICLE PROCUREMENT FUNDING
FISCAL YEAR (DOLLARS IN THOUSANDS)

	1964	1965	1966	1967	1968	1969
Delta						
OSO	3,650	361	2,900	3,800	4,900	-
Relay	-	-	-	-	-	-
Syncom	3,400	-	-	-	-	-
Tiros	3,800	1,100	-	-	-	-
Pioneer	4,100	2,900	7,000	4,600	6,600	6,600
Biosatellite	-	9,000	12,000	-	-	-
Explorers	11,750	12,350	10,100	24,800	24,850	5,500
Modifications	-	10,200	-	-	-	-
TOTAL DELTA	26,700	35,911	32,000	33,200	36,350	12,100
Agena						
AOSO	-	-	-	-	6,885	12,400
OGO	10,172	8,126	14,356	15,569	15,844	6,665
OAO	5,626	9,039	15,089	19,612	11,032	10,823
Echo	805	-	-	-	-	-
ATS	-	3,057	14,244	15,844	6,665	-
Nimbus	3,516	6,358	6,200	6,200	6,200	6,200
Orbiter	170	2,335	22,146	20,541	22,687	1,800
Ranger	14,863	3,136	205	-	-	-
Mariner	10,351	2,377	178	-	-	-
Explorers	2,697	11,560	4,075	-	-	-
Modifications	-	4,800	-	-	-	-
TOTAL AGENA	48,200	50,788	76,493	77,766	69,313	37,888

	1964	1965	1966	1967	1968	1969
Centaur-Surveyor	32,000	47,805	50,407	48,051	32,150	2,600
Scout						
Explorers	6,600	4,296	7,700	8,400	6,000	4,800
OART	1,500	1,400	-	1,200	1,200	1,200
Modifications	-	2,100	-	-	-	-
TOTAL SCOUT	8,100	7,796	7,700	9,600	7,200	6,000
Atlas-OART	1,786	972	-	-	-	-
TOTAL LAUNCH VEHICLE PROCUREMENT	116,786	143,272	166,600	168,617	145,013	58,588

LAUNCH VEHICLE UTILIZATION
CALENDAR YEAR

		1964	1965	1966	1967	1968	1969
Delta							
OSO	D	1	1	1	2	1	1
Relay	D	1					
Syncom	D	1					
Tiros	D/TAD	1		1	1		
Pioneer	ITAD		1	2	1	2	2
Biosatellite	ITAD			4	2		
Explorers		4	4	2	6	7	7
TOTAL DELTA		8	6	10	12	10	10
Agena							
AOSO	TAT						2
OGO	TAG/AAG	1	2	2	1	2	2
OAO	AAG		1	1	1	1	1
Echo	TAG	1					
ATS	AAG			1	2	2	
Nimbus	TAG	1	1	1	1	1	1
Orbiter	AAG			3	2	4	1
Ranger	AAG	2	2				
Mariner	AAG	2					
Explorers	TAG		1	2			
TOTAL AGENA		7	7	10	7	10	7
Centaur-Surveyor			3	4	4	5	1
Scout							
Explorers		5	5	6	9	4	5
OART		4	2	1	1	1	1
TOTAL SCOUT		9	7	7	10	5	6
Atlas OART		1	-	-	-	-	-
TOTAL VEHICLES		25	23	31	33	30	24

RESEARCH AND DEVELOPMENT

APPROPRIATION LANGUAGE

(To be provided later)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars)

	Budget Plan			Obligations		
	1964	1965	1966	1964	1965	1966
Program by activities:						
1. Manned space flight.....	2,719,246	2,963,350	3,294,300	2,656,724	3,001,453	3,287,418
2. Scientific investigations in space.....	603,646	619,285	697,856	572,102	653,002	696,257
3. Space applications.....	100,204	77,715	104,144	96,673	91,618	103,610
4. Space technology.....	298,692	281,400	318,000	283,563	308,028	317,255
5. Aircraft technology.....	21,795	36,800	62,000	17,368	40,944	61,493
6. Supporting operations.....	237,847	312,550	338,500	188,552	381,955	337,967
Total.....	3,981,430	4,291,100	4,814,800	3,814,982	4,477,000	4,804,000
Financing:						
Comparative transfers to/from (-) other accounts.....	-	-	-	9,425	-	-
Unobligated balance available, start of year:						
For completion of prior year budget plans (-).....	-	-	-	-114,564	-200,872	-85,687
Available to finance new budget plans (-).....	-4,974	-	-	-4,974	-	-
Unobligated balance transferred from "Construction of facilities" (76 Stat. 731) and (75 Stat. 355) (-)	-15,472	-	-	-15,472	-	-

Program and Financing (in thousands of dollars)--Continued

	Budget plan			Obligations		
	1964	1965	1966	1964	1965	1966
Unobligated balance transferred to "Construction of facilities" (77 Stat. 439).....	-	-	-	-	1,779	-
Reprogramming to prior year budget plan.....	-72,494	72,494	-	-	-	-
Unobligated balance available, end of year.....	1,779	-	-	200,872	85,687	96,487
New obligational authority..	3,890,269	4,363,594	4,814,800	3,890,269	4,363,594	4,814,800
New obligational authority:						
Current authorization:						
Appropriation.....	3,926,000	4,363,594	4,814,800	3,926,000	4,363,594	4,814,800
Transferred to:						
"Construction of facilities" (77 Stat. 439) (-).....	-20,046	-	-	-20,046	-	-
"Administrative operations" (77 Stat. 439) (-).....	-15,685	-	-	-15,685	-	-
Appropriation (adjusted)	3,890,269	4,363,594	4,814,800	3,890,269	4,363,594	4,814,800

Note.— Reconciliation of budget plan to obligations:			
Total budget plan.....	3,981,430	4,291,100	4,814,800
Deduct portion of budget plan to be obligated in subsequent years.....	258,277	85,687	96,487
Add obligations of prior year budget plans.....	91,829	271,587	85,687
Total obligations.....	3,814,982	4,477,000	4,804,000

Type size: 8 point 22 picas Case 130. Red underscore Case 210

STANDARD FORM 304
July 1964, Bureau of the Budget Circular No. A-11, Revised.
304-101

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND DEVELOPMENT

OBJECT CLASSIFICATION (in thousands of dollars)

Identification code 27-00-0108-0-1-251	1964 actual	1965 estimate	1966 estimate
National Aeronautics and Space Administration			
~~Personnel compensation:~~			
~~11.1 Permanent positions~~			
~~11.3 Positions other than permanent~~			
~~11.5 Other personnel compensation~~			
~~Total personnel compensation~~			
~~12.0 Personnel benefits~~			
~~19.0 Benefits for former personnel~~			
~~21.0 Travel and transportation of persons~~			
22.0 Transportation of things	6,204	11,357	11,731
23.0 Rent, communications, and utilities	18,245	35,669	38,741
24.0 Printing and reproduction	506	1,624	1,653
25.1 Other services	3,383,112	3,879,558	4,203,323
25.2 Services of other agencies	110,669	109,406	109,996
26.0 Supplies and materials	134,239	142,222	158,278
31.0 Equipment	153,944	279,085	267,706
32.0 Lands and structures	6,877	16,910	11,197
~~33.0 Investments and loans~~			
41.0 Grants, subsidies, and contributions	1,088	1,167	1,375
~~42.0 Insurance claims and indemnities~~			
~~43.0 Interest and dividends~~			
~~44.0 Refunds~~			
~~99.0~~ Total obligations, National Aeronautics and Space Administration	3,814,884	4,476,998	4,804,000
(Mono cast: 21.5)	(Mono cast: 5)	(Mono cast: 5)	(Mono cast: 4.9)

☆ GPO: 1964—O-722-488

Type size: 8 p 22 picas 180. Re ierscore Case 210

STANDARD FORM 300
July 1964, Bureau of the Budget
Circular No. A-11, Revised.
300-101

OBJECT CLASSIFICATION - p. 2

Identification code 27-00-0108-0-1-251	1964 actual	1965 estimate	1966 estimate
ALLOCATION ACCOUNTS			
25.2 Services of other agencies.....	....	2	....
32.0 Lands and structures.....	98	....	....
Total obligations, allocation accounts.....	98	2	....
99.0 Total obligations.....	3,814,982	4,477,000	4,804,000
Obligations are distributed as follows:			
National Aeronautics and Space Administration.....	3,814,884	4,476,998	4,804,000
Commerce, Bureau of Public Roads...	98	2	....
(Mono cast: 21.5)	(Mono cast: 5)	(Mono cast: 5)	(Mono cast: 4.9)

☆ GPO:1964—O-732-469

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI SPACECRAFT

1. Project Objectives:

To increase operational proficiency and knowledge of technology in manned space flight. This includes the development of earth orbital rendezvous techniques, long duration flights, extravehicular capability, controlled reentry, and astronaut operational space flight experience in a two-man spacecraft as a prerequisite for the manned lunar missions.

2. Project Content:

Design and development of a two-man spacecraft to support long duration missions of up to two weeks. This spacecraft will be equipped to rendezvous and dock in space with a specially designed target vehicle, the modified Agena D. The spacecraft will be launched by a modified (man rated) Titan II launch vehicle, the Gemini Launch Vehicle. Two unmanned and ten manned flights are planned.

The following major spacecraft items are being procured:

Reentry Modules	12-flight 1-project orbit (high altitude thermal environment test) 6-boilerplate 4-static articles 1-mockup
Adapter Modules	18-flight configurations 1-mockup

Schedule and funding considerations have deferred decisions on finalizing the procurement of all 18 Adapter Modules, and 12 of these modules are included in the current procurement.

3. Summary Project Schedules:

The first unmanned flight was successfully completed in April, 1964. The second unmanned flight is scheduled for this calendar year and will be followed by the first manned flight in early CY 1965.

No. and Description	Quarters by Calendar Year FY 1965	FY 1966 (Prelim)	FY 1966 (Final)
GT-1 Launch Environment - Unmanned	1-64	2-64	Launched
GT-2 Qualify Systems - Unmanned	3-64	3-64	4-64
GT-3 First Manned (Orbital)	4-64	4-64	1-65
GT-4 Long Duration - Manned	1-65	1-65	2-65
GT-5 Long Duration - Manned	2-65	2-65	3-65
GT-6 First Rendezvous	---	3-65	4-65
GT-7 Long Duration	---	4-65	1-66
GT-8 Rendezvous	---	1-66	1-66
GT-9 Rendezvous	---	2-66	2-66
GT-10 Rendezvous	---	66	66
GT-11 Rendezvous	---	66	66
GT-12 Rendezvous	---	67	67

4. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	252,300	168,900	39,200	12,500
b. FY 1966 Preliminary Budget	260,000	165,300	131,100	49,700
c. FY 1966 Budget	280,500	165,300	122,700	19,100

5. Project Manpower:

a. Major Contractor (Equivalent Direct Man Years)

McDonnell Aircraft Corporation	4,047	3,650	2,315	735

b. NASA In-House Direct Manpower

6. Project Procurement:

McDonnell Aircraft Corporation

a. Current Status

(1) Type - Currently CPFF conversion to CPIF in process, with terms to be effective from April 1, 1964.
(2) Amount on contract as of July 31, 1964 --- $486.6M
(3) Scope negotiated to date: The scope to be negotiated encompasses the hardware listed in 2 above. The delivery schedule for spacecraft is as follows:

Calendar Year

1963	1964	1965	1966
1	2	6	3

b. Anticipated Changes:

The cost above the amount on contract included in the spacecraft estimate is $303.0M. This includes provision for the following that are the subject of negotiation with the contractor: technical changes approved by NASA; contractor changes that are pending NASA approval; contractor increased cost estimates for major subsystems suppliers, and overall increase in cost rates.

7. Project Changes Since FY 1965 President's Budget:

Project Objectives: Are unchanged

Project Content:

The Gemini project has carried the development of paraglider techniques for controlled land landings through the completion of the demonstration phase. Weight, performance and schedule implications have resulted in discontinuance of the paraglider as a part of the Gemini project. Water landing and recovery will now be used throughout the flight program.

Project Schedule:

Extension of developmental and testing activity along with a lightning strike and hurricane interference at the launch complex, have caused minor flight schedule changes.

Project Funding:

Funding increases are due to added developmental activity, the schedule changes, associated contractor cost estimate increases, and improved requirement definitions.

8. Justification of FY 1966 Budget Estimates:

The FY 1966 estimate of $165.3M provides for delivery of six spacecraft and will support five launches. Thus, spacecraft assembly and checkout will be the major contractor activities throughout the year.

(No major contract actions are expected, as the McDonnell conversion to CPIF should be completed in FY 1965.)

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI LAUNCH VEHICLES

1. Project Objectives:

To man rate the Titan II for use as the Gemini Launch Vehicle, and to modify and test the Atlas/Agena system so that the Agena D can be used as the target vehicle in Gemini rendezvous flights.

2. Project Content:

The Air Force Space Systems Division (SSD), acting as a NASA contractor, will modify and test the Titan II and Agena D, procure all vehicles, integrate the Atlas/Agena system, and provide technical supervision of launches under the NASA Operations Director.

Titan II modifications have been completed except for the acceptance testing of GLV #3 thru #15. The Agena D effort includes providing multiple engine restart in orbit and ground control of the engine.

The following major launch vehicle items are in the procurement plan to support a twelve (12) mission program.

15 Gemini Launch Vehicles
8 Agenas
7 Atlases

Schedule and funding considerations have deferred decisions on finalizing all of the above procurements. At this time 12 GLV's, 7 Agenas, and 6 Atlases are being procured as well as certain major launch vehicle long-lead time items.

3. Summary Schedules:

The flight program in support of the Gemini project has scheduled the use of the Titan II for two flights in CY 1964, four in CY 1965, five in CY 1966, and one in CY 1967. The Atlas/Agena is scheduled for one flight in CY 1965, four in CY 1966, and one in CY 1967.

4. **Project Funding**: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	110,000	111,300	72,500	20,500
b. FY 1966 Preliminary Budget	117,700	115,400	97,500	37,600
c. FY 1966 Budget	122,700	115,400	88,600	8,500

5. Project Manpower: (Equivalent Direct Man Years)

a. Major Contractor (s):

Martin Marietta Corporation (Titan II)	1,661	1,697	1,358	500
Lockheed Aircraft Corporation (Agena Modifications)	510	344	247	123

6. Project Procurement:

Martin Marietta Corporation (Titan II)

a. Current Status

(1) Type of contract --- CPIF
(2) Amount negotiated --- $197.9M
(3) Scope negotiated: 15 Gemini Launch Vehicles to be delivered as follows:

Calendar Year

1963 - 1
1964 - 3
1965 - 4
1966 - 4
1967 - 3

Note: 12 GLV are under firm order with long-lead time items for 3 additional. Termination order for last 3 GLV may be effected up to Dec. 1, 1964 by project direction without excessive cost penalty for deferring final decision beyond that date.

b. Anticipated Changes

Additional cost of $3.8M for future changes in scope.

Lockheed Aircraft Corporation (Agena Modification)

a. Current Status

(1) Type of contract --- CPIF
(2) Amount negotiated --- $59.1M

(3) Scope negotiated: 8 modified Agena D Vehicles to be develivered as follows:

Calendar Year

1965 - 3	Note:	7 Agenas are under firm order.
1966 - 4		Termination of the 8th Agena may be
1967 - 1		effected by project direction.

b. Anticipated Changes

Additional cost of $2.7M for future changes in scope.

7. Project Changes Since FY 1965 President's Budget:

Current funding requirement increases for FY 64, 65, and 66 are principally due to requirements for additional hardware improvements to the Gemini Launch Vehicle. The requirement for these hardware improvements became evident following the vertical tests of GLV #1. Refinement of earlier cost estimates by the AF has also been a factor.

8. Justification of FY 1966 Budget Estimate:

The FY 1966 estimate for $88.6M provides primarily the incremental funding required by SSD to support the final delivery and operational support of vehicles to be launched in FY 1966 and FY 1967.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI SUPPORT - PREFLIGHT OPERATIONS

1. Project Description:

Supports the overall Gemini mission by providing pre-launch spacecraft testing and checkout at the launch pad.

2. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	5,300	2,300	1,900	1,600
b. FY 1966 Preliminary Budget	2,600	2,300	1,900	1,600
c. FY 1966 Budget	2,900	2,300	1,900	1,600

Analysis and Justification of Significant Changes in Project Funding:

No significant change

3. Justification of FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded: (Dollars in Millions)

Major activities/end items:

(1) Data Reduction & Analysis

FY 1964	FY 1965	FY 1966
$ .4	$ .2	$ .4

These funds provide for the analysis of the data obtained in checking out the spacecraft prior to launch.

(2) Multi-Purpose Materials & Equipment

FY 1964	FY 1965	FY 1966
$ 1.1	$ .6	$ .5

Provides test equipment common to all contractor test activity, such as signal generators, oscilloscopes, and other calibration devices.

(3) Engineering & Technical Services

FY 1964	FY 1965	FY 1966
$ 1.0	$ .9	$ .5

Supports the contractors performing minor modifications and changes in connection with facility activation, and typically includes electrical and mechanical installation activity.

(4) Materials & Supplies

FY 1964	FY 1965	FY 1966
$ .2	$ .5	$ .4

Provides for the modification and activation of test equipment, including installation (electrical and mechanical) of test and ground support equipment.

b. Contractor Manpower:

Not applicable

c. Services of Other Government Agencies:

Not applicable

d. FY 1966 Procurement of Capital Items:

Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI FLIGHT OPERATIONS

1. Project Description:

Includes the planning, support, and actual flight test of manned space systems from lift-off to recovery.

2. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	4,200	18,800	16,800	9,300
b. FY 1966 Preliminary Budget	4,100	14,800	16,800	12,100
c. FY 1966 Budget	3,600	15,900	21,900	5,800

Analysis and Justification of Significant Changes in Project Funding:

No significant change

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function Activity and/or End Items Funded: (Dollars in Millions)

Major activities/end items funded:

(1) Flight Controller Support

FY 1964	FY 1965	FY 1966
$ .5	$ 1.1	$ .8

This activity provides: (1) observation and analysis of vehicle systems and flight performance during missions, (2) mission simulations, (3) proficiency in operational modes of flight vehicle systems and ground station equipment, (4) analyses leading to compatibility of systems design with operational control modes, and (5) refinement of operations documentation and procedures for subsequent missions.

(2) Real-Time Computer Program Formulation:

FY 1965	FY 1966	FY 1967
$ .5	$ .6	$ .5

Supports the studies leading to the development of the following particular mathematical techniques: (1) special perturbation techniques, (2) special closed loop powered flight guidance equations, (3) treatment of tracking data in trajectory determination, (4) determination of the trajectory/radiation interface, and (5) development of automated trajectory programs.

(3) Task Force Support:

FY 64	FY 65	FY 66
$ -0-	$ 10.7	$ 17.0

These funds provide for the estimated reimbursements to DOD for air, water, and ground mission recovery support and involve such elements as ships, aircraft, communications facilities, and personnel. Estimates are based on the scope of support and level of effort anticipated for the scheduled flights.

(4) U.S. Weather Bureau:

FY 64	FY 65	FY 66
$ .3	$ .4	$..4

Provides for the reimbursement to the U. S. Weather Bureau, This agency provides a coordinated program of operational support during launch periods, and continues climatological and forecast development studies pertinent to launch and reentry problems

(5) In addition to the major activities listed above, Flight Operations estimates also support the following activities: trajectory studies, computer software, handling & retrieval equipment, and communication and test equipment.

b. Contractor Manpower:

Not applicable

c. Services of Other Government Agencies:

(1) DOD

Services provided-see a. above.

Reimbursement:

FY 64	FY 65	FY 66
$ -0-	$ 10.7	$ 17.0

(2) U.S. Weather Bureau

Services provided - see a. above

Reimbursement:

FY 64	FY 65	FY 66
$ .3	$ .4	$. 4

d. FY 1966 Procurement of Capital Items:

Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI - CREW OPERATIONS

1. Project Description:

Crew Operations funds provide for training of astronauts and for the purchase and operation of related training and simulation equipment.

2. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	4,400	2,700	1,400	900
b. FY 1966 Preliminary Budget	3,600	2,600	1,900	1,300
c. FY 1966 Budget	3,700	2,600	2,100	1,700

Analysis and Justification of Significant Changes in Project Funding:

No significant changes

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

Major activities/end items funded: (Dollars in Millions)

(1) Simulator Spares

FY 1964	FY 1965	FY 1966
$ .1	$..3	$. .2

These estimates support the replacement of worn and damaged simulator parts.

(2) Simulator & Trainer Maintenance

FY 1964	FY 1965	FY 1966
$ .4	$ .5	$ .5

Estimates for the maintenance of the simulators in operational condition and the modifications that are required to simulate the environment of progressively more sophisticated missions. (Each Gemini astronaut receives at least 100 hours of simulator training.)

(3) In addition to the major estimates listed above, Crew Operations estimates include support for the following: visual display systems, centrifuge training, in-flight astronaut equipment, part task trainer support, and docking trainer support.

b. Contractor Manpower:

Not applicable

c. Services of Other Government Agencies:

Not applicable

d. FY 1966 Procurement of Capital Items:

Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI SPACECRAFT & LAUNCH VEHICLE SUPPORT

1. Project Description:

Consists of procurement and flight qualification tests of various astronaut support systems. This project includes flight crew life support systems and components and supporting extravehicular equipment.

2. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 President's Budget	4,400	3,500	2,000	900
b. FY 1966 Preliminary Budget	3,000	4,600	3,600	3,500
c. FY 1966 Budget	3,000	4,000	2,700	2,700

Analysis and Justification of Significant Changes in Project Funding:

Funding increase in FY 67 is attributed to refinement of cost estimates based upon improved definition of support required for project completion.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded: (Dollars in Millions)

(1) Space Suits:

FY 1964	FY 1965	FY 1966
$ .7	$ 1.7	$ 1.3

These estimates provide for the procurement of Gemini suits to be used for qualification testing, flight, and flight training.

(2) Extravehicular Equipment:

FY 1964	FY 1965	FY 1966
$ .1	$ .3	$ .7

Provides for procurement of astronaut chest pack and allied equipment required for extravehicular activities.

(3) Bioinstrumentation:

FY 1964	FY 1965	FY 1966
$ .6	$ .2	$ .2

Provides for the procurement of bioinstrumentation equipment necessary to monitor the medical safety of astronauts during flight.

(4) In addition to the major activities listed above, Spacecraft and Launch Vehicle Support provides for the procurement of the following flight qualified systems: food, water, and waste management systems; flight and training survival equipment; personal hygiene equipment.

b. Contractor Manpower:

Not applicable

c. Services of Other Government Agencies:

Not applicable

d. FY 1966 Procurement of Capital Items:

Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: GEMINI - SPACE MEDICINE

1. Project Description:

Includes studies and development of equipment necessary to insure the safety of the astronauts and the effective performance of their mission assignments.

2. Project Funding: (Dollars in Thousands)

	FY 1964	FY 1965	FY 1966	FY 1967
a. FY 1965 Presidents Budget	3,000	2,200	3,000	3,000
b. FY 1966 Preliminary Budget	3,100	3,300	3,000	3,000
c. FY 1966 Budget	2,500	2,900	2,200	2,200

Analysis and Justification of Significant Changes in Project Funding:

No significant change

3. Justification of FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded: (Dollars in Millions)

(1) Development of Liquid Transport System:

FY 1964	FY 1965	FY 1966
$ -0-	$ .1	$ .6

These estimates support the extension of the NASA/DOD liquid transport portable life support system development effort and the integration and qualification of a system for extended extravehicular operations. Present extravehicular systems limit the task capabilities of the astronauts, whereas this system will provide sufficient thermal capacity and weight rates to overcome this limitation.

(2) Space Suit Component Development:

FY 1964	FY 1965	FY 1966
$ .4	$ .7	$ .5

This effort includes the design, development, test, and integration of improved components and systems into existing suit assemblies and the design and incorporation of additional components required for extravehicular activities.

(3) Experimental Medical Studies:

FY 64	FY 65	FY 66
$ .9	$ .3	$ .6

These studies provide for evaluation of the physiological, biochemical, and cardiovascular responses to space flight and include the equipment (other than bioinstrumentation for medical safety monitoring) required for in-flight biomedical experiments, optimizing biomedical data by programming for automatic analysis, establishing the requirements for artifical lighting in space, and defining the physiological requirements for design of space vehicle life support equipment and space suits, visors and filters.

(4) In addition to the major activities listed above, Space Medicine estimates include support for the following: food and package development, survival materials testing, survival equipment development, and effects of recompression after exposure to vacuum.

Medical Operations:

FY 64	FY 65	FY 66
$ .50	$ .675	$ .575

FY 196[illegible] requirements in Medical Operations provide for the acquisition and analysis of biomedical flight data for each manned flight. This line also bears the cost of training and positioning ground support medical forces for each of the Gemini manned flights and for the medical training of astronauts in basic physiology, in the use of life support and protective equipment, and in emergency medical procedures.

b. Contractor Manpower:

Not applicable

c. Services of Other Government Agencies: (Dollars in Millions)

Task	Agency	FY 64	FY 65	FY 66
Food & Package Dev.	Army/Quartermaster	$.100	$ -0-	$ -0-
Space Suit Component	Army/Quartermaster	.040	-0-	-0-
Experimental Medical Studies	NIH	.010	-0-	-0-
	USPHS	.039	-0-	-0-
	Navy/Aero Medical Center	.015	-0-	-0-
	USPHS	.055	-0-	-0-
	Air Force	-0-	.100	.110
	Air Force School of Aviation Medicine	.018	-0-	-0-
Effects of Decompression After Exposure to Vacuum	Air Force/School of Aviation Medicine	$.011	-0-	-0-
	Navy/Aviation Crew Equip. Lab.	.045	-0-	-0-
	Air Force/Holloman AFB	.020	-0-	-0-
	Air Force/Systems Command	.023	-0-	-0-
	Navy/Bur. of Weapons	.100	-0-	-0-
Medical Operations	DOD	.50	.675	.575
		$ .526	$.775	$.685

d. FY 1966 Procurement of Capital Items

Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT

1. Project Objectives:

Development of a spacecraft system with capability to land men on the Moon and return them safely to Earth.

2. Project Content:

The spacecraft system is to be capable of missions of two weeks duration with stay time on the lunar surface of approximately one day. The lunar-orbital rendezvous flight mode will be utilized. The spacecraft is comprised of three modules: Command Module, Service Module, and Lunar Excursion Module. The overall program consists of three flight phases:
(1) unmanned suborbital and Earth-orbital flights;
(2) manned Earth-orbital, long duration flights and Earth-orbital rendezvous flights; and
(3) manned lunar flights and lunar landing.
An extensive ground test program is interwoven with a ballistic and earth orbital flight test program culminating in lunar flights of fully qualified spacecraft. Planned are four Little Joe II test launches and three Saturn I, 12 Saturn IB and 15 Saturn V launches of various spacecraft configurations including the lunar missions.

3. Summary Project Schedules:

No. and Description	Schedules (Quarter & CY) FY'65	FY'66(Prelim)	FY'66(Final)
LJ II-3	2-64	4-64	2-65
LJ II-4	1-65	3-65	4-65
LJ II-5	2-65	1-65	1-66
LJ II-6	3-65	3-65	3-66
LJ II-7		4-65	Under Study
LJ II-8		Under Study	Under Study
1 - SA-9 Micrometeoroid Exp.*		4-64	4-64
1 - SA-8 " " *	2-65	1-65	1-65
1 - SA-10 " " *		2-65	2-65
4 - S/C Dev. Flts. (Sat. IB)	66	66	66
4 - S/C Qual. Flts. & Opers. (Sat. IB)	67	67	67
4 - S/C Dev. & Qual. Flights (Sat. V)	67	67	67
4 - S/C Opers. (Sat. IB)	68	68	68
6 - S/C Qual. Flights & Opers. (Sat. V)	68	68	68
5 - S/C Opers. (Sat. V)	69	69	69

* OART payloads.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY1965 Pres. Budget	901,900	945,800	750,800	694,600	612,400	469,800
b. FY1966 Prelim. Budget	901,700	996,000	999,600	858,400	717,200	517,500
c. FY1966 Budget	877,600	998,600	1,135,000	1,094,700	876,300	624,000

5. Project Manpower: See
Manpower Data for: Command and Service Modules project
Navigation and Guidance project
Lunar Excursion Module project

6. Project Procurement: See Contract Data for above projects

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives - Unchanged.

b. Project Content:

Increased reliance on unmanned tests, introduction of Block concept, elimination of on-board maintenance, black box maintenance on ground, less testing at Cape, modified guidance and navigation concept.

c. Project schedules - no change.

d. Project Funding:

Significant changes in program indicated in (b) above and a comprehensive review of cost estimates for major contract effort.

8. Justification of FY 1966 budget estimate:

Spacecraft funds for FY 1966 will be used to support testing, development and ground support activities indicated in the individual write-ups for CM/SM, LEM, G&N, Integration & Checkout support, ACE. Funds will be required also for two Little Joe II launchings, one for an intermediate altitude abort flight with a Block I CM/SM and the other for back-up. Two spacecraft development flights using Saturn IB vehicles are also scheduled during FY 1966.

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT - COMMAND AND SERVICE MODULES

1. Project Objectives:

Development of the Command and Service Modules of the Apollo Spacecraft. The Command Module comprises the three-man crew control center and re-entry module. The Service Module comprises a propulsion and utility module to support the Command Module and provide propulsion for mid-course corrections, retro into and escape from lunar orbit.

2. Project Content:

The development program includes extensive ground tests of the Modules and their subsystems for purposes of development, qualification and reliability testing. The Command Module major subsystems consist of the Guidance and Navigation, Stabilization and Control, Reaction Control, Environmental Control, Electrical Power, Communication, Launch Escape, Heat Shield and Earth Landing Systems. Little Joe II flight tests provide necessary data on the spacecraft abort and propulsion systems. Development and operational flights aboard the Saturn I, IB and V launch vehicles are as detailed in the Apollo Spacecraft project. Various configurations of the Command and Service Modules were flown on Saturn I (SA 5-7) and will fly on the twelve Saturn IB and fifteen Saturn V launches which follow. To support this program, a total of nineteen boilerplates (eleven ground tests, four flight tests, and four little Joe II and Pad Abort) and thirty-four airframes (fourteen Block I and twenty Block II) are included in the development and operational program.

3. Summary Project Schedules:

Project Milestones:	Schedules Presented (Quarterly & CY) FY '65	FY '66 (prelim.)	FY '66 (Final)
a. Complete manufacturing of Service Module for propulsion and combined systems test at WSMR	-	4-'64	4-'64
b. Complete manufacturing of Command and Service Module for the first Saturn IB flight	-	1-'65	1-'65

Flight schedules, developmental and operational for the Command and Service Modules, are as shown on the Apollo Spacecraft project.

4. Project Funding:

	1964	1965	1966	1967	1968	1969
FY 1965 Pres. Budget	527,300	520,500	379,000	296,500	245,500	186,000
FY 1966 Prelim.Budget	533,200	564,000	494,100	401,000	355,000	279,200
FY 1966 Budget	548,950	534,000	583,700	549,300	415,000	301,000

5. Project Manpower:

a. Contractor: North American Aircraft

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
20,000	19,600	17,000	14,400	11,700	8,200

b. NASA In-House Direct Manpower:

6. Project Procurement:

CM/SM North American Aviation NAS-9-150

a. Current status:

(1) Type of Contract - CPFF

(2) Cost negotiated to date - $1,463.8 million

(3) Scope negotiated to date - Design, development, fabrication assembly, and test and launch support on Command and Service Modules - June 1962 - February 1966.

b. Anticipated Changes:

(1) Estimated additional cost involved - Approximately $2 billion

(2) Additional Scope - Extension of Contract for period - February 1966 - End of program

(3) Estimated dates changes will be negotiated -

1st Quarter FY 1965
3rd Quarter FY 1965

7. Project Changes Since FY 1965 President's Budget:

See Apollo Spacecraft project.

8. Justification of FY 1966 budget estimate:

In FY 1966, the ground and flight testing of the Block I CSM will be essentially completed and the manufacture of the Block II configuration will be well underway. The reliability and qualification testing of all major subsystems for the CSM should be completed in the early part of the fiscal year.

The ground test program for FY 1966 will continue the dynamics, static, flotation and propulsion systems testing started in the previous year. In addition, three CSM will be delivered for use in vibration, thermal, thermal-vacuum and land impact testing.

During FY 1966, seven Block I CSM for flight test will be delivered. Five CSM will be delivered to KSC for use on the Saturn IB launch vehicle in the CSM development and long-duration operation program. The remaining two CSM's will be used at WSMR for pad abort and high altitude abort tests.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT - NAVIGATION AND GUIDANCE

1. Project Objectives:

Development and production of Navigation and Guidance Systems for the Apollo Spacecraft. The functions of the Navigation and Guidance System are to determine the position, velocity, and trajectory of the spacecraft and to provide information to control the spacecraft's engines for the maneuvers necessary to accomplish the lunar landing mission.

2. Project Content:

Navigation and Guidance equipment will be developed and furnished for both the Command Module and the Lunar Excursion Module. To a large degree, identical types of equipment will be used in both modules. The project includes nine Block I and nine Block II ground test units, one Block I and one Block II flight test (developmental) units and nine Block I and 17 Block II operational units for the Command Module and 11 ground test units, one flight test (developmental) unit and 16 operational units for the Lunar Excursion Modules.

3. Summary Project Schedules:

Project Milestones	Schedules Presented		
	FY'65	FY'66(Prelim)	FY'66(Final)
a. Functional Systems Delivered for Test	FY'64	--	Blk I Complete FY'64 Blk II FY'65
b. Complete Development, Qualification & Reliability Testing for Command Module	FY'65	--	Blk I FY'66 Blk II FY'67
c. Flight Qualified Systems Delivered for CM	4-FY'65	--	Blk I {1-FY'65, 8-FY'66} Blk II {3-FY'66, 6-FY'67, 7-FY'68}
d. Flight Qualified Systems Delivered for LEM	FY'65	--	2-FY'66 8-FY'67 6-FY'68

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	91,500	83,800	58,500	56,700	46,000	9,300
b. FY 1966 Prelim. Budget	91,500	89,600	87,700	96,000	58,300	22,300
c. FY 1966 Budget	91,500	95,900	97,700	95,000	70,000	31,000

5. Project Manpower:

a. Contractors: ACSP & MIT

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
ACSP	2,500	4,000	4,000	3,600	3,000	1,500
MIT	578	645	553	500	400	220

b. NASA In-House Direct Manpower:

6. Project Procurement:

Navigation and Guidance — Contractor: A C Spark Plug NAS 9-497

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $67.5 Million

(3) Scope negotiated to date - June 1964 - December 1964 Assembly and test of eight Block I and four Block II G&N systems

b. Anticipated Changes:

(1) Estimated additional costs involved - about $47.0 Million

(2) Additional scope involved - Dec 1964-Feb 1969 - Computer and optics effort formerly the responsibility of Raytheon and Kollsman. An additional contract with ACSP is in process to provide G&N systems for Blck II with estimated costs through runout of approximately $250.0 Million. 22 CM/SM Systems - 25 LEM Systems.

Navigation and Guidance

Contractor: MIT
NAS 9-153

a. Current Status:

(1) Type of Contract - Cost Reimbursement

(2) Cost negotiated to date - $38.3 Million

(3) Scope negotiated to date - Design and development of Apollo spacecraft guidance and navigation through November 30, 1964

b. Anticipated Changes:

(1) Estimated additional costs involved - About $62 Million

(2) Additional scope involved - To continue effort through FY 1970.

7. Project Changes Since FY 1965 President's Budget:

See 92-914-00 Apollo Spacecraft

8. Justification of FY 1966 budget estimate:

During fiscal 1965 contracts were negotiated for Block II guidance and navigation systems for all remaining command and lunar excursion module spacecraft for the lunar landing program as presently planned. Design of the Block II system was finalized during fiscal year 1965 and initial deliveries of Block II guidance and navigation systems will be made during fiscal year 1966. Development testing of Block II guidance and navigation systems will be completed during fiscal year 1966 and qualification and reliability testing will be initiated.

Delivery of all 19 Block I guidance and navigation systems currently under contract will be completed during fiscal year 1966. Fifteen Block II guidance and navigation systems for ground and flight test purposes will be delivered during fiscal year 1966.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT - LUNAR EXCURSION MODULE

1. Project Objectives:

Development of the Lunar Excursion Module which, with the Command Module and Service Module forms the complete Apollo Spacecraft. The Lunar Excursion Module will have the capability of separating from the Command and Service Modules and performing lunar descent from lunar Orbit, landing,ascent, rendezvous and docking with the spacecraft which remains in lunar orbit.

2. Project Content:

The development program includes ground tests of Lunar Excursion Module; structural, subsystems, and reliability testing. The Lunar Excursion Module major subsystems consist of the Structure, Guidance and Navigation, Stabilization and Control, Reaction Control, Environmental Control, Propulsion, Electrical Power, Instrumentation, Communications, Crew Provisions and Landing Gear systems. Modules will be flight tested on selected Saturn IB and Saturn V flights prior to the lunar landing mission. A total of ten ground test articles, two flight test articles and fourteen Lunar Excursion Modules are included in the development and operational program.

3. Summary Project Schedules

	Schedules Presented (FY)		
Project Milestones	FY '65	FY '66 (Prelim)	FY '66 (Final)
a. Complete preliminary design	'64	-	Complete
b. Complete major subsystem contracts	'64	-	Complete
c. Complete ground qualification tests of ascent engine	'65	-	'66
d. Deliver first LEM test article	'65	Underway	'65
e. Begin system integration test program (LTA-1)	'65	-	'65
f. Complete manufacture of LEM-1 for KSC	-	'67	'67
g. First rendezvous flight using Saturn IB (207)	-	'67	'68

4. **Project Funding:**

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
FY 1965 Pres. Budget	156,500	189,900	142,200	110,000	95,000	63,000
FY 1966 Prelim.Budget	156,500	185,700	197,800	179,200	128,800	49,000
FY 1966 Budget	135,000	217,000	265,800	258,500	195,800	118,000

5. Project Direct Manpower:

a. Contractor: Grumman Aircraft Engineering Company

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
3,600	4,600	4,500	3,600	2,500	1,200

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current status: Grumman Aircraft Engineering Co. NAS 9-1100

(1) Type of contract - CPFF

(2) Cost negotiated to date - $966.5 million

(3) Scope negotiated to date - 11 LEM's plus LTA's and FTA's. First delivery March 1965, last delivery December 1967.

b. Anticipated changes:

(1) Estimated additional cost involved - About $325 million

(2) Additional scope involved - Three additional LEM's. Last delivery August 1968.

7. Project Changes Since FY 1965 President's Budget:

See Apollo Spacecraft project

8. <u>Justification of FY 1966 Budget Estimate</u>:

During FY 1965, ten ground test LEM's (LTA's) and two flight LEM's will be in process of manufacture. Two of these LTA's will have been delivered; one for dynamic testing and the other for modal and separation testing.

During FY 1966 five LTA's will be delivered. Three will be retained at Grumman Aircraft Engineering Company (GAEC) for structural, integrated systems and environmental testing. One LTA will be delivered to NAA for CSM/LEM compatibility tests. The remaining LTA will be shipped to WSMR for propulsion and combined systems testing.

The ascent and descent engine qualification tests will be completed during FY 1966.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT - INTEGRATION, CHECKOUT AND RELIABILITY SUPPORT

1. Project Description:

MSC is responsible for the Integration, Checkout, and Reliability program for the Apollo Spacecraft. The General Electric Company supports MSC in this responsibility by providing engineering support to the Apollo Program Office, MSC, in the technical areas of integration, checkout and reliability. In addition, GE is the prime contractor for the Acceptance Checkout Equipment-Spacecraft (ACE-S/C). ACE-S/C is to be utilized for the whole of the Spacecraft preflight testing program and verification of the operational flight readiness of the Spacecraft.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	58,400	62,500	36,000	31,000	31,000	31,000
b. FY 1966 Prelim. Budget	62,400	53,300	36,000	36,000	36,000	36,000
c. FY 1966 Budget	60,700	44,500	69,300	51,000	33,000	21,000

d. Analysis and Justification of Significant Changes in Project Funding:

Changes in projected funding in FY 1965 are due to schedule adjustments permitting later delivery of earlier ACE-S/C Stations, and in FY 1966 the addition of five additional ACE-S/C Stations (for a new total of 15 stations).

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Item Funded:

	FY 1964	FY 1965	FY 1966
Integration, C/O & Reliability Support to MSC	6.0	6.5	6.5
ACE-S/C Hardware Program (15 Stations)	54.7	38.0	62.8

The Integration, C/O & Reliability Support funds cover engineering support to MSC-ASPO in the GSE and checkout portions of the CM/SM-LEM Program.

The ACE-S/C Hardware program funds cover the costs of design, fabrication, test and checkout, installation, maintenance and operations, and spare parts for 15 ACE-S/C Stations to be installed at NAA-Downey, GAEC-Bethpage, MSC and KSC.

b. Contractor Manpower:

		FY 1964	FY 1965	FY 1966
General Electric	(MSC)	180	182	180
	(Daytona)	400	900	850

c. Services of Other Government Agencies:

None

d. FY 1966 Procurement of Capital Items:

None

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACECRAFT - SPACE MEDICINE

1. Project Description: The Space Medicine program consists of activity directed toward: 1). The establishment of human requirements and tolerances for Apollo; 2). The design, development, test and evaluation of spacecraft hardware for life support, crew safety, crew operational effectiveness and the medical monitoring of crewman physiological status; 3). The evaluation, equipment development and implementation of medical training and the operational functioning of the medical monitors who are members of the ground support team.

2. Project Funding: - By Fiscal Year - In Thousands of Dollars

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. 1965 President's Budget	8,000	11,000	16,600	16,600	15,500	15,500
b. 1966 Prelim. Budget	10,500	13,200	13,500	13,500	16,500	----
c. 1966 Budget	5,400	**7,900**	**13,600**	13,600	12,500	12,500

d. Analysis and Justification of Significant Changes in Project Funding:

The increase from FY 65 to FY 66 in the FY 66 Budget line is the result of increased effort in the space suit area, directed primarily toward providing improved operational efficiency; the development of equipment for in-flight medical experiments; further efforts to improve food and waste management in extended flights; definition of the low frequency noise tolerance problem in spacecraft; and the initiation of studies of the characteristics of effects resulting from impact to establish emergency limits. The $6 million dollar reduction between the 1965 President's Budget for FY 66 and the 1966 Budget reflects the decision to go to a liquid cooled suit as the solution to the astronaut thermal balance problem; the completion of a series of studies to define human tolerances, involving acceleration, impact, vibration and atmosphere selection.

Significant also was the fact that some studies planned and investigated for the Apollo program were determined to have reached the stage for continuation under the Advanced Manned Missions program.

Justification for FY 1966 Budget Estimates

a. Identification of Requirements by Major Function, Activity and/or Cost Items Funded:

(1) Specialized Space Suit and Component Development Test and Equipment.

FY 64	FY 65	FY 66
.1	.2	.9

This effort will support the development of an increased mobility capacity for Apollo space suits. It will include improvement of components to provide greater flexibility of motion, refinement of techniques to be used in the testing programs, and specialized testing such as high vacuum, acoustic, and thermal cycling. (testing)

(2) Noise and Vibration

FY 64	FY 65	FY 66
.3	.8	1.5

These estimates will support increased efforts on the noise tolerance problems of Apollo, particularly in the low frequency range. It will also support studies involving the acoustic attenuation in the Command Module, and a series of studies concerned with physical tolerances to LEM descent acceleration.

(3) Development of Instrumentation for Inflight Medical Experiments

FY 64	FY 65	FY 66
0	.4	.9

This effort will be directed toward the development of hardware associated with inflight medical experiments required to assess the effects of flight upon astronaut physical condition and performance.

(4) Cardiovascular System Studies

FY 64	FY 65	FY 66
.9	.7	.8

These estimates reflect the collection, analyses and reduction of physiological and psycho-physiological data which will serve as a basis for flight stress studies.

(5) Other Development Activity

FY 64	FY 65	FY 66
4.1	5.8	6.5

These efforts support a variety of studies and development activities. Included are investigations of thermal balance in space suits, including the development of thermal analogs, establishment of metabolic loads and development of test instruments, medical operations for the training of medical monitors; development of a space suit heat transport system and development of improved restraint and support systems; development of spacecraft bioinstrumentation; and the development of spacecraft environmental control system components and subsystems.

b. Contractor Manpower

Not applicable.

c. Services of Other Agencies

TASK	AGENCY	FY 64	FY 65	FY 66
Sanitation and Personal Hygiene	U.S. Air Force	.025	.075	.050
Survival Equipment	U. S. Army	.050	-0-	-0-
Toxicity of Spacecraft Atmosphere	U. S. Navy and U. S. Air Force	.100	.175	.200
Noise Vibration and Acceleration	U. S. Air Force	.100	.200	.175
Radiation	Oak Ridge Inst. Nuclear Studies	.075	.220	.150
	U. S. Air Force	.050	.060	.050
Crew Performance Criteria	U. S. Air Force	.030	.030	.030
Thermal Stress	U. S. Air Force	.050	.150	.100
Space Suit Testing	U. S. Air Force	.075	.100	.075
Restraint Systems	U. S. Air Force	.160	.150	.150
Cardiovascular Studies	U. S. Air Force	.300	.200	.200
Medical Operations		-0-	-0-	.233
		1,015	1.360	1.413

GPO 936750

d. FY 1966 Procurement of Capital Items:

Not applicable.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE

1. Project Objectives:

To develop a two-stage launch vehicle capable of placing approximately 17,000 pounds of payload in a 100-nautical mile Earth orbit. The vehicle will be used for unmanned development flights of boilerplate Apollo spacecraft and for the launching of micro-meteoroid payloads. Elements of the launch vehicle and its checkout and launch systems have application to the Saturn IB and Saturn V launch vehicle systems.

2. Project Content:

The vehicle consists of two stages (the S-I powered by a cluster of eight H-1 engines developing 1,500,000 pounds of thrust, and the S-IV powered by a cluster of six RL-10 engines developing 90,000 pounds of thrust) and an instrument unit (IU) that contains the vehicle's inertial guidance system, control system and telemetry and tracking systems. Ten flight vehicles and the seven ground test stages make up the project. Seven of the flight test vehicles have been launched successfully from the John F. Kennedy Space Center. Three remain to be launched.

3. Summary Project Schedule:

A flight of a boilerplate Apollo command and service module was accomplished during September 1964. The flight test program will be completed with three micro-meteoroid payload flights which are planned to be launched during FY 1965.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	204,200	120,600	16,200
b. FY 1966 Prelim. Budget	188,700	74,200	9,400
c. FY 1966 Budget	187,100	68,400	4,400

5. Project Manpower:

a. Contractor(s): Not applicable.

b. NASA In-House Direct Manpower:

6. Project Procurement: See the following projects:

Saturn I Vehicle - S-I Stage
Saturn I Vehicle - S-IV Stage

7. Project Changes Since FY 1965 President's Budget:

Project Funding:

The decrease in FY 1964 and 1965 requirements resulted primarily from (1) a reduction in requirements for the S-I stage, I.U. and Vehicle Support, (2) successful launch of SA-5 which permitted a reduction in estimated requirements for engineering changes and (3) deletion of six previously planned S-IV stages which permitted greater savings than previously estimated.

8. Justification of FY 1966 budget estimate:

Funds are required in FY 1966 to conclude the Saturn I Program and to provide for a smooth transition from the Saturn I Program into the Saturn IB Program.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - S-I STAGE

1. Project Objectives:

   To develop the first stage for the Saturn I launch vehicle. The S-I stage design, development and operations experience gained will be applied to the Saturn IB stage which is a modified S-I stage.

2. Project Content:

   The project contains ten flight test stages and three ground test stages. Eight H-1 engines, producing 1.5 million pounds of thrust provide power for this stage. The first eight flight stages were produced by MSFC and the last two by Chrysler Corporation, Space Division, at the Michoud Plant in New Orleans, Louisiana. Fabrication and assembly of all ten stages has been completed. All stages will have been shipped to KSC by the first quarter of CY 1965.

3. Summary Project Schedules:

   See Saturn I flight schedule, Saturn I Vehicle project

S-I Stage Schedule	Static Firing Test Completion	Arrive at KSC
S-I-9	4/64	9/64
S-I-8	6/64	12/64
S-I-10	10/64	3/65

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	59,000	20,600	---
b. FY 1966 Prelim. Budget	59,200	12,100	2,500
c. FY 1966 Budget	59,500	9,900	700

5. Project manpower:

   a. Contractor: Chrsyler (Equivalent Manyears)

FY 1961-64	FY 1965	FY 1966	Total
4,460	610	44	5,114

b. NASA In-House Direct Manpower:

6. Project Procurement: Chrysler NAS 8-4016

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $125.0 Million

(3) Scope negotiated to date - Fabricate, assemble and checkout of two S-I flight stages; Activation of Michoud facility, preliminary design and development of S-I stage effort.

b. Anticipated Changes:

(1) Not applicable.

(2) Not applicable.

(3) Not applicable.

7. Project Changes Since FY 1965 President's Budget:

See Saturn I Vehicle project

8. Justification of FY 1966 budget estimate:

FY 1966 S-I funds will be used for post-flight evaluation and engineering services, documentation completion, and conclusion of launch support activity at Cape Kennedy.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - S-IV STAGE

1. Project Objectives:

To develop the second stage for the Saturn I launch vehicle. Design, development and operations experience gained with this liquid-oxygen liquid hydrogen engine powered stage will be applied to the S-IVB second stage of the Saturn IB, and the S-IVB third stage of the Saturn V.

2. Project Content:

Six flight stages and four ground test stages have been produced by Douglas Aircraft Co., Inc. Missile and Space Systems Division. The six RL-10 engines which are produced by United Aircraft provide a 100,000 lb. thrust. Of the six flight stages, three have been flown (S-IV-5 and 6 and 7). The remaining three S-IV stages (S-IV-8, 9 and 10) will be flown during FY 1965.

3. Summary Project Schedules:

See Saturn I for flight schedule, Saturn I Vehicle project

Stage Develop. Sched. (C.Y.)	Static Firing Test Completion	Ship to KSC
S-IV-9	8/64	9/64
S-IV-8	11/64	12/64
S-IV-10	3/65	3/65

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	82,100	55,400	6,400
b. FY 1966 Prelim. Budget	78,400	30,200	2,500
c. FY 1966 Budget	82,600	25,000	1,500

5. Project manpower:

a. Contractor: Douglas (equivalent manyears)

FY 1961 - 1964	FY 1965	FY 1966
8,241	1,285	100

b. NASA In-House Direct Manpower:

6. Project Procurement: Douglas Aircraft NAS 7-1

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $219,000,000

(3) Scope negotiated to date - Design, development and fabrication of six flight stages and four prototypes

b. Anticipated Changes:

(1) Not applicable.

(2) Not applicable.

(3) Not applicable.

7. Project Changes Since FY 1965 President's Budget:

See Saturn I Vehicle project

8. Justification of FY 1966 budget estimate:

S-IV funds will be used for post-flight evaluation and engineering services, documentation completion, and launch support activities necessary to terminate Cape Kennedy launch support operations.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I - VEHICLE INSTRUMENT UNIT

1. Project Objectives:

To develop a unit that will provide Saturn I vehicle with inertial guidance, control logic, telemetry and tracking. The units developed will have direct application to the Saturn IB and Saturn V launch vehicles.

2. Project Content:

The program contains six flight units and five ground test units. Of the six flight test units, three have been successfully flown, one other has been assembled, and two are in the fabrication and assembly phase. Testing of the ground test units was satisfactorily completed in September 1964. (MSFC acts as prime contractor for the unit. Major subcontractors are Bendix and IBM.)

3. Summary Project Schedules:

See Saturn I flight schedules, Saturn I Vehicle project

Instrument Unit Development Schedule (C.Y.)

	Checkout Completion	Del. KSC
S-IU-9	8/64	8/64
S-IU-8	12/64	12/64
S-IU-10	1/65	3/65

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	14,200	3,600	--
b. FY 1966 Prelim. Budget	11,500	2,200	--
c. FY 1966 Budget	9,100	3,000	--

5. Project Manpower:

a. Contractor(s): Not applicable.

b. NASA In-House Direct Manpower:

6. Project Procurement: Not applicable.

7. Project Changes Since FY 1965 President's Budget:

See Saturn I Vehicle project

8. Justification of FY 1966 budget estimate:

No FY 1966 funds required.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - GROUND SUPPORT EQUIPMENT

1. Project Objectives:

To provide the hardware required to handle, operate and checkout the vehicle for the 10 Saturn I vehicle launches. Automatic checkout techniques developed will be utilized in the Saturn IB and Saturn V projects.

2. Project Content:

The equipment procured has been installed at KSC launch complexes 34 and 37B through Saturn I-9.

3. Summary Project Schedule:

See flight schedule Saturn I, Saturn I Vehicle project.

All equipment essentially on hand.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	4,400	3,700	--
b. FY 1966 Prelim. Budget	4,400	1,800	--
c. FY 1966 Budget	3,700	1,700	--

5. Project manpower:

a. Contractor(s): Not applicable.

b. NASA In-House Direct Manpower:

6. Project Procurement: Not applicable

7. Project Changes Since FY 1965 President's Budget:

See Saturn I Vehicle project

8. Justification of FY 1966 budget estimate:

No FY 1966 funds required.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - H-1 ENGINE PROCUREMENT

1. Project Objectives:

To furnish H-1 engine to support the Saturn I (S-I Stage) launches.

2. Project Content:

Deliver for use in the Saturn I, S-I Stage project, approximately 148 engines of which 80 engines are for Saturn I flights and the remaining 68 engines for spares and tests.

3. Summary Project Schedules:

All H-1 engines have been delivered to meet the Saturn I launch schedule, **Saturn I Vehicle project.**

4. Project Funding:

	FY 64	FY 65	FY 66
a. FY 1965 President's Budget	3,200	-	-
b. FY 1966 Preliminary Budget	3,100	-	-
c. FY 1966 Budget	3,100	-	-

5. Project Manpower:

a. 1964 In-House Direct Manpower

6. Project Procurement:

Not applicable

7. Project Changes Since FY 1965 President's Budget:

None

8. Justification of FY 1966 Budget Estimate:

No FY 1966 Funds required.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - RL-10 ENGINE PROCUREMENT

1. Project Objectives:

To furnish RL-10 engines to support the Saturn I (S-IV Stage) launches.

2. Project Content:

Deliver for use in the Saturn I, S-IV Stage project, approximately 67 engines.

3. Summary Project Schedule:

All RL-10 engines have been delivered to meet the Saturn I launch schedule, **Saturn I Vehicle project.**

4. Project Funding:

	FY 64	FY 65	FY 66
a. FY 1965 President's Budget	4,900	-	-
b. FY 1966 Preliminary Budget	3,700	-	-
c. FY 1966 Budget	3,700	-	-

5. Project Manpower:

a. Contractor(s) - Not applicable.

b. NASA In-House Direct Manpower:

6. Project Procurement

Not applicable

7. Project Changes Since FY 1965 President's Budget:

See **Saturn I Vehicle project.**

8. Justification of FY 1966 budget estimate:

No FY 1966 funds required.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN I VEHICLE - VEHICLE SUPPORT

1. Project Objective:

   Provide stuides, services, or equipment that are common to more than one stage or system of the vehicle.

2. Project Content:

   Vehicle support in FY 1966 covers contractor and MSFC engineering support for conclusion of Saturn I vehicle stuides, and post-flight analysis. Vehicle support also includes Computation and Communication Services, propellant costs, the conclusion of launch support activity at Cape Kennedy and pad refurbishment.

3. Summary Project Schedules:

   Support is scheduled to meet Saturn I development and launch requirements as shown in the Saturn I Vehicle project.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966
a. FY 1965 Pres. Budget	36,400	37,300	4,800
b. FY 1966 Prelim. Budget	28,400	23,400	1,700
c. FY 1966 Budget	25,400	28,800	2,200

5. Project Manpower:

   a. Contractor(s): Not applicable.

   b. NASA In-House Direct Manpower:

6. Project Procurement: Not applicable.

7. Project Changes Since FY 1965 President's Budget:

   See Saturn I Vehicle project.

8. Justification of FY 1966 budget estimate:

Vehicle support funding will be used to provide computer services and other Marshall efforts associated with post-flight evaluation and engineering services. Support funds will also be used for pad refurbishment at Cape Kennedy.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE

1. Project Objectives:

   Development of a launch vehicle capable of placing approximately 35,000 pounds in a 100 nautical mile earth orbit; verification of command module (CSM) and lunar excursion module (LEM) systems operation; and the performance of rendevous, docking and crew transfer operations.

2. Project Content:

   The Saturn IB vehicle consists of two stages, the S-IB and the S-IVB, and an Instrument Unit. (See Saturn IB Vehicle, Saturn IB Vehicle - S-IB stage, and Saturn IB Vehicle - Instrument Unit projects. The vehicle is to be man-rated for earth-orbital testing. The program includes a total of 12 flight test vehicles and two ground test vehicles for dynamic testing and facility checkout of launch compleses 34 and 37.

3. Summary Project Schedules:

   Flights

SA-201-2	FY'66
SA-203-6	FY'67
SA-207-211	FY'68
SA-212	FY'69

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	149,900	260,100	272,500	232,000	147,000	31,500
b. FY 1966 Prelim. Budget	148,600	258,600	263,600	221,300	134,600	27,700
c. FY 1966 Budget	146,900	251,100	266,700	227,300	167,200	96,900

5. Project Manpower:

   a. Contractors: Not applicable.

   b. NASA In-House Direct Manpower:

6. Project Procurement: See the following projects:

S-IB Stage
S-IVB Stage
Instrument Unit
Ground Support Equipment
H-1 Engine Procurement
J-2 Engine Procurement

7. Project Changes Since FY 1965 President's Budget:

d. Project Funding: KSC requirements which were previously programmed under R&D were determined to be chargeable to CofF funds under the facility "turn-key" concept.

8. Justification of FY 1966 budget estimate:

During FY 1966 a significant milestone will be accomplished with the launching of the first Saturn IB vehicle. During this flight, the S-IVB stage and the J-2 engine will be flight tested for the first time. Since the S-IVB stage is also the third stage of the Saturn V vehicle, the success of this first Saturn IB flight will have significant impact not only on the Saturn IB but also on the Saturn V program. It will also significantly affect the spacecraft program since Saturn IB is to be used for flight testing of the Command and Service Module and later for flight testing of the complete Apollo spacecraft configuration. Two Saturn IB flights are planned during FY 1966.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - S-IB STAGE

1. Project Objectives:

Development of the first stage of the Saturn IB vehicle

2. Project Content:

The S-IB is powered by a cluster of 8 H-1 engines (see H-1 Engine Development project which develop a total of 1,600,000 lbs. of thrust at sea level. The S-IB stage is a modified version of the S-I stage (see Saturn I Vehicle - SI Stage project which is used on the Saturn I vehicle. S-IB stage effort includes fabrication, assembly and test of 12 flight test stages and the modification of the Saturn I Dyanmics Stage for Saturn IB dynamics test and facility checkout of Launch Complexes 34 and 37B.

3. Summary Project Schedules:

S-IB Stages will be delivered to support the Saturn IB flight schedule (Saturn IB Vehicle project).

	Static Firing Test Completion MSFC	Arrive at KSC
First S-IB Flight Stage (S-IB-I)	3/65	8/65

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	39,200	79,100	77,600	54,500	22,000	-
b. FY 1966 Preliminary Budget	46,000	72,400	74,200	53,500	23,400	2,000
c. FY 1966 Budget	48,000	69,400	75,500	53,600	25,100	2,000

5. Project Manpower:

a. Contractor: Chrysler (Equivalent Man Years)

FY 61-64	FY 65	FY 66	FY 67	FY 68	FY 68	TOTAL
790	2,420	1,970	1,550	830	90	7,650

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) CPFF (conversion to CPIF under consideration)

(2) $20.1 million

(3) Fabricate, assemble, static fire, checkout and deliver 12 S-IB flight stages. Provide engineering support and logistic spare parts

b. Anticipated Changes:

(1) about $27 million

(2) Launch support and systems engineering

(3) Last quarter of FY 65 for launch support effort

7. Project Changes Since FY 1965 President's Budget:

See Saturn IB Vehicle project

8. Justification of FY 1966 Budget Estimate:

S-IB Stage

During FY 1966 fabrication, assembly, checkout and static testing will be completed on four (4) S-IB stages. Two of these stages will be assembled in a vehicle configuration at Cape Kennedy and flight tested. Fabrication and assembly will be completed on a third stage and will begin or continue on eight (8) additional S-IB flight stages. Long lead procurement will begin on the last stage in the Saturn IB program later in the fiscal year.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - S-IVB STAGE

1. Project Objectives:

Development of the second stage of the Saturn IB vehicle to produce sufficient thrust to achieve earth orbital velocity. The S-IVB stage will also be used for the third stage of the Saturn V vehicle.

2. Project Content:

The S-IVB stage is powered by a single J-2 engine developing 200,000 lbs. of thrust. (See J-2 Engine Development project.) Basic development of the S-IVB stage is being carried on as part of the Saturn V project (See Saturn V Vehicle - SIVB Stage). The project includes engineering design, test and manufacturing effort compatible with the Saturn IB flight schedule (see Saturn IB Vehicle project). Battleship and structural testing, static test firings, dynamics, all systems and facilities checkout ground tests are part of the project. Twelve flight stages will be produced.

3. Summary Project Schedules:

S-IVB stages will be delivered to support the Saturn IB flight schedule as shown in the Saturn IB Vehicle project.

	Static Firing Test Completion	Arrive at KSC
First S-IVB Flight Article	6-'65	8-'65

4. Project Funding:

	1964	1965	1966	1967	1968	1969
FY 1965 (Pres. Budget)	21,600	57,000	64,500	52,300	32,000	5,000
FY 1966 (Prelim. Budget)	30,100	51,500	66,000	52,300	31,800	5,000
FY 1966 (Budget)	32,800	50,000	70,600	50,900	31,800	5,000

5. Project Manpower:

a. Contractor: Douglas Aircraft

	Equivalent Manyears				
FY 1961-64	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
784	1894	2328	1924	1260	210

b. NASA In-House Direct Manpower:

Project Procurement: Douglas NAS 7-101

a. Current status:

(1) Type of contract: CPFF (consideration being given to converting to CPIF in 1st quarter of FY 1966)

(2) Cost negotiated to date: $58.4 million

(3) Scope negotiated to date: Four flight stages, items peculiar to S-IVB/IB program on the Battleship, all-systems, dynamics, and facility checkout stages.

b. Anticipated Changes:

(1) Estimated additional cost involved: About $180 million

(2) Additional scope involved: Eight flight stages, development, test and launch support

(3) Estimated date change will be negotiated: 2nd quarter of FY 1965

7. Project Changes Since FY 1965 President's Budget:

See Saturn IB Vehicle project

8. Justification of FY 1966 Budget Estimate:

During FY 1966, fabrication, assembly, checkout and acceptance testing will be completed on four (4) S-IVB Stages. Two of these stages will

be assembled in a vehicle configuration and launched from Cape Kennedy. In addition, fabrication and assembly will either commence or continue on seven (7) additional S-IVB stages

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - INSTRUMENT UNIT

1. Project Objectives:

Development of an Instrument Unit which contains inertial guidance, control, telemetry and tracking systems.

2. Project Content:

The project includes facilities checkout, structural, vibration and dynamic tests and the production of twelve flight units to meet the requirements of the Saturn IB project. (See Saturn IB Vehicle project)

3. Summary Project Schedules:

Instrument Units will be delivered to support the Saturn IB flight schedule as shown in the Saturn IB Vehicle project.

	Complete Fabrication and Assembly	Arrival at KSC
First Flight Instrument Unit	5-'65	8-'65

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
FY 1965 (Pres. Budget)	14,200	28,400	25,600	14,900	4,000	-
FY 1966 (Prelim.Budget)	12,800	30,400	31,600	20,900	8,000	2,000
FY 1966 (Budget)	13,200	40,000	39,900	25,900	11,000	-

5. Project Manpower:

a. Contractor: International Business Machines

Equivalent Manyears

FY 1961-64	FY 1965	FY 1966	FY 1967	FY 1968	TOTAL
83	579	853	683	471	2669

b. NASA In-House Direct Manpower:

6. Project Procurement: IBM NAS 8-5469, 8-11561, 8-11562

a. Current Status:

(1) Type of contract: CPIF

(2) Cost negotiated to date: $5.8 million

(3) Scope negotiated to date: Fifteen Digital Flight Guidance Computers, fifteen Flight Data Adapters, one Prototype Digital Guidance Computer and Data Adapter, one set of Digital Guidance Computer and Data Adapter Test Equipment.

b. Anticipated Changes:

(1) Estimated additional cost involved: About $80 million

(2) Additional scope involved: Increased role for IBM in the assembly and checkout of the Instrument Unit.

(3) Estimated date change will be negotiated: November 1964

7. Project Changes Since FY 1965 President's Budget:

See Saturn IB Vehicle project

8. Justification of FY 1966 budget estimate:

In FY 1966 two Saturn IB Instrument Units will be completely assembled, checked out and flight tested. Fabrication and assembly will be completed on two Instrument Units and will begin on three additional Instrument Unit configurations. Long lead procurement will be initiated for four additional Instrument Units.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - GROUND SUPPORT EQUIPMENT

1. Project Objectives:

Development of ground support equipment required to handle, operate and checkout assembled vehicles and to provide for maintenance of the equipment.

2. Project Content:

The Saturn IB Vehicle Ground Support Equipment (GSE) includes automatic checkout systems as test units. The GSE encompasses computer controlled automatic checkout stations and mechanical support equipment for the Instrument Unit, S-IVB, and S-IB stages. In addition, the GSE encompasses computer controlled automatic launch vehicle checkout stations and mechanical support equipment for VLF-34 and VLF-37.

3. Summary Project Schedules:

Ground Support Equipment will be made available to support Saturn IB launches, as shown in the Saturn IB Vehicle project.

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
FY 1965 (Pres. Budget)	33,000	31,500	12,800	4,000	4,000	--
FY 1966 (Prelim.Budget)	24,000	38,200	9,700	5,000	3,600	2,500
FY 1966 (Budget)	21,600	36,700	9,700	7,300	4,100	--

5. Project Manpower:

a. Contractor: General Electric

Equivalent Manyears

FY 1961-64	FY 1965	FY 1966	FY 1967	FY 1968
155	338	325	290	60

b. NASA In-House Direct Manpower:

6. Project Procurement: General Electric NAS W-410

a. Current status:

(1) Type of contract: CPFF

(2) Cost negotiated to date: $8.9 million

(3) Scope negotiated to date: Engineering support and ESE design effort which is presently funded through December 31, 1964.

b. Anticipated changes:

(1) Estimated additional cost: About $21 million

(2) Additional scope involved: Configuration of ESE design effort, ESE fabrication effort, engineering support

(3) Estimated date change will be negotiated: October-December 1964

7. System Changes Since FY 1965 President's Budget:

See Saturn IB Vehicle project

8. Justification of FY 1966 budget estimate:

By the end of FY 1966, stage and vehicle GSE will be developed including the Saturn IB breadboard (GSE checkout prototype). Mechanical support equipment and electrical support equipment for Launch Complex 34 will be developed and will be operationally ready. Mechanical support equipment and electrical support equipment for Launch Complex 37B will also be developed and tested at Cape Kennedy.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - H-1 ENGINE PROCUREMENT

1. Project Objectives:

To furnish H-1 engines to support the Saturn IB, S-IB Stage launches.

2. Project Content:

There will be delivered for use in the Saturn IB, S-IB Stage project, 18 static test and spare H-1 engines and 96 flight engines to meet the Saturn IB launch schedule.

3. Summary Project Schedules:

H-1 engine deliveries will meet the requirements of the Saturn IB launch schedule. (Saturn IB Vehicle project)

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	8,000	12,400	9,700	4,000	500	-
b. FY 1966 Preliminary Budget	6,500	12,400	9,700	4,000	500	-
c. FY 1966 Budget	6,500	12,400	9,700	4,000	500	

5. Project Manpower:

a. Contractor(s): Rocketdyne (Equivalent Man Years)

FY 61-64	FY 65	FY 66	FY 67	FY 68	TOTAL
150	354	235	93	23	855

6. Project Procurement: (Rocketdyne NAS 7-162)

a. Current Status:

(1) CPFF (plan to change to CPIF July 1965)

(2) $26 million

(3) 92 Saturn IB Engines

b. Anticipated Changes:

(1) $6.9 million

(2) 22 H-1 engines, design changes, supporting parts, launch support

(3) July 1965

7. Project Changes Since FY 1965 President's Budget:

See **Saturn IB Vehicle project**

8. Justification of FY 1966 Budget Estimate:

During FY 1966 38 H-1 engines will be delivered and long lead procurement will be initiated for the remaining H-1 engines in the presently planned Saturn IB program.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - J-2 ENGINE PROCUREMENT

1. Project Objectives:

To furnish J-2 engines to support the Saturn IB, Stage S-IVB launches.

2. Project Content:

There will be delivered for use in the Saturn IB, S-IVB Stage project, seven static test and spare J-2 engines and twelve flight engines to meet the Saturn IB launch schedule.

3. Summary Project Schedules:

J-2 Engine deliveries will meet the requirements of the Saturn IB launch schedule. (See Saturn IB Vehicle project)

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968
FY 1965 (Pres. Budget)	6,400	11,000	12,500	3,300	-
FY 1966 (Prelim.Budget)	6,400	11,000	12,500	3,300	-
FY 1966 (Budget)	6,400	11,400	14,000	6,000	400

5. Project Manpower:

a. Contractor: Rocketdyne - J-2

Equivalent Manyears

FY 1961-64	FY 1965	FY 1966	FY 1967	FY 1968	TOTAL
233	310	380	160	10	1,093

b. NASA In-House Direct Manpower:

6. Project Procurement: Rocketdyne NAS 8-19

a. Current status:

(1) Type of contract: CPFF (plan to change to CPIF January 1965)

(2) Cost negotiated to date: $14.1 million

(3) Scope negotiated to date: Nine J-2 Engines

b. Anticipated Changes:

(1) Estimated additional cost involved: About $24 million

(2) Additional scope involved: Ten J-2 Engines, design changes, supporting parts and services.

(3) Estimated date change will be negotiated: January 1965

7. Project Changes Since FY 1965 President's Budget:

See **Saturn IB Vehicle project**

8. Justification of FY 1966 budget estimate:

During FY 1966, seven J-2 engines will be delivered for use on the Saturn IB S-IVB stages and long lead time procurement will be initiated for the remaining J-2 engines in the presently planned Saturn IB program.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN IB VEHICLE - VEHICLE SUPPORT

1. Project Objectives:

Provide studies, services, and equipment that are common to more than one stage or system of the vehicle.

2. Project Content:

Vehicle support includes system analyses of vehicle and associated GSE, general engineering support services not specifically identified with individual stages or vehicle units, investigation of such areas as performance, weight control, stage and payload separation, emergency detection studies, wind tunnel, dynamic, reliability and vehicle control and simulative tests, direct engineering support for test program preparation and test analysis, computer services, logistic support, procurement of such items as additional ground telemetry equipment, instrumentation, RF systems and telemetry and GSE measuring equipment, transportation and maintenance.

3. Summary Project Schedules:

Support is scheduled to meet Saturn IB development and launch requirements, as shown in the Saturn IB Vehicle project.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	27,500	40,700	52,200	53,300	52,800	6,500
b. FY 1966 Prelim. Budget	22,800	35,700	46,200	39,800	33,800	6,200
c. FY 1966 Budget	18,400	31,200	47,300	38,300	32,500	5,700

5. Project Manpower:

a. Contractor: Not applicable.

b. NASA In-House Direct Manpower:

6. Project Procurement: **Not applicable.**

7. Project Changes Since FY 1965 President's Budget:

See Saturn IB Vehicle project.

8. Justification of FY 1966 budget estimate:

Vehicle Support funds in FY 1966 will provide engineering and fabrication services, repair and maintenance of test stands, component and subsystem testing, updating and maintaining computer equipment and computer services, system documentation, and component qualification of critical components. Vehicle support funds will also be used to support Saturn IB vehicle oriented studies and study programs such as bending mode investigations and wind tunnel testing. In addition, vehicle support funds will be used for transportation of stages, communications, and inspection services provided by other Government agencies.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE

1. Project Objectives:

To develop a launch vehicle system with sufficient payload capability to carry a spacecraft on a mission of manned circumlunar navigation and lunar landing.

2. Project Content:

The Saturn V is a large three stage launch vehicle (282' x 33' diameter) with a capability of: (1) placing a payload of 240,000 lbs. into a 100 nautical mile earth orbit, or, (2) providing escape velocities for payloads of 90,000 lbs. The first, or booster, stage (S-IC) has a cluster of five F-1 engines with a total thrust of 7,500,000 lbs. The second stage (S-II) has a 1,000,000 lb. thrust using a cluster of five J-2 engines. The third stage (S-IVB), which uses a single J-2 engine, is almost identical to the second stage of the Saturn IB vehicle. The vehicle inertial guidance system is housed in the Instrument Unit above the S-IVB stage. The project comprises a vehicle development program including Ground Support Equipment (GSE); Saturn V vehicles for Dynamic Tests and Facility Checkout; development of three Stages and the Instrument Unit; delivery of six Saturn V vehicles for development and qualification purposes, and delivery of nine Saturn V vehicles for operational use, for a total of 15 Saturn V launch vehicles. In addition, ground test stages will be utilized for facility checkout, all systems, battleship and structural testing.

3. Summary Project Schedules:

Project Milestone	Schedules Presented (Quarter & CY) FY'65	FY'66(Prelim)	FY'66(Final)
a. Dynamics Test Program Initiation		3-65	4-65
b. Flight Test Program			
4-L/V Dev	67	67	67
6-L/V Dev and Oper's	68	68	68
5-L/V Oper's	69	69	69

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY1965 Pres. Budget	799,600	988,400	1,136,500	1,000,600	732,400	449,000
b. FY1966 Prelim. Budget	800,400	973,900	1,110,900	1,015,800	729,900	400,700
c. FY1966 Budget	690,900	1,031,600	1,236,500	1,187,300	1,109,900	897,900

5. Project Manpower: and
6. Project Procurement: See

Saturn V (S-IC Stage)
" (S-II Stage)
" (S-IVB Stage)
" (Instrument Unit)
" (F-1 Procurement)
" (J-2 Procurement)
" (Vehicle GSE)
" (Vehicle Support)

7. Project Changes Since FY 1965 President's Budget:

The differences in the estimates shown for Saturn V for FY 1964 and FY 1965 are directly related to the funding restrictions imposed upon this project as a result of Congressional action on the supplemental appropriation request. The increases shown for FY 1966 and ensuing years reflect the agency's most recent estimate of project requirements.

8. Justification of FY 1966 budget estimate:

The FY 1966 budget estimate provides funding for extensive vehicle ground testing in preparation for flight tests; checkout of the vehicle GSE breadboard; facilities checkout of position one at Launch Complex #39, and installation and checkout of Launch Complex #39. During FY 1966, long lead hardware procurement and fabrication and assembly of a number of stages and other components for various flight vehicles will continue.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - S-IC STAGE

1. Project Objectives:

Development of the first stage of the Saturn V Vehicle to produce sufficient thrust for vehicle lift-off and achievement of required first stage terminal velocity.

2. Project Content:

The S-IC stage is powered by a cluster of five F-1 engines developing a total thrust of 7,500,000 lbs. (See F-1 Engine Development project). The project includes: the ground test program including fuel tank, all systems, structural and dynamic tests; delivery of fifteen flight stages; definition of facility - GSE interfaces; facility checkout; and stage GSE sets to support the Saturn V program.

3. Summary Project Schedules:

Project Milestones	Schedules Presented (Quarter & CY) FY 65	FY 66 (Prelim)	FY 66 (Final)
(a) Static Test Program Initiation	--	2-65	2-65

(b) Delivery of 15 S-IC Stages to support the Saturn V launch program, F-1 Engine Development project.

4. Project Funding:

Run-out costs by year through FY 69 (Thousands of Dollars)

	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
FY 65 (Pres. Budget)	249,400	271,600	248,100	220,000	175,400	125,500
FY 66 (Prelim.)	255,900	235,400	248,100	225,700	189,300	125,500
FY 66 Budget	234,100	293,200	299,800	233,000	202,000	157,000

5. Project Manpower

(a) Contractor

Boeing NAS 2577
5606
5608

Direct Manpower
(In Equivalent Manyears)

FY 61 thru FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
10,227	9,273	9,015	8,076	7,299	5,844

(b) NASA In-House Manpower

6. Project Procurement

Saturn V S-IC Stage Contractor: Boeing

a. Current Status

(1) Type of Contract

NAS 8-2577 & 8-5608: - Cost plus fixed fee.
NAS 8-5606: Cost reimbursement.

(2) Cost negotiated to date

NAS 8-2577 $ 37.8M
NAS 8-5606 $ 18.6M
NAS 8-5608 $476.3M

(3) Scope negotiated to date

NAS 8-2577 - Preliminary effort prior to engineering, fabrication, assembly, checkout etc. of the S-IC stage.
NAS 8-5606 - Furnish R&D facilities equipment.
NAS 8-5608 - Activation of Michoud facility; design, development and delivery of ten (10) S-IC stages (2 ground stages and 8 flight stages); furnish test and checkout equipment for Saturn V vehicles and furnish support to MSFC.

b. Anticipated Changes

(1) Estimated additional cost(s) involved -

Approximately $820 million.

(2) Additional scope involved -

Design changes to present configuration; five follow-on stages; additional program requirements; additional variance.

(3) Estimated date(s) change(s) will be negotiated -

Additional variance	June 1965
Design changes to present configuration	March 1966
Follow-on Stages	April 1966
Additional Program requirements	December 1967

7. Project Changes Since FY 1965 President's Budget: (Explain and justify)

(See Saturn V Vehicle project)

8. Justification of FY 1966 budget estimate:

FY 1966 funding will provide for checking and testing of the all-systems, structural, and dynamic stages. These funds will also provide for testing of the facility checkout stage which, after testing, will be used to check out positions #1 and #2 at L.C.#39, KSC. The all-systems stage, upon completion of testing, will be used to check out the test stand at the Mississippi Test Facility. During FY 1966, fabrication and assembly will either begin or continue on six flight stages and long lead procurement will be initiated for four additional flight stages.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - S-II STAGE

1. Project Objectives:

Development of the second stage of the Saturn V (Three-stage) Launch Vehicle.

2. Project Content:

The S-II stage is powered by a cluster of five J-2 engines generating a total thrust of 1,000,000 lbs. (See J-2 Engine Development project. The project includes: electro-mechanical mock-up, battleship, structural, all-systems, facility checkout and dynamic test stages; 15 flight stages; facility-GSE interface determination; and delivery of stage GSE sets to support the Saturn V program.

3. Summary Project Schedules:

Project Milestones	Schedules Presented (Quarter & CY) FY'65	FY'66(Prelim)	FY'66(Final)
a. Battleship Test Program Initiation	FY'65	4-64	4-64
b. All Systems Test Program Initiation	---	4-65	4-65

c. Delivery of 15 S-II stages to support the Saturn V launch program, Saturn V Vehicle project.

4. Project Funding:

Runout costs by year through FY 1969:

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	165,100	189,900	195,500	170,000	117,000	56,40
b. FY 1966 Prelim. Budget	171,800	159,400	195,500	178,200	126,100	56,40
c. FY 1966 Budget	134,000	201,100	224,700	192,200	162,000	124,00

5. Project Manpower:

a. Contractor: North American Aviation, S&ID

Direct Manpower (In Equivalent Manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
7,925	6,430	6,263	6,263	4,870	2,100

b. NASA In-House Direct Manpower:

6. Project Procurement:

Saturn V S-II Stage Contractor: NAA S&ID
NAS 7-200

a. Current Status:

(1) Type of Contract - cost plus fixed fee

(2) Cost negotiated to date - $352.4 Million
Authorized but not negotiated - $332.3 Million

(3) Scope negotiated to date - Delivery of six flight stages and four ground test stages.

b. Anticipated Changes:

(1) Estimated additional cost involved - Approximately $430 Million.

(2) Additional scope involved - Additional variance; five follow-on flight stages; design changes to present configuration; additional program requirements.

(3) Estimated date(s) change(s) will be negotiated -
Additional variance - June 1965
Design Changes to present configuration - March 1966
Follow-on stages - April 1966
Additional Program requirements - June 1967

7. **Project Changes Since FY 1965 President's Budget:**

See Saturn V Vehicle project.

8. **Justification of FY 1966 budget estimate:**

FY 1966 funding will provide for: continuation of battleship testing and test firing of the all-systems stage at Santa Susana; structural testing at Seal Beach; facility checkout at Mississippi Test Facility and at position #1, Kennedy Space Center. Fabrication and assembly will be completed on the dynamic stage and testing of that stage will begin at MSFC. FY 1966 budget will also provide funds for the completion of fabrication and assembly of three flight stages. Fabrication and assembly will continue on the fourth flight stage and will be initiated on three additional flight stages. Long lead procurement will also be started for two more flight stages.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - S-IV B STAGE

1. Project Objectives:

Development of the third stage of the Saturn V Vehicle, which is essentially the same as the second stage of the Saturn IB Vehicle, to produce sufficient thrust as a final stage to achieve a predicted earth orbit or escape trajectory for the payload.

2. Project Content:

The S-IVB Stage is powered by a single J-2 engine developing 200,000 lbs. of thrust (see J-2 Engine Development project). Basic development of the stage is being carried on under this project. The project includes: battleship, structural, all-systems, dynamic and facilities checkout stages; the delivery of 15 flight stages; the determination of facility - GSE interfaces; and delivery of stage GSE sets to support the Saturn V program.

3. Summary Project Schedules:

Project Milestones	Schedules Presented (Quarter & CY) FY'65	FY'66(Prelim)	FY'66(Final)
a. Battleship Test Program Initiation		2-64	4-64
b. All Systems Test Program Initiation		1-66	4-65

c. Delivery of 15 S-IVB stages to support the Saturn V launch program, Saturn V Vehicle project.

4. Project Funding: Runout Costs - By Fiscal Year -(In Thousands of Dollars)

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	116,000	126,800	149,100	144,600	108,500	46,500
b. FY 1966 Prelim. Budget	126,700	123,400	149,100	144,600	117,500	46,500
c. FY 1966 Budget	115,800	160,600	188,700	150,600	125,000	82,500

5. Project Manpower:

a. Contractor: Douglas Aircraft Co.

Direct Manpower (in Equivalent Manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
4,697	4,582	4,772	4,642	3,916	1,976

b. NASA In-House Direct Manpower:

6. Project Procurement:

Saturn V S-IVB Stage

Contractor: Douglas Aircraft Co.
NAS 7-101

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $155.9 Million
Authorized but not negotiated - $218.9 Million

(3) Scope negotiated to date - Delivery of six flight stages and five ground test stages.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - Approximately $400 Million

(2) Additional scope involved - Design changes to present configuration; 9 follow-on stages; additional program requirements.

(3) Estimated date(s) change(s) will be negotiated -
Design changes - March 1965
Additional program requirements - July 1965
Follow-on stages - August 1965

7. Project Changes Since FY 1965 President's Budget:

See 92-933-00 Saturn V Vehicle

8. Justification of FY 1966 budget estimate:

FY 1966 funding will provide for initiation of all-systems testing at SACTO, and dynamic testing of the stage at MSFC; checkout of L.C. #39 at KSC; completion of fabrication and assembly of the first two flight stages; and initiation of fabrication and assembly of three additional flight stages. Long lead procurement will also take place for six additional flight stages. Also in FY 1966, test of the S-IVB restart capability will be initiated.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - INSTRUMENT UNIT

1. Project Objectives:

Development of an Instrument Unit which will house the Saturn V vehicle electronic intelligence systems and components and provide each component with a controlled environment.

2. Project Content:

The Instrument Unit includes an all inertial guidance system, a control system, and telemetry and measuring capabilities. The project encompasses: design and component testing; facility - GSE interface determination; structures, vibration, dynamic, systems and facilities checkout test units; and 15 flight units in support of the Saturn V launch program. (Saturn V Vehicle project)

3. Summary Project Schedules:

Instrument Units will be delivered to support the Saturn V flight schedule as shown in the Saturn V Vehicle project.

4. Project Funding:

Runout costs by year through FY 1969:

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	69,900	78,100	72,600	55,100	27,600	8,700
b. FY 1966 Prelim. Budget	57,700	84,700	78,800	62,500	33,300	20,500
c. FY 1966 Budget	55,500	81,000	91,200	69,100	59,000	41,300

5. Project Manpower:

a. Contractor: IBM

Direct Manpower (in Equivalent Manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
677	1,324	1,070	1,171	1,117	782

b. NASA In-House Direct Manpower:

6. Project Procurement:

Saturn V Instrument Unit Contractor: IBM
NAS 8-14000

a. Current Status:

(1) Type of Contract - Contractor presently working under a cost incurrence letter. Prime contract expected to be signed November 1, 1964.

(2) Cost negotiated to date: Proposal - $147.6 Million

(3) Scope negotiated to date - Design, development and fabrication of 15 Instrument Units.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - Approximately $35 Million

(2) Additional scope involved - Design changes to present configuration; additional requirements.

(3) Estimated date(s) change(s) will be negotiated -
Design changes to present configuration - January 1968
Additional requirements - January 1968

Saturn V Instrument Unit Contractor: IBM
NAS 8-11561,11562

a. Current Status:

(1) Type of Contract - Cost Plus Incentive Fee

(2) Cost negotiated to date - $51.7 Million

(3) Scope negotiated to date - Design, development and fabrication of data adapters and guidance computers for use in Saturn V instrument unit. (Quantity-15)

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - About $20 Million

(2) Additional scope involved - Design changes to present configuration; additional requirements.

(3) Estimated date(s) change(s) will be negotiated -
Design changes - January 1968
Additional requirements - January 1968

7. Project Changes Since FY 1965 President's Budget:

See Saturn V Vehicle project.

8. Justification of FY 1966 Budget estimate:

FY 1966 budget will provide funding for the continuation of systems testing and facility checkout of the vibration, dynamic and flight systems test units; fabrication and assembly of two flight units, and procurement of long lead hardware for seven additional flight units.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE GROUND SUPPORT EQUIPMENT

1. Project Objectives:

Development of non-facility ground support equipment required to handle, operate and checkout assembled vehicles and to provide for maintenance of the equipment.

2. Project Content:

The Saturn V vehicle Ground Support Equipment includes an automatic checkout system which was developed as a test unit in the Saturn IB project **to facilitate pre-launch countdowns and to improve launch reliability. Also included is equipment to be installed in Launch Complex 39 facilities, and the development and procurement of special test equipment and components.**

3. Summary Project Schedule:

Ground Support Equipment will be made available to support Saturn V launches as shown in **the Saturn V Vehicle project.**

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	25,800	70,100	71,500	54,000	36,600	29,600
b. FY 1966 Prelim. Budget	23,400	75,700	65,400	58,000	36,600	29,600
c. FY 1966 Budget	14,700	**60,700**	**88,600**	62,700	42,100	29,600

5. Project Manpower:

a. Contractor: RCA

Direct Manpower (In Equivalent Manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
110	258	368	118	100	50

b. NASA In-House Direct Manpower:

6. Project Procurement:

Saturn V Vehicle GSE — Contractor: RCA
NAS 8-2430,5423,5433
11582,13007.

a. Current Status:

(1) Type of Contract - NAS 8-2430,5433,11582-Cost plus fixed fee
NAS 8-13007 - Fixed price, incentive fee

(2) Cost negotiated to date - $29 Million

(3) Scope negotiated to date - Production of 17 RCA 110A computers and associated data links.

b. Anticipated Changes:

(1) Estimated additional cost involved - $25 Million

(2) Additional scope involved - Fabrication of seven Saturn V display systems; logistic and maintenance contract; installation costs for 15 computers; increase quality and reliability requirements; design changes.

(3) Estimated date(s) change(s) will be negotiated -
Display systems - Dec 1964
Logistics and maintenance contract - Jan 1965
Computer installation - Jan 1965
Quality and Rel. Requirement - Jan 1965
Design changes - Dec 1967

7. Project Changes Since FY 1965 President's Budget:

See **Saturn V Vehicle project.**

8. Justification of FY 1966 budget estimate:

FY 1966 budget estimates provide funding for completion of design, installation, and checkout of the Saturn V Automation System Development Facility breadboard; the vehicle GSE installation and checkout of launcher/umbilical towers #1 and #2; checkout of the launch control center; checkout of High Bays #1 and #3 of the Vertical Assembly Building and Pad A of Launch Complex #39. During FY 1966, eleven (11) RCA 110A computers will be delivered by the contractor.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - F-1 ENGINE PROCUREMENT

1. Project Objectives:

To furnish F-1 engines to support the Saturn V (Stage S-IC) launches.

2. Project Content:

There will be delivered for use in the S-IC stage system of the Saturn V launch vehicle project, 24 static test and spare engines, 10 vehicle ground test engines and 75 flight engines to meet the Saturn V launch schedule.

3. Summary Project Schedule:

F-1 engine deliveries will meet the requirements of the Saturn V launch schedule.

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	56,200	67,400	111,400	85,300	37,500	2,000
b. FY 1966 Preliminary Budget	56,200	67,400	111,400	85,300	37,500	2,000
c. FY 1966 Budget	41,000	78,600	97,000	95,000	47,000	2,200

5. Project Manpower: (Direct Manpower for Equivalent Man Years)

a. Contractor: Rocketdyne (NAS 8-5604)

FY 61-64	FY 65	FY 66	FY 67	FY 68	FY 69
1,353	1,950	2,216	2,225	1,074	99

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of Contract - CPFF

(2) Cost negotiated to date - $161.7 million

(3) Scope negotiated to date - Fabricate, inspect, acceptance test and deliver 76 F-1 engines; Fabricate and/or procure, inspect, test, & deliver 24 engine transporters and associated equipment Fabricate support hardware for the program; logistic supply support; Field Engineering; training; documentation; manuals data evaluation program.

b. Anticipated Changes:

Forecasted changes resulting from R&D program (scope change)

(1) Estimated additional cost(s) involved - Anticipated chages $93 million
Follow on Program 113 million

(2) Additional scope involved:

a) Follow on costs through program completion (33 engines & associated support)

b) Forecasted changes resulting from R&D program

(3) Estimated date(s) change(s) will be negotiated -

a) Forecasted change allowances: Aprox. every 6 months

b) Additional scope - May 1966

7. Project Changes Since FY 1965 President's Budget:

See **Saturn V Vehicle project**

8. Justification for FY 1966 Budget Estimate:

FY 1966 budget estimate provides for procurement of long lead items for 36 engines and delivery of 26 engines.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE - J-2 ENGINE PROCUREMENT

1. Project Objectives:

To furnish J-2 engines to support the Saturn V (S-II and S-IVB stages) launches.

2. Project Content:

There will be delivered for use in the Saturn V (S-II Stage) 14 static test and spare engines, 25 vehicle ground test engines and 75 flight engines. The Saturn V S-IVB Stage will utilize three static test and spare engines, 5 vehicle ground test engines and 15 flight engines. Total procurement of J-2 engines thus involves 17 static test and spare engines, 30 vehicle ground test engines and 90 flight engines to meet the Saturn V launch schedule.

3. Summary Project Schedule:

J-2 engine deliveries will meet the requirements of the Saturn V launch schedule.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	41,700	45,300	72,700	51,900	16,200	1,500
b. FY 1966 Prelim. Budget	42,000	46,000	72,700	51,900	16,200	1,500
c. FY 1966 Budget	29,200	62,800	83,800	70,100	27,400	1,500

5. Project Manpower:

a. Contractor: Rocketdyne NAS8-5603
Direct Manpower (In equivalent manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
1,270	1,780	2,260	1,880	710	40

6. Project Procurement:

J-2 Engine Procurement — Contractor: Rocketdyne NAS 8-5603

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $89.5 Million

(3) Scope negotiated to date - 55 engines & 6 simulators

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - About $185 Million

(2) Additional scope involved - 102 additional engines

(3) Estimated date change will be negotiated - October 1964

7. Project Changes Since FY 1965 President's Budget:

See Saturn V Vehicle project.

8. Justification of FY 1966 budget estimate:

FY 1966 budget estimate provides for procurement of long lead items for 48 engines and delivery of 41 engines.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SATURN V VEHICLE VEHICLE SUPPORT

1. Project Objectives:

Provides studies, services, and equipment that are common to more than one stage or system of the vehicle.

2. Project Content:

Vehicle support includes: engineering and fabrication support; computer services; range safety devices and tracking beacons for use during Saturn V operations; procurement of instrumentation; recording and data reduction equipment; activation and operation of the dynamic test stand; activation and operation of Mississippi Test Facility; procurement of vehicle test propellants; special tooling and fabrication of test hardware and fixtures; procurement of special test equipment for calibration and support of component testing; wind tunnel testing; cryogenic flow calibrations; vehicle propellant blast hazard testing; dimensional and non-destructive testing equipment for assembly and quality verification; quality and inspection services; development and operation of marine transport capabilities; use of special aircraft for emergency movement of outsized cargo; communications operations and equipment for special networks; vehicle systems engineering integration and analyses; vehicle documentation.

3. Summary Project Schedules:

Vehicle Support is scheduled to meet Saturn V development and launch requirements as shown in the Saturn V Vehicle project.

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	75,500	139,200	137,000	146,800	157,100	140,100
b. FY 1966 Prelim. Budget	66,700	120,700	130,000	131,700	137,900	99,100
c. FY 1966 Budget	66.600	93,600	162,700	169,200	175,400	134,800

5. Project Manpower:

a. Contractor: General Electric NAS w-410 (MTO Only)

Direct Manpower (in equivalent manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
110	274	753	1,141	1,238	1,254

b. NASA In-House Direct Manpower:

6. Project Procurement:

Saturn V Vehicle Support Contractor: G.E. NASw-410 (MTO portion only)

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $16.9 Million

(3) Scope negotiated to date - Plant and test support at Mississippi Test Facility including such items as transportation, security and other housekeeping services, t technical support including operation of labs and maintenance of test facilities.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - About $130 Millio

(2) Additional scope involved - Continuation of above scope on a year-to-year basis.

(3) Estimated date(s) change(s) will be negotiated - Just pric to beginning of each fiscal year.

7. Project Changes Since FY 1965 President's Budget:

See the Saturn V Vehicle project.

8. Justification of FY 1966 budget estimate:

FY 1966 funds are required for activation and operation of the Mississippi Test Facility; conversion of marine transportation barges and the transportation of vehicle stages from manufacturing sites to various test centers; activation of the dynamic test stand; continuation of vehicle integration and vehicle documentation efforts; procurement of instrumentation, telemetry and GSE measuring equipment; integration of special communication networks in support of vehicle test program; wind tunnel and dynamic testing; procurement of vehicle test propellants; pro-rata share of computer services; range safety devices and tracking beacons; maintenance, engineering and logistic support.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: H-1 ENGINE DEVELOPMENT

1. Project Objectives:

Development of a liquid oxygen/RP-1 (kerosene) engine for use in a cluster of eight in the first stage of the Saturn I and Saturn IB vehicles. The engine will be rated at 200,000 lbs. thrust.

2. Project Content:

The H-1 engine of 165,000 lbs. thrust rating was used successfully in the first four Saturn I launches. The remaining six Saturn I launches utilize the 188,000 lb. thrust engines. The Saturn IB will use the uprated 200,000 lb. thrust engines. Approximately 5000 single engine tests (including the earlier 165,000 lb. thrust engine, as well as the 188,000 and 200,000 lb. thrust engines) and approximately 70 cluster firings, including 10 flight tests in the Saturn I vehicle are included in the program. These tests will be supplemented by component tests directed towards increased reliability. Approximately 262 engines will be delivered for the Saturn I and IB program. Development effort will continue throughout the vehicle flight programs to provide support to these flights.

3. Summary Project Schedules:

Project Milestones	FY 65	Schedules Presented (FY) FY 66 (Prelim)	FY 66 (Final)
a. H-1 Engine Qualification	FY 65	FY 65	FY 65

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	11,100	9,800	6,800	6,100	5,800	5,800
b. FY 1966 Preliminary Budget	14,100	9,800	6,800	6,100	5,800	5,800
c. FY 1966 Budget	14,100	9,800	6,800	6,100	5,800	-

5. Project Manpower:

a. Contractor: Rocketdyne

FY 61-64	FY 65	FY 66	FY 67	FY 68	TOTAL
986	291	174	160	160	1,771

b. NASA In-House Direct Manpower:

6. Project Procurement: Rocketdyne NAS 7-190

a. Current Status:

(1) CPFF

(2) $11.9 million

(3) Design, develop, and test 14-1 188K thrust engine

b. Anticipated Changes:

(1) Approximately $26 million

(2) (a) modify test facilities, uprate engine to 200K thrust, improve injector - turbine exhaust systems;(2) provide for scope changes and follow-on development effort.

7. Project Changes Since FY 1965 President's Budget:

No changes

8. Justification of FY 1966 Budget Estimate:

The H-1 Development Program will be substantially reduced in FY 1966. Funds will be devoted primarily to completing the 200K engine qualification program and in continuing a product improvement effort. A significant part of the product improvement effort is concerned with providing support to the Saturn IB flight program, improving propulsion system performance and in contributing to the weight-saving program through engine refinement. Following the qualification of the 200K engine, this engine will be flight tested in the first and subsequent Saturn IB flights.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: RL-10 ENGINE DEVELOPMENT

1. Project Objectives:

Development of a liquid oxygen-liquid hydrogen engine of 15,000 lbs. thrust for use in clusters of six in the second stage of the Saturn I vehicle and in pairs in the second stage of the Centaur vehicle.

2. Project Content:

Approximately 6,000 single engine tests and 40 cluster firings (including 3 Saturn I flights and 2 Centaur flights) will be completed before the engine is qualified. Approximately 67 engines will be delivered for the Saturn I program. Development effort will contine throughout the vehicle flight programs.

3. Summary Project Schedules:

Project Milestones	Schedules Presented (FY) FY 65	FY 66 (Prelim.)	FY 66 (Final)
a. RL-10 A-3 Production Qualification	--	65	65
b. RL-10 A-3-3 PFRT	--	66	-
c. RL-10 A-3-3 Production Qualification	--	67	-

4. Project Funding:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	20,000	17,900	17,000	16,500	16,000	15,800
b. FY 1966 Preliminary Budget	20,000	17,900	15,000	12,000	-	-
c. FY 1966 Budget	20,000	17,900	2,000	-	-	-

5. Project Manpower:

a. Contractor: Pratt & Whitney

FY 61-64	FY 65	FY 66	FY 67	TOTAL
2,929	630	476	404	4,439

b. NASA In-House Direct Manpower:

6. Project Procurement: (Pratt & Whitney NAS 8-5623)

a. Current Status:

(1) CPFF

(2) $30 million

(3) Design, development and testing of RL-10 engine. Also provides for product improvement effort

b. Anticipated Changes (i.e. to place balance of current approved program under contract)

(1) Estimated additional cost(s) involved - $9 million

(2) Additional scope involved - Extension of development program to September 1966

(3) Estimated date(s) change(s) will be negotiated - September 1965

7. Project Changes Since FY 1965 President's Budget:

No changes

8. Justification of FY 1966 Budget Estimate:

RL-10 engine funding in FY 1966 will be devoted to the completion of preliminary rating tests and qualification of the RL-10 A-3-3 engine. Continuing development of the RL-10 engine has been necessary to achieve the high performance required to carry out the suveyor mission. Additional FY 66 RL-10 development funds will be used for post-flight evaluation of Saturn I flight data and the reestablishment of spare RL-10 engines not used in the Saturn I program for other purposes.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: F-1 ENGINE DEVELOPMENT

1. Project Objectives:

Development of a 1,500,000 lb. thrust liquid oxygen and RL-1 (kerosene propellant) engine for use in a cluster of five in the first stage of the Saturn V vehicle.

2. Project Content:

Approximately 1,500 engine tests will be made during the development program through qualification. These tests will be supplemented by component tests directed toward increased reliability. Approximately 106 engines will be delivered in the Saturn V flight vehicle program. Development effort will continue throughout the flight vehicle program to provide necessary engineering support.

3. Summary Project Schedules:

Project Milestones	Schedules Presented FY'65	FY'66(Prelim)	FY'66(Final)
a. Delivery of first flight engine	FY'65	--	FY'65
b. Design Release Qual. Engine	FY'65	--	FY'65
c. Complete flight rating tests	FY'65	FY'65	FY'65
d. Completion of Engine Qualification	--	FY'67	FY'67

4. Project Funding: Runout Cost - By Fiscal Year -(In Thousands of Dollars)

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	62,300	64,100	68,200	62,800	55,100	46,800
b. FY 1966 Prelim. Budget	68,300	64,100	69,200	64,800	55,100	46,800
c. FY 1966 Budget	68,300	62,100	69,200	64,800	49,900	38,800

5. Project Manpower:

a. Contractor: Rocketdyne NASw-16
Direct Manpower (In Equivalent Manyears)

FY'59 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
6,632	1,668	1,506	1,399	1,137	888

b. NASA In-House Direct Manpower:

6. Project Procurement:

F-1 Engine Development — Contractor: Rocketdyne NASw-16

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $273.8 Million

(3) Scope negotiated to date - Design, develop and test a single thrust chamber liquid propellant rocket booster engine of 1,500,000 pound nominal thrust.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - About $180 Million

(2) Additional scope involved - Follow-on costs through program completion - Forecasted change allowance.

(3) Estimated date(s) change(s) will be negotiated - Periodically through FY 1969.

7. Project Funding Changes Since FY 1965 President's Budget:

The differences shown are the result of more refined estimates of engineering support requirements.

8. Justification of FY 1966 budget estimate:

Design, development and intensive testing of the F-1 engine will continue in FY 1966 with approximately one-half of the engine components qualified for manned flight by the end of the fiscal year. The components of the engine will be improved by operating the engine under extreme limits and environmental conditions and by refining the proof tested components where necessary. Complete engine qualification is schedule to be completed during FY 1967.

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: J-2 ENGINE DEVELOPMENT

1. Project Objectives:

Development of a 200,000 lb. thrust liquid oxygen and liquid hydrogen engine for use as a single engine in the second stage of the Saturn IB and the third stage of the Saturn V vehicles, and, as a cluster of five in the second stage of the Saturn V vehicle.

2. Project Content:

Approximately 1,500 engine tests will be made during the development program through qualification. These tests will be supplemented by component testing directed toward increased reliability. A total of 157 engines will be delivered in the Saturn IB and Saturn V flight vehicle programs. Development effort will continue throughout these flight vehicle programs to provide necessary engineering support.

3. Summary Project Schedules

	Project Milestone	Schedules Presented FY'65	FY'66(Prelim)	FY'66(Final
a.	Preliminary flight rating test	FY'64	FY'65	FY'65
b.	Delivery first flight engine	FY'65	--	FY'65
c.	Complete engine qualification	FY'66	FY'66	FY'66
d.	Complete flight rating test	FY'65	FY'65	FY'65
e.	Engine qualified for unmanned flight	FY'65	--	
f.	Delivery first production engine	--	FY'64	FY'64

4. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

		1964	1965	1966	1967	1968	1969
a.	FY 1965 Pres. Budget	56,600	61,600	61,700	48,100	43,600	35,100
b.	FY 1966 Prelim. Budget	63,600	61,600	62,700	50,600	43,600	35,100
c.	FY 1966 Budget	63,600	59,600	62,700	50,600	39,000	29,900

5. Project Manpower:

a. Contractor: Rocketdyne NAS8-19
Direct Manpower (In Equivalent Manyears)

FY'61 thru FY'64	FY'65	FY'66	FY'67	FY'68	FY'69
4,385	1,730	1,490	1,140	910	690

b. NASA In-House Direct Manpower:

6. Project Procurement:

J-2 Engine Development — Contractor: Rocketdyne NAS 8-19

a. Current Status:

(1) Type of Contract - Cost plus fixed fee

(2) Cost negotiated to date - $182.7 Million

(3) Scope negotiated to date - Design, develop and test J-2 200K thrust engine to qualification.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved - About $130 Million

(2) Additional scope involved - Follow-on costs through program completion.

(3) Estimated date(s) change(s) will be negotiated - Periodically through FY 1969.

7. Project Funding Changes Since FY 1965 President's Budget:

The differences shown are the result of more refined estimates of engineering support requirements.

8. Justification of FY 1966 budget estimate:

During FY 1966 a continuing intensive test program is planned to complete component qualification, culminating in the completion of engine qualification. This date is important since it will certify the flight worthiness of the J-2 engine for use in manned flight. The components of the engine will be improved by operating the J-2 under extreme limits of environment conditions and by refining the proof tested components where necessary.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: MISSION CONTROL SYSTEMS

1. Project Description:

The focal point for the gathering and transmission of information, advice and recommendations to the astronauts engaged in each manned space flight will be the Integrated Mission Control Center (IMCC) at Houston, Texas. The IMCC will exercise operational direction and technical management for manned space flight missions in all aspects of ground support from the beginning of countdown through flight operations to recovery.

This project includes the development, operation and maintenance of the IMCC and the associated interface equipment at the Kennedy Space Center, as well as the technical integration of the IMCC with the world-wide manned space flight network.

2. Project Funding: Runout Cost - By Fiscal Year -(In Thousands of Dollars)

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	52,500	41,400	33,800	34,600	32,100	32,000
b. FY 1966 Prelim. Budget	52,500	41,500	36,400	35,700	35,100	35,000
c. FY 1966 Budget	47,500	38,500	36,400	35,700	35,100	34,900

d. Analysis and Justification of Significant Changes in Project Funding:

The greater part of the equipment for the IMCC was procured in FY 1964. The reduction in the estimate for FY 1965 is the result of delay in implementing the IMCC. Procurement of spares and modifications and maintenance and operations costs were reduced.

3. Justification of FY 1966 Budget Estimate

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
Integrated Mission Control Center	$44,907	$ 28,674	$ 28,350

The FY 1966 estimate provides for the continued rental of six IBM 7094 Data Processing Systems and for the large Programming effort required for the complex Apollo missions. (Purchase of the computers is not planned since they are now rapidly becoming obsolete and will probably be replaced in the FY 1967-68 period.). The estimate also provides for spares to keep the IMCC functioning properly, and although the IMCC was designed with considerable versatility, modifications will be required as its use for specific missions gets under way and as presently unforeseen changes are necessary in the flight plans. The amount shown will also provide for contractor personnel who will maintain and operate the IMCC during both simulated and actual flights.

	FY 1964	FY 1965	FY 1966
Ground Operational Support System	1,674	4,500	2,500

The FY 1966 estimate provides for contractor engineering and technician personnel to continue effort of integrating the IMCC with the ground network and for Launch and Interface Equipment.

Electronic Systems Test and Support Laboratory Equipment	708	530	500

The FY 1966 estimate provides for the equipment and effort that assures compatibility between the ground and the spacecraft equipment. It also provides for equipment used in the IMCC to test new techniques and evaluate the performance of the IMCC itself.

Control Systems Support	241	530	500

The FY 1966 estimate provides for the continued lease of teletype, switchboard and miscellaneous communications equipment used in the IMCC. It also provides funds for obtaining contractor assistance to solve special technical problems in the Mission Control Systems area.

b. Contractor manpower:	FY 1964	FY 1965	FY 1966
Philco	324	400	400

The FY 1966 estimated manpower is required to continue the M&O of the IMCC.

	FY 1964	FY 1965	FY 1966
IBM	237	270	280

The FY 1966 estimated manpower is for continued programming support and M&O in the Real-time Computer Complex area of the IMCC.

c. Services of Other Government Agencies: Not applicable.

d. FY 1966 Procurement of Capital Items: Not applicable.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: APOLLO SPACE OPERATIONS

1. Project Description:

Three major categories of Apollo space operations support are provided under this project: pre-flight, flight and crew.

Pre-flight operations includes the effort required to check out the spacecraft at the launch area prior to launching. Among the services provided are those for the collection, recording and evaluation of checkout telemetry data, and those for the connecting and checkout of the ground support equipment.

Flight mission operations include the planning, support and actual accomplishment of the spacecraft mission from lift-off to recovery. Included are the broad areas of mission planning, flight control and operational support.

Crew operations provide for the training and integration of crew activities with the engineering design and development of Apollo spacecraft and with flight mission planning. Equipment requirements for crew training are also provided.

2. Project Funding: Runout Costs - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	2,900	21,600	40,900	39,900	44,900	35,600
b. FY 1966 Prelim. Budget	3,700	30,400	41,000	39,500	55,900	35,200
c. FY 1966 Budget	3,700	23,400	41,000	49,600	56,600	36,100

d. Analysis and Justification of Significant Changes in Project Funding:

The increase of $.8 Million in FY 1964 was necessary to provide additional maintenance equipment and support of astronaut space readiness training aircraft. The FY 1965 estimate was increased from $21.6 Million to $23.4 Million by the addition of procurement of aircraft for astronaut space readiness training with offsetting reductions in other project areas. Estimates for FY 1967 through FY 1969 were increased to provide for the procurement of additional Free Flight Lunar Landers in FY 1967 and for their maintenance in subsequent fiscal years.

3. Justification of FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
Preflight Operations	100	3,600	11,400

The FY 1966 funds will complete the program of installation of necessary ground support equipment and will support the preparation of spacecraft for the initial Saturn IB flights.

Flight Operations	2,400	5,800	13,400

The estimate for FY 1966 is based on planned schedules for procurement of special operations equipment, training of ground support personnel and the direct support of the initial Saturn IB flight schedule during this period, including reimbursement to DOD for recovery operations support.

Crew Operations	1,200	14,000	16,200

The FY 1966 estimates provide for flight crew academic and mission training; flight crew participation in the direct support of initial Saturn IB flights and mission simulation and training for early Saturn V flights; procurement of aircraft for space readiness training of the astronauts coming on board in FY 1966; and support and maintenance of space readiness training aircraft.

b. Contractor Manpower: Not applicable

c. Services of Other Government Agencies:

	FY 1964	FY 1965	FY 1966
DOD Task Force Support	-0-	-0-	9,000

These funds provide for reimbursement to DOD for recovery operations support of the Saturn IB flight scheduled in FY 1966.

d. FY 1966 Procurement of Capital Items: Not applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: LAUNCH OPERATIONS SUPPORT

1. Project Description:

This project includes the development, procurement, installation, maintenance and operation of the NASA facilities at the Merritt Island Launch Area (MILA) and the Eastern Test Range (ETR) required in support of the Manned Lunar Landing Program. NASA and DOD each fund for the development, procurement, installation, maintenance and operation of facilities in the Cape Kennedy area for which they are operationally responsible regardless of specific location.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	24,700	37,300	51,000	57,000	57,000	57,000
b. FY 1966 Prelim. Budget	24,700	43,000	59,500	57,000	57,000	57,000
c. FY 1966 Budget	19.400	30.100	53,600	57,000	57,000	57,000

d. Analysis and Justification of Significant Changes in Project Funding:

The reduction in FY 1965 results largely from adjustments to the funding position on major support contractors at KSC.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
AFETR Operations Support	$ 8,460	$ 4,254	$ 9,690

Reimbursement for launch support services provided by the Air Force and range contractors and the basic equipment, supplies and stock materials required by the range contractors in support of the program. The level of funding is based on requirements in support of the initial Saturn IB launches scheduled during the period and the terms of the Webb/McNamara agreement of 17 January 1963 which delineates funding responsibility.

	FY 1964	FY 1965	FY 1966
Contractor Support	$ 9,599	$17,192	$32,140

Provides for base support services in the MILA area, special maintenance and necessary modifications of facilities, base communications support, photographic services and launch support operations. These services are required for normal operation and maintenance of the MILA area and direct support for specific Apollo launches during the FY 1966 time frame.

Equipment	1,398	8,654	11,720

Provides for the major equipments required in accordance with the terms of the support contracts for the performance of support services. This equipment includes, trucks, dozers, cranes, etc. The funding is based on a projection of requirements developed under Contractor Support planning.

b. Contractor Manpower:

	(Equivalent Manyears)		
Contractor	FY 1964	FY 1965	FY 1966
TWA	-0-	1,600	1,750
RCA	-0-	158	195
Bechtel	-0-	132	230
*Launch Support Operations	-0-	421	693

*Contract award expected in 2nd Quarter, FY 1965.

c. Services of Other Government Agencies:

Agency	FY 1964	FY 1965	FY 1966
USAF	8,460	4,254	9,690

d. FY 1966 Procurement of Capital Items: None

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: LAUNCH INSTRUMENTATION

1. Project Description:

Launch instrumentation is the group of technical systems and facilities at Cape Kennedy required to monitor and determine the performance of launch flight vehicles and associated launch support facilities. Included are launch control centers, tracking and telemetry sites, computing facilities, displays, flight TV receiving equipment, facility and environmental instrumentation, and associated data communication links. All equipment is located on MILA, Cape Kennedy, or the adjacent Florida mainland.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. 1965 Pres. Budget	11,800	14,000	15,000	15,000	15,000	15,000
b. 1966 Prelim. Budget	11,800	12,000	15,000	15,000	15,000	15,000
c. 1966 Budget	8.500	10.400	12.900	15.000	15,000	15,000

d. Analysis and Justification of Significant Changes in Project Funding:

There is an on-going requirement for launch instrumentation at least through the Apollo program. The support provided is of critical importance in the determination of flight performance and the development of launch vehicles. Range instrumentation support is provided by the Air Force under an agreement between NASA and the Secretary of Defense dated January 17, 1963, but program-oriented and precision close-in instrumentation support is provided under this budget item.

Funds required each fiscal year increase until a leveling off at $15.0 occurs in 1967. This is correlated directly with the increasing complexity of launch vehicle flights.

Actual expenditures in FY 1964 were less than anticipated due to the delay in construction of associated facilities under the C of F program.

Revised lower estimates for FY 1965 and FY 1966 are occasioned by refinement of project requirements.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
(1) Telemetry Equipment	$ 462,121	$ 538,300	$1,200,000

Single sideband calibration equipment, narrow-band S-band receivers, and predetection diversity combining equipment are required for handling telemetry from future Saturn vehicles.

(2) Tracking Equipment	1,880,700	1,065,150	1,800,000

A broadband conical scan antenna feed system, a technique for digitizing doppler data at receiver sites, and a technique for obtaining direct ODOP ranging data will be developed. Present baselines will be extended to increase accuracy.

(3) Timing Equipment	284,409	293,000	400,000

Equipment for providing additional timing formats and for accomplishing time signal distribution to additional stations on MILA will be purchased.

(4) Data Analysis and Display Equipment	142,331	919,000	600,000

Development of a data presentation system having improved resolution will be pursued. Electroluminescent display panels and equipment for the LIEF (data exchange with MSFC) system will be procured. Use of color will be investigated.

(5) Facility and Environmental Instrumentation	920,746	1,039,970	1,600,000

Launch test site instruments and instruments for specialized facility tests will be procured. Facility and environmental instrumentation problem areas will be investigated.

(6) Acoustic Measuring System	139,064	299,255	150,000

Accuracy and reliability will be improved as necessary for the larger Saturn vehicles. The number of acoustic measuring points will be increased from 80 to 155, and equipment for semi-automatic data reduction will be procured.

	FY 1964	FY 1965	FY 1966
(7) Electromagnetic Hazards Control	383,473	212,200	400,000

Equipment will be procured and techniques will be investigated as appropriate for suppressing or minimizing electromagnetic interference which has the potential for causing catastrophic effects during launch of a vehicle.

(8) Operational Television System	133,023	505,000	850,000

The system will be expanded to provide for a dual-launch pad coverage and more flexible and more accurate ground equipment.

(9) Special Instrumentation	443,344	116,500	150,000

A system for determining the sway, structural loading, and flexure of a vehicle on a launch pad will be developed. The development of a close-in high accuracy optical system for obtaining initial flight path data will be continued.

(10) Instrumentation Operation and Maintenance	3,026,171	3,587,140	5,000,000

This provides for maintenance, repair, replacement, and operation of launch instrumentation equipment, including computer programming. Materials, supplies, and labor are included.

(11) Prototype Engineering and Fabrication	691,598	821,435	750,000

Contractual services are required for the design and construction of printed circuit boards and chassis prototypes prior to release of specifications for hardware procurement.

(12) Launch Vehicle Operations	--	1,003,050	--

This provides for automated telemetry checkout equipment and RF Checkout equipment for launch complexes 34 and 37, high speed measuring equipment, supplies and materials, and maintenance, repair and replacement of equipment.

b. Contractor manpower:

	Man-years		
	FY'64	FY'65	FY'66
Federal Electric Corporation	-0-	120	174

c. **Services of Other Government Agencies:**

None

d. **FY 1966 Procurement of Capital Items:**

None

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SYSTEMS ENGINEERING CHECKOUT EQUIPMENT, RELATED ENGINEERING DESIGN AND OTHER ENGINEERING SUPPORT

1. Project Description:

This effort includes provision of engineering support to the NASA Headquarters Apollo Project Office primarily in the areas of reliability and documentation. In reliability, efforts have been directed toward techniques and methods for assessing mission success and flight safety probabilities as well as the development of failure-effects analysis. Evaluation methods have been under development for reliability and quality program planning. The documentation function includes development of documentation plans, and requirements, selection and modification of existing documents and development of new ones.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. FY 1965 Pres. Budget	26,000	32,000	32,000	32,000	32,000	32,000
b. FY 1966 Prelim. Budget	22,000	32,000	32,000	32,000	32,000	32,000
c. FY 1966 Budget	18,800	32,000	31,000	30,000	30,000	30,000

d. Analysis and Justification of Significant Changes in Project Funding:

None

3. Justification for FY 1966 Budget Estimate:

The FY 1966 funds are for continuation of the General Electric contract in an engineering support role and other items as shown below. It is necessary to maintain a continuous effort, requiring constant updating of material and studies in accordance with launch schedule, mission assignments, and the requirements of an advancing program.

a. Identification of Requirements by Major Function, Activity, and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
(1) Mission Rel. & Safety Analysis	7,500	8,500	8,500
(2) Reliability Eng'ng	3,000	3,000	3,000
(3) Quality Assurance	3,000	3,000	3,000
(4) Operations Documentation Instrumentation, and Data Requirements	600	600	600
(5) Documentation Support	1,229	1,250	1,250
(6) Performance Analysis	500	1,950	950
(7) GOSS Rel. Assessment	-0-	3,500	3,500
(8) GSE Rel. Assessment	-0-	2,750	2,750
(9) Checkout Prog. Assessment	-0-	1,950	1,950
(10) Checkout Effect. Studies	-0-	3,000	3,000
(11) I.L.C.C.S. Engineering	3,000	-0-	-0-
(12) Checkout Tol. Control	-0-	1,000	1,000
(13) Measurement and Stimulus Techniques	-0-	1,500	1,500

b. Contractor Manpower:

Contractor	Equivalent Manyears		
	FY'64	FY'65	FY'66
G.E.	900	600	600

c. Services of Other Government Agencies:

None

d. FY 1966 Procurement of Capital Items:

None

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SYSTEMS ENGINEERING - SYSTEMS

1. Project Description:

This effort is primarily study and evaluation of mission objectives, system concepts, technological state-of-the-art, functional performance and test requirements, optimum system configuration, and programming requirements. Outputs include the top level Apollo System Specification, design requirements and results of special studies. Much of this service is provided by Bellcomm Corporation.

2. Project Funding:

Runout Cost - By FY - In Thousands of Dollars

	1964	1965	1966	1967	1968	1969
a. 1965 President's Budget	14,900	14,000	14,000	14,000	14,000	14,000
b. 1966 Preliminary Budget	9,800	14,000	14,000	14,000	14,000	14,000
c. 1966 Budget	10,000	14,000	15,000	16,000	16,000	16,000

d. Analysis and Justification of Significant Changes in Project Funding:

None

3. Justification for FY 1966 Budget Estimate:

This activity provides for continuing program-wide technical support needed for the successful accomplishment of the Apollo Program. Its purpose is to provide assurance that the functional and performance requirements of all elements of the program are compatible with each other and with the mission objectives. Studies have been completed which reaffirmed the selection of the lunar orbital rendezvous (LOR) mode for the Apollo mission. Recent systems engineering activities include increased emphasis on development of top-level specifications for Apollo that insure that each subsystem element will be developed in accordance with the overall system requirement. Studies concerning flight mission assignments, guidance and navigation, communications and tracking networks and checkout effectiveness are in progress. Fiscal year 1966 funding provides for an extension of most of the analyses now under way and initiation of new efforts, including mission error analysis, design evaluations of checkout systems and support to the Apollo Science Program.

a. Identification of Requirements by Major Function, Activity, and/or End Items Funded:

	FY 1964	FY 1965	FY 1966
(1) Systems Engineering	8,670	12,000	13,000
(2) Pre-flight Engineering Studies	633	1,120	2,120
(3) Project Galaxie (WOO)	257	200	220
(4) Contingency Plan	-0-	680	500
(5) Air Force Contract Support	388	-0-	-0-

b. Contractor Manpower:

Contractor	Equivalent Manyears		
	FY 1964	FY 1965	FY 1966
Bellcomm	215	340	350

c. Services of Other Government Agencies:

Bureau of Standards	-	$40,000

d. FY 1966 Procurement of Capital Items:

None

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: SPACECRAFT TECHNOLOGY

1. Project Description:

Spacecraft Technology provides for development of improved or alternate systems, subsystems, components and materials relating primarily to spacecraft, structures, flight systems and human factors requirements. This project provides for substitutes to mainstream hardware in approved projects on a scheduled basis and incorporates state-of-the-art advances into current projects to assure performance and reliability.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	18,700	20,200	20,200	20,200	20,200	20,200
b. FY 1966 Preliminary Budget	21,800	20,600	20,200	20,200	20,200	20,200
c. FY 1966 Budget	6,000	23,800	23,200	23,200	23,200	23,200

d. Analysis and Justification of Significant Changes in Project Funding:

The increase in FY 1965 and subsequent years over obligations incurred in FY 1964 reflects the restoration of funds to this project element which were reduced from the initial FY 1964 program of $18.7 million and reprogrammed to provide for critical Gemini program requirements. The reprogramming action became feasible due to a mid-year reorientation of the technology program which was undertaken to eliminate research activity from the MSF program, and thus direct efforts primarily to the development of alternates and improvements to systems, subystems, etc. of the Apollo and Gemini programs. The funding estimates for FY 1965 and subsequent years provide for the level of effort necessary for these developments during an increasingly critical period in which mainstream hardware is reaching flight test status and systems are being exposed to actual flight environments, as well as the assumption of funding responsibility for space medicine tasks required for the Apollo and Gemini programs.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded: Not Applicable

b. Contractor manpower: Not Applicable

c. Services of Other Government Agencies: Not Applicable

d. FY 1966 Procurement of Capital Items: Not Applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: LAUNCH VEHICLE TECHNOLOGY

1. Project Description:

Launch Vehicle Technology provides for development of improved or alternate systems, subsystems, components and materials which comprise the Launch Vehicle structure, control and propulsion systems. Tasks in the program involve vehicle aerodynamics, guidance and navigation, control systems, and the integration of engines into the launch vehicles. These efforts insure that advances in the state-of-the-art are phased into the mainstream program, and that alternate systems are available on a scheduled basis as substitutes for mainstream hardware.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	12,900	13,000	13,100	13,100	13,100	13,100
b. FY 1966 Preliminary Budget	14,200	13,000	13,100	13,100	13,100	13,100
c. FY 1966 Budget	14,200	13,100	13,100	13,100	13,100	13,100

d. Analysis and Justification of Significant Changes in Project Funding:

The initial FY 1964 program estimate for this project was $12.9 million, and this approximate level of effort has been continued in FY 1965 and subsequent fiscal years. During fiscal year 1964, an additional $1.3 million was programmed to undertake critical Launch Vehicle Technology tasks in support of the Apollo Mainstream program.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded: **Not Applicable**

b. Contractor manpower: Not Applicable

c. Services of Other Government Agencies: **Not Applicable**

d. FY 1966 Procurement of Capital Items: **Not Applicable**

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: PROPULSION TECHNOLOGY

1. Project Description:

Propulsion Technology provides for development of alternates and improvements to systems, subsystems, components and materials which offer improved performance and/or reliability of launch vehicle propulsion systems and spacecraft propulsion systems. Alternate developments can be substituted for mainstream hardware in approved projects on a scheduled basis. Improvements are undertaken to incorporate state-of-the-art advances into current projects.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	12,800	12,200	13,300	13,300	13,300	13,300
b. FY 1966 Preliminary Budget	14,400	13,200	13,300	13,300	13,300	13,300
c. FY 1966 Budget	7,600	13,800	13,300	13,300	13,300	13,300

d. Analysis and Justification of Significant Changes in Project Funding:

The increase in FY 1965 over obligations incurred in FY 1964 reflects the restoration of funds to this project element which were reprogrammed to provide for critical Gemini program requirements. The reprogramming action became feasible due to a mid-year reorientation of the technology program which was undertaken to eliminate research activity from the MSF program, and thus direct efforts primarily to the development of alternates and improvements to systems, subsystems, etc. of the Apollo and Gemini programs. The funding estimated for FY 1965 and subsequent years provides for such propulsion developments during an increasingly critical period in which mainstream hardware is reaching flight test status and systems are being exposed to actual flight environments.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

b. Contractor manpower: Not Applicable

c. Services of Other Government Agencies: Not Applicable

d. FY 1966 Procurement of Capital Items: Not Applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: LAUNCH OPERATIONS TECHNOLOGY

1. Project Description:

Launch Operations Technology provides for development of alternates and improvements to systems, subsystems, components and materials relating to launch operations including assembly and checkout; launch area transport; propellant storage and transfer; high pressure gas storage, transfer, use and possible reuse; communications and data transmission; and other systems within the launch complexes, to enhance reliability and safety and to assure operational success.

2. Project Funding: Runout Cost - By Fiscal Year - In Thousands of Dollars

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
a. FY 1965 President's Budget	2,100	3,500	3,400	3,400	3,400	3,400
b. FY 1966 Preliminary Budget	3,200	3,500	3,400	3,400	3,400	3,400
c. FY 1966 Budget	2,400	3,200	3,400	3,400	3,400	3,400

d. Analysis and Justification of Significant Changes in Project Funding:

The increase in FY 1965 and subsequent years, over obligations incurred in FY 1964, reflects the accelerated task efforts required to assure reliability and operational success of the Apollo and Gemini launch vehicles.

3. Justification for FY 1966 Budget Estimates:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

b. Contractor manpower: Not Applicable

c. Services of Other Government Agencies: Not Applicable

d. FY 1966 Procurement of Capital Items: Not Applicable

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF MANNED SPACE FLIGHT

PROJECT TITLE: ADVANCED MANNED MISSIONS

1. Project Description/Justification:

The objectives of the Advanced Studies Project are to provide analyses and study of present hardware systems for growth potential; to develop requirements for future systems; to provide guidance for research and technology activity; and to provide information upon which future program decisions can be based.

The Advanced Studies Activities involve the continuing study effort leading to the definition and preliminary design and specification of possible future manned space flight missions, based on the assumption that exploration of the moon is only the first major step in the manned exploration of space. Specific areas of investigation include earth orbital, lunar systems, planetary and interplanetary systems, and launch vehicle systems studies.

This activity is required to enable the NASA to advance technology in required areas, provide a sound basis for future programs, and permit near optimum scientific and technical programs. Advanced study and planning is necessary and essential to enable full consideration of the foregoing factors and to define the resource requirements for future missions.

2. Project Funding: (In Thousands of Dollars)

	FY 1964	FY 1965	FY 1966
a. Advanced Studies	21,200	26,000	26,000
b. Continuation vs. New	N/A	N/A	N/A
c. University contracts and grants	N/A	N/A	N/A

3. Specific mechanisms or channels for program coordination with other interested agencies:

Through various scientific and technical panels and committees, program coordination is obtained with other interested agencies. The prime example is the Aeronautics and Astronautics Coordinating Board (AACB) through which earth orbital studies of DOD and NASA are coordinated.

This has resulted in what is considered a good national earth orbital study program. Many informal coordinations of studies take place with the National Academy of Sciences, the Weather Bureau, the U. S. Department of the Interior (Geological Survey) and various parts of the DOD including the Army Corps of Engineers, Systems Command of the USAF, and the Naval Research Laboratory. These coordinating activities are beneficial to the overall effort in that they provide an across-the-board understanding of programs among the various agencies.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ORBITING SOLAR OBSERVATORIES

1. Project Objectives: To comprehensively study the sun by placing selected experiments on a stabilized platform in orbit above the earth's atmosphere. It is expected that this study will lead to a better understanding of the solar phenomena and the processes by which they occur. Primary emphasis in experiment selection will be given to those investigations which detect and measure electromagnetic radiation varying from the ultraviolet to the gamma ray portion of the solar spectrum.

2. Project Content: The project consists of eight approved missions, one of which (OSO-I) has been successfully launched. The Delta Launch Vehicle is used to place the spacecraft in a circular orbit of approximately 300 nautical miles in altitude and at an inclination of 33 degrees to the equator. The observatory is capable of pointing instruments directly at the center of the solar disc and of scanning across the disc. Pointing accuracy is approximately 60 seconds of arc. Experiments are selected for each mission to provide for a progressive program of scientific investigations.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man-Years)

a. Contractor:	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Ball Brothers	116	155	175	127	96	34

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of Contract:

OSO-B	- CPFF
OSO-C	- CPFF
OSO-D & E	- CPIF to be negotiated with a CPFF for integration portion of the contract.

(2) Cost negotiated to date:

OSO-B	- $5,445,800
OSO-C	- $3,313,200
OSO-D & E	- $2,311,000 (funded under a letter contract)

(3) Scope negotiated to date: OSO-B thru E - To design, fabricate, assemble and test one prototype and four OSO spacecraft plus provide launch and post-launch support.

b. Anticipated Changes:

(1) Estimated additional costs involved:

OSO-B	-0-
OSO-C	$1,289,000
OSO-D and E	$7,099,000
OSO-F, G, H	$9,810,000

(2) Additional scope involved:

OSO-C	To provide for spacecraft modification resulting from experiment integration.
OSO-D and E	To provide scope as defined under (3) above by definitizing the contract with the Ball Brothers Research Corporation.
OSO-F,G,H	Design, fabrication, assembly and test of three spacecraft plus launch and post-launch support.

(3) Estimated dates Changes will be Negotiated:

OSO-C	1964
OSO-D and E	1965
OSO-F,G,H	1965

7. <u>Project Changes Since FY 1965 President's Budget</u>:

a. Project Objectives: No change

b. Project Content: An accident during preparation for launch caused extensive damage to the OSO-B spacecraft. It has been necessary to replace the spacecraft and most of the experiment hardware. This has been done at a minimum of cost and delay by utilizing the prototype spacecraft and the experiment spares. As a result the

mission will be flown at an additional cost of less than $2,000,000. OSO-F, G, and H contracts have been deferred in accordance with desires of the House and Senate Committees until after the FY 1966 hearings.

c. Project Schedules: Second flight has slipped to late 1964 as a result of the accident. Third flight slipped one quarter, no change in subsequent flights.

d. Project Funding: Funding requirements increased from the budget request in two areas. The contractors proposal for D and E came in higher than anticipated and the estimated cost for data analysis of the second flight has been increased. This increase was largely offset by the deferral of OSO-F, G, and H procurement.

8. Justification of FY 1966 Budget Estimates: FY 1966 funds will provide for completion of data analysis for OSO-I and for analysis of data obtained from OSO B and C. The funds will provide for continued development of spacecraft and experiments for OSO-D and E and for starting the development of spacecraft and experiments for OSO-F and OSO-G.

FUNDING & LAUNCH SCHEDULE

PROJECT: Orbiting Solar Observatory

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget (A-H)	15,416	11,000	10,400	9,005	7,445	2,555	500	-	56,321
'66 Preview (A-H)	15,343	11,847	12,930	12,236	9,492	3,532	1,552	700	67,632
'66 Budget (A-H)	15,343	13,827	9,903	11,400	11,409	6,846	2,902	700	72,330
Launch Vehicle Allocation									
'65 Budget	4,789	3,711	2,700	2,750	3,500	2,000	-	-	19,450
'66 Preview	4,789	3,650	361	2,900	3,800	4,900	-	-	20,400
'66 Budget	4,789	3,650	361	2,900	3,800	4,900	-	-	20,400

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	2	1	1	2	1		
'66 Preview	1	1	1	2	1	1	
'66 Budget	1	1	1	2	1	1	

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ORBITING ASTRONOMICAL OBSERVATORIES

1. Project Objectives: To perform precision telescopic observations of the entire sky from above the earth's atmosphere so as to measure the absorption and emission characteristics of the sun, stars, planets, nebulae and the interplanetary and interstellar media in the infrared to gamma ray region. Primary emphasis will be given to the ultraviolet region for flights scheduled in this decade; however, small experiments in the X-ray and gamma ray regions will also be incorporated. Experiments in the infrared, X-ray, gamma ray, and "visible" regions will receive emphasis in the next decade along with the ultraviolet region.

2. Project Content: The project as now planned involves the development of a standardized spacecraft, ground controllable in orientation and function, which is precisely stable after orientation. In this decade the program involves the development of five major experiments and a number of smaller experiments and the construction of five spacecraft. The spacecraft will be placed in nearly circular orbits of about 430 nautical miles and about 32° inclination to the equator by modified Atlas-Agena launch vehicles. The project also includes advanced development work toward infrared and X-ray experiments to be flown in a follow-on series of flights.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man-Years)

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Grumman	261	255	250	275	270	270

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of contract: Cost plus incentive fee.

(2) Cost negotiated to date: $84,900,765

(3) Scope negotiated to date: Development of prototype and two flight units.

b. Anticipated Changes:

(1) Estimated additional costs involved: $82,127,000

(2) Additional scope involved:

(A) Several engineering changes to the OAO A&B contract including domeless startracker redesign, additional spares and field support, flywheel and jet control system redesign and battery redesign.

(B) Refurbish prototype as a flight unit.

(C) Procure two additional flight units.

(3) Estimated dates changes will be negotiated:

Refurbish prototype	- November 1964
Procure OAO-C	- September 1964
Procure OAO-D	- September 1965

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No change

b. Project Content: Procurement of the OAO-D spacecraft has been deferred to FY 1966. The prototype spacecraft will be refurbished for use as a flight unit. Backup experiments consisting of gamma-ray, hard X-ray, and soft X-ray instruments, are being procured for possible use on OAO-A together with the University of Wisconsin experiment because of difficulties in the production of ultraviolet image tubes for the Smithsonian experiment. An additional instrument will be procured for use together with the Smithsonian experiment on the prototype spacecraft (OAO-A2) should it be necessary to defer the flight of the Smithsonian experiment until 1966. This action should substantially increase the probability of meeting the original objectives of the first mission and will provide additional flight experience prior to the launches of OAO-B and OAO-C.

c. Project Schedules: Flight of the first OAO has slipped one quarter because of technical difficulties experienced with the Smithsonian experiment. The second flight (refurbished prototype) scheduled one year after first, third and fourth on 9 month centers.

d. Project Funding: Fund requirements were reduced in FY 1965 by the deferral of the OAO-D procurement to FY 1966.

8. Justification of FY 1966 Budget Estimate: Fiscal Year 1966 funds will provide for the support of the launch of OAO-A1 and for completion of the preparation of OAO-A2. They will also provide for initial data analysis costs for these flights. Development of the spacecraft and experiments for OAO-B will be essentially completed with FY 1966 funds and major efforts will be devoted to OAO-C. Experiments for OAO-D will be supported and a start on the spacecraft for OAO-D will be made. Advance development work toward follow-on experiments will be continued but actual hardware development for OAO-E spacecraft and experiments is not planned until FY 1967.

FUNDING & LAUNCH SCHEDULE

PROJECT: Orbiting Astronomical Observatory

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-E	79,447	39,800	47,600	31,201	18,230	12,360	-	-	228,638
'66 Preview A-J	78,642	36,697	31,177	38,315	44,260	50,486	39,630	157,810	477,017
'66 Budget A-J	78,642	35,574	31,377	32,300	36,000	41,000	45,000	168,000	467,893
Launch Vehicle Allocation									
'65 Budget	4,756	7,854	13,400	6,950	10,900	10,900	6,850	-	61,610
'66 Preview	4,756	4,292	8,611	12,212	11,432	10,832	8,850	54,860	115,845
'66 Budget	7,021	5,626	9,039	15,248	19,582	11,032	10,832	41,616	119,996

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget		1	1	1	1	1	
'66 Preview		1	1	1	1	1	5
'66 Budget		1	1*	1	1	1	5

*Refurbished Prototype

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ADVANCED ORBITING SOLAR OBSERVATORIES

1. Program Objectives: To make continuous and comprehensive studies of the sun from above the obscuring and distorting influences of the earth's atmosphere from a stabilized platform with resolution an order of magnitude higher than is currently possible with OSO. These studies will be aimed at a more complete understanding of the structure, dynamics, and composition of the sun and its relationship to the environment of planets and interplanetary space. The AOSO program will develop and launch a spacecraft capable of providing a stabilized platform with a pointing accuracy of ± 5 seconds of arc from which these studies can be made.

2. Program Content: The program as now planned involves the development of the systems needed for four flight missions. The spacecraft will be launched into a circular polar orbit of 330 nautical miles by a thrust-augmented Thor-Agena vehicle. The orbit will be inclined 83 degrees in a retrograde direction in order to provide up to nine months of continuous sunlit observation for the spacecraft. Experiments are being selected for each mission to provide for a comprehensive study of solar phenomena by examination of the solar spectrum from the ultraviolet to the X-ray region.

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

a. Contractor:	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Republic	90	110	233	275	170	140

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status

1. Type of contract: Cost-plus-fixed-fee controlled level of effo .

2. Cost negotiated to date: $5,970,000

3. Scope negotiated to date: Provide detailed engineering designs, system engineering, trade-off analysis, reliability assessment,

limited breadboard and engineering model development of critical subsystems and components. In addition, provide detailed plans for reliability assurance and testing, costs and schedules, and detailed subsystem specifications.

b. Anticipated Changes

1. Estimated additional costs involved: $60,147,000

2. Additional scope involved: Development and qualification of prototype systems and engineering models, and construction, integration, testing and launch of four flight spacecraft.

3. Estimated date changes will be negotiated:

Prototype development	1964
Flight Spacecraft development	1965

7. Project Changes Since FY 1965 President's Budget: The schedule for the first launch has been changed from 1968 to 1969 to provide additional design time in the early stages of development before proceeding to hardware fabrication.

8. Justification of FY 1966 Budget Estimate: Fiscal Year 1966 funds will provide for continuation of the development of the prototype spacecraft and experiments for the first two missions. They will also provide the procurement of long leadtime items for the first two flight spacecraft and for design of the ground operations equipment.

FUNDING & LAUNCH SCHEDULE

PROJECT: Advanced Orbiting Solar Observatory

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget (A-D)	1,700	4,100	9,000	27,500	31,000	28,500	17,750	9,250	128,800
'66 Preview (A-D)	1,700	6,212	7,183	25,300	33,209	28,193	19,143	10,043	130,983
'66 Budget (A-D)	1,700	6,212	7,400	25,600	33,709	28,282	20,769	18,750	142,422
Launch Vehicle Allocation									
'65 Budget	-	-	-	-	5,400	12,000	7,600	-	25,000
'66 Preview	-	-	-	-	-	4,935	12,400	7,265	24,600
'66 Budget	-	-	-	-	-	6,885	12,400	5,715	25,000

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget					2	2	
'66 Preview						2	2
'66 Budget						2	2

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ORBITING GEOPHYSICAL OBSERVATORIES

1. Project Objectives: To develop a standard earth orbiting observatory type spacecraft capable of carrying large numbers of experiments in a wide variety of orbits and having an active service life of about one year. To investigate by a concerted interdisciplinary approach the geophysical phenomena and processes involved or evolving from the interrelationships of solar activity, the interplanetary and galactic medium, and the terrestrial magnetic field and atmosphere.

2. Project Content: The project as now planned involves the development and production of eleven observatory spacecraft, each carrying twenty or more experiments. The first spacecraft (OGO-I) was launched on September 4, 1964, into a highly eccentric orbit out to about 80,000 nautical miles from the earth with an inclination 31 degrees to the equator. Although the spacecraft did not acquire earth orientation because booms carrying experiments interferred with the horizon scanner, useful data is being obtained from almost all of the twenty experiments. Two more missions (OGO-B and OGO-E) are planned for launch into similar orbits to continue these investigations. OGO's C, D, and F will be launched into more circular polar orbits with an apogee of about 500 nautical miles to make studies of the atmosphere and ionosphere. The orbits of later spacecraft will be determined on the basis of experience with earlier flights and will be planned for a comprehensive study of the environment of the earth during the period of maximum solar activity.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man Years)

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
STL	600	450	440	360	630	580

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Types of contracts: Fixed price incentive

(2) Cost negotiated to date: $78,363,200

(3) Scope negotiated to date: Development of systems and construction of a prototype and five flight units; experiment handling and spacecraft integration for OGO-A, C, and D.

b. Anticipated Changes:

(1) Estimated additional costs involved: $12,821,000

(2) Additional scope involved: Refurbish and modify the prototype spacecraft for use as OGO-F; provide for experiment handling and spacecraft integration for OGO-D and OGO-F; procure spares.

(3) Estimated dates changes will be negotiated: September 1965

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No change

b. Project Content: In order to support other high priority programs within available financial and manpower resources certain changes were introduced in the OGO project which acted to reduce FY 1965 requirements. These included a stretchout of the flight schedule and use of the refurbished prototype as the OGO-F spacecraft.

c. Project Schedule: **Launch of OGO-D slips three months and OGOE&F slip six months.** A return to the more desirable schedule of two per year is planned for the 1968 to 1970 time period to give more complete coverage during the period of maximum solar activity.

d. Project Funding: FY 1965 fund requirement was reduced by the schedule slip and the procurement of the refurbished prototype for OGO-F rather than a new flight spacecraft.

8. Justification of FY 1966 Budget Estimate: Fiscal Year 1966 funds will provide for completion of work on OGO-D and E spacecraft and experiments and for analysis of data from the first five missions. They will also provide for development of experiments for OGO-F and for refurbishing and modifying the prototype spacecraft for use as OGO-F. A start will be made on the development of experiments for OGO-G.

FUNDING & LAUNCH SCHEDULE

PROJECT: Orbiting Geophysical Observatory

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-K	58,496	45,500	44,500	40,469	40,000	33,400	18,400	7,500	288,265
'66 Preview A-K	58,496	44,228	40,888	34,285	45,071	43,643	43,731	27,080	337,422
'66 Budget A-K	58,496	42,868	30,231	32,500	33,000	49,102	46,727	24,520	317,444
Launch Vehicle Allocation									
'65 Budget	12,356	7,777	10,923	13,444	14,100	15,300	8,900	-	82,800
'66 Preview	12,356	6,148	11,446	4,800	7,600	12,900	11,800	16,700	83,750
'66 Budget	10,735	10,172	10,563	14,356	15,569	15,844	6,665	-	83,904

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	1	3	1	2	2	2	
'66 Preview	1	3	1	1	1	2	2
'66 Budget	1	2	2	1	2	2	1

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: PHYSICS AND ASTRONOMY SUPPORTING RESEARCH AND TECHNOLOGY

1. Project Description/Justification: The objectives of the Physics and Astronomy Supporting Research and Technology program are to provide a sound theoretical base for the flight programs, to initiate development of instrumentation for future experiments and to conduct ground based balloon and aircraft observations for correlation with flight program results. In general, SR&T covers the effort supporting the flight program which is not a part of an approved flight project. Basic research leading to specific experiments, new technology with application to specific on-going or proposed flight projects, development of instrumentation and spacecraft subsystems to the point where they can be incorporated with a minimum risk into a flight program is the heart of the SR&T program.

The work is being done in University, Industrial and Government laboratories in 29 states. During FY 1964 there were 100 tasks being carried on by Universities, 23 by Industry, 20 by other government laboratories, and 47 by NASA field centers.

The FY 1965 and FY 1966 programs reflect a reorganization of the SR&T program which involved transfer of tasks previously funded under the Lunar and Planetary program at the same time that other tasks were transferred to the Lunar and Planetary program. The purpose of this reorganization was to concentrate the effort in a given scientific discipline into one program or the other to make optimum use of scientific manpower for program management. Work in the disciplines of Planetary Atmospheres, Space Chemistry and Planetary Astronomy was transferred to the Lunar and Planetary program. Work in the disciplines of Particles and Fields, Solar Physics, Meteoroids and Cometary Physics, and Interplanetary Spacecraft Technology was transferred to the Physics and Astronomy Program. The name of the Geophysics and Astronomy program was changed to Physics and Astronomy to reflect the reassignment of scientific responsibilities.

The net effect of the transfer of program responsibilities was a slight reduction in total program from FY 1964 to FY 1965. New tasks are being introduced into the program in FY 1965 primarily by limiting the funding of existing tasks to that absolutely required to carry them until FY 1966 funds are available. This general reduction in forward funding of research tasks will result in a substantially increased requirement for FY 1966 funds if a modest program growth is to be attained.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Particles and Fields	4,173	5,300	5,900
Ionosphere and Radio Physics	879	1,100	1,400
Meteoroids and Cometary Physics	864	1,110	1,500
Planetary Atmospheres & Space Chemistry	3,154	-	-
Solar Physics	2,420	2,800	3,200
Astronomy and Geodesy	3,007	3,145	3,550
Interplanetary Spacecraft Technology	-	300	300
Interdisciplinary Space Science	1,503	2,145	2,150
Project TOTALS	16,000	15,900	18,000
b. Continuation vs. New:			
Continuation of existing contracts, grants and in-house tasks	12,690	12,968	15,500
New contracts, grants and in-house tasks	3,310	2,932	2,500
Project TOTALS	16,000	15,900	18,000
c. University contracts & grants:	6,790	6,800	8,700

3. Specific mechanisms or channels for program coordination with other interested agencies: The Space Science Board of the National Academy of Sciences - a body of leading scientists that periodically reviews the NASA space science program and acts in an advisory capacity.

The Unmanned Spacecraft Panel of the AACB - a joint NASA/DOD group that provides a mechanism for coordination of the space efforts of both agencies. Representatives of other agencies are requested to participate as required.

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: EXPLORERS

1. Project Description/Justification: The objectives of the Explorer projects are:

   a. To measure the properties of the earth's upper atmosphere, the ionosphere, radiowave propagation, and energetic particles and fields in space.

   b. To conduct experiments in astronomy, geodesy, astrochemistry and astrophysics.

   c. To cooperate with other nations in the launching of satellites.

   Explorers provide a means of placing experiments into orbits especially selected for specific scientific investigations and for conducting experiments which are not compatible with the larger orbiting observatories. They provide a means of utilizing the capabilities of foreign research organizations to attain United States and foreign country research objectives on a cooperative basis with consequent reductions in cost to the United States. Explorers also provide for participation of university and other small research groups which do not have the facilities or manpower for larger spacecraft development efforts.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Energetic Particles Explorers	1,075	782	800
Atmosphere Explorers	918	1,029	871
Ionosphere Explorers	1,152	551	187
Interplanetary Explorers	5,045	8,283	6,669
Air Density/Injun Explorers	870	588	530
Beacon Explorers	890	857	533
Geodetic Explorers	1,450	4,066	4,035
Radio Astronomy Explorers	-	1,100	4,000
University Explorers	-	1,300	5,000
United Kingdom Satellites	1,211	350	129
Alouette/ISIS (Canada)	1,745	2,250	3,042
French Satellites	70	163	104
San Marco (Italy)	1,100	600	800
ESRO Satellites	-	70	200
Total Spacecraft & Support	15,526	21,989	26,900
Scout Launch Vehicles	6,600	4,296	7,700
Delta Launch Vehicles	11,750	12,350	10,100
Thor-Agena Launch Vehicles	2,697	11,560	4,075
Project TOTALS	21,047	28,206	21,875

	FY 1964	FY 1965	FY 1966
b. Continuation vs. New			
Continuation of existing contracts & in-house tasks	13,138	18,353	22,030
New contracts and in-house tasks	2,388	3,636	4,870
Total Spacecraft & Support	15,526	21,989	26,900
c. University contracts	2,900	5,300	9,600

3. Specific mechanisms or channels for program coordination with other interested agencies: The Space Science Board of the National Academy of Sciences - a body of leading scientists that periodically reviews the NASA space science program and acts in an advisory capacity.

The Unmanned Spacecraft Panel of the AACB - a joint NASA/DOD group that provides a mechanism for coordination of the space efforts of both agencies. Representatives of other agencies are requested to participate as required.

Geodetic Satellite Policy Board - a policy making group that includes representatives from NASA, DOD, and Department of Commerce. This group establishes requirements for the National Geodetic Satellite program.

Geodetic Satellite Working Group - an advisory group to the Geodetic Satellite Policy Board made up of representatives from the above three agencies plus representatives from the Smithsonian Astrophysical Observatory and several universities.

Topside Sounder Working Group - a coordinating body for the Joint U.S./Canadian Topside Sounder Satellite program made up of representatives from NASA, the National Bureau of Standards, the Canadian Defense Research and Telecommunications Establishment, The Army Signal Corp, and the Applied Physics Laboratory of Johns Hopkins University.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: SOUNDING ROCKETS

1. Project Description/Justification: The objectives of this project are: to study the upper atmosphere, the ionsphere, the geomagnetic field, energetic particles, the sun and the stars by means of vertical soundings; to test instrumentation prior to launch in satellites and probes; to cooperate with other countries in space research.

   Sounding Rockets are launched from sites in the United States, Canada, Australia and India and from shipboard launchers. About 115 flights per year are planned through 1967. A level of about 125 flights is planned for 1968 and 1969 during the period of maximum solar activity.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Experiments	8,797	7,790	9,200
Rocket Development	601	644	700
Attitude Control Systems	1,406	1,098	1,500
Engineering Support	470	347	500
Test and Evaluation	100	221	200
Ground Instrumentation	3,123	2,800	2,800
Rocket Procurement	2,453	3,100	3,100
Project Totals	16,950	16,000	18,000
b. Continuation vs New:			
Continuation of existing contracts and in-house tasks	12,850	14,103	15,000
New contracts and in-house tasks	4,100	1,897	3,000
Project Totals	16,950	16,000	18,000
c. University contracts	3,482	3,724	4,500

3. Specific mechanisms or channels for program coordination with other interested agencies: COSPAR, Working Group II, Panel on Synoptic Sounding Rockets - an international coordinating body.

Interdepartmental Committee on Atmospheric Sciences - a coordinating group made up of representatives from NASA, DOD, Department of Commerce, and other interested agencies.

Report on Sounding Rocket Launching - a notification of successful launching transmitted to the three World Data Centers.

In addition, there is considerable informal coordination within the scientific community.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ADVANCED STUDIES - PHYSICS AND ASTRONOMY

1. Project Description/Justification: The purpose of this project is to conduct advanced planning for missions to be accomplished under the Physics and Astronomy Program. Studies will range from conceptual studies for formulation of basic mission requirements and characteristics to specific feasibility studies of spacecraft and ground equipment design and project definition. Missions to be included will be advanced Explorers; advanced solar, astronomical and geophysical observatories; and interplanetary, solar and galactic probes.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Explorer Studies	--	100	400
Observatory Studies	--	100	800
Probe Studies	--	400	800
Project Total		600	2,000
b. Continuation vs. New			
Continuation of existing contracts and grants	--	--	--
New contracts and grants	--	600	2,000
Project Total	--	600	2,000
c. University contracts and grants	--	--	300

3. Specific mechanisms or channels for program coordination with other interested agencies: The Space Science Board of the National Academy of Sciences - a body of leading scientists that periodically reviews the NASA space science program and acts in an advisory capacity.

   The Unmanned Spacecraft Panel of the AACB - a joint NASA/DOD coordination group that provides a mechanism for the space efforts of both agencies. Representatives of other agencies are requested to participate as required.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: DATA ANALYSIS

1. Project Description/Justification: NASA has the obligation of making available to the public the information gained from space exploration. The accumulation of data from flight programs provides a pool of scientific data that will be useful to scientists, particularly as it permits the use of data from a number of satellite, sounding rocket, and space probe experiments. This new project will provide for cataloging of data, distribution of reduced data to interested researchers, and financial support of promising proposals that would make use of the data in storage.

2. Project Funding (Program Plan in thousands of dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Operation of the Data Center			600
Support of research tasks			3,400
Project Totals			4,000
b. Continuation vs New:			
Continuation of existing contracts*			600
New contracts and grants			3,400
Project Totals			4,000
c. University contracts and grants			2,400

*Operation of Data Center funded under SR&T in FY 1964 and FY 1965.

3. Specific mechanisms or channels for program coordination with other interested agencies: Geophysics Research Board, National Academy of Sciences (Subcommittee on the Consolidated Upper Atmosphere and Space Data Center).

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: RANGER

1. Project Objectives: To design and develop spacecraft which will be used to obtain high resolution pictures of the lunar surface, to land survivable instrument packages on the Moon, and to obtain by means of non-visual techniques significant new and useful data concerning the lunar topography, environment, and composition.

2. Project Content: Nine Ranger spacecraft to be launched on Atlas-Agena Launch Vehicles - The first two as engineering test models, the next three to land an instrumented capsule on the moon to transmit seismological data from the Moon's surface, and the last four to obtain high resolution television pictures of the lunar surface. The Ranger program to date has successfully tested the first 3-axis stabilized U. S. spacecraft, executed the first midcourse correction in space, and has obtained 4316 high resolution photographs of the lunar surface, with the best resolution being approximately one foot. There are two remaining flights in this program. They are designed to again obtain additional high resolution pictures of the lunar surface, at different impact sites and/or under different lighting conditions.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower:

a. Contractor:	FY 1964	FY 1965	FY 1966
JPL	470	260	15 direct man years

b. NASA In-house Direct Manpower:

6. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No changes

b. Project Content: No changes

c. Project Schedules: The launches of the eighth and ninth Rangers were postponed until 1965.

d. Project Funding: Funding in FY 1965 increased because of the six month schedule slip and the additional cost which resulted from rework of the camera subsystem.

7. Justification of FY 1966 Budget Estimate: FY 1966 funding will pay for analysis of data from missions eight and nine.

FUNDING & LAUNCH SCHEDULE

PROJECT: Ranger

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	124,623	41,000	8,800	-	-	-	-	-	174,423
'66 Preview 1-5,A-D	120,749	30,563	14,500	-	-	-	-	-	165,812
'66 Budget 1-5,A-D	120,749	30,563	16,500	1,000	-	-	-	-	168,812
Launch Vehicle Allocation									
'65 Budget	84,216	11,200	2,000	-	-	-	-	-	97,416
'66 Preview	74,122	15,103	2,762	-	-	-	-	-	91,987
'66 Budget	77,867	14,863	3,136	205	-	-	-	-	96,071

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	4						
'66 Preview	2	2					
'66 Budget	2*	2					

*RA6 Launched Jan. 30, 1964
RA7 Launched July 28, 1964

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: SURVEYOR LANDER

1. Project Objectives: To develop spacecraft capable of soft landing scientific instruments on the moon, and to acquire basic data on selected areas of the lunar surface as required to support project Apollo. Surveyor will provide closeup television coverage of the lunar surface, and measure its physical and chemical properties.

2. Project Content: Seventeen Surveyor spacecraft will be launched by the Atlas-Centaur launch vehicle. These attitude stabilized spacecraft will be capable of a midcourse correction maneuver to ensure lunar intercept. The spacecraft will be decelerated by a main retromotor, with velocity adjusted by the vernier propulsion system as commanded by the radar altimeter and doppler velocity sensor, in a closed-loop guidance system, so that touchdown on the moon will be at near zero velocity. The Surveyor will be designed to make a minimum of 30 days of scientific measurements and telemeter this data back to earth.

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
JPL	170	320	380	340	280	200
Hughes*	1,700	1,600	660	250		

*Current contract for first seven Surveyor missions only.

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of contract: Cost plus fixed fee

(2) Cost negotiated to date: $134,898,000 (includes $7,074,000 fee)

(3) Scope negotiated to date: Delivery of seven identical flight spacecraft, a prototype spacecraft, test articles for subsystem tests and a set of subassemblies for reliability testing. The contract also includes four sets of system test equipment for use at the Hughes Aircraft Company, the combined systems test facility at General Dynamics/Astronautics and at AFETR, command and data handling consoles for the three DSIF sites, and a launch operations trailer.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved: $98,000,000.

(2) Additional scope involved: The scope of the program is being increased to significantly strengthen the project subsystem and system test programs, and to improve the reliability of the spacecraft system and ground operations equipment. Major changes in deliverable hardware include the following: the first four flight spacecraft will carry an engineering payload for functional performance evaluation; the last three spacecraft will carry a scientific payload; a second prototype is required because of the two payload configurations. Because of the excessive amount of test time and engineering changes accumulated by the original prototype it is no longer suitable as a full prototype spacecraft. Henceforth, it will be used as an engineering development model and replaced by a new prototype. Two additional sets of subassemblies are being procured to support the development and operational phases of the program. Several subsystem test articles will be procured to support the expanded ground test program. Four dynamic models have been added for use in the Centaur development program.

(3) Estimated date changes will be negotiated: These changes will be negotiated before the end of 1964. The contract for the Follow-on Surveyors is expected to be awarded early in 1965.

7. <u>Project Changes Since FY 1965 President's Budget</u>:

a. Project Objectives: No change

b. Project Content: Two previously planned lightweight Surveyors, similar to Surveyors E, F, and G, have been eliminated in favor of two additional heavy Surveyors with increased scientific payload.

c. Project Schedules: Because of spacecraft development problems the first launch has been deferred for about five months.

d. Project Funding: Funding requirements for the current series of Surveyors increased in FY 1965 due to initiation of a backup vernier propulsion system, main engine improvement program, and increases in the prime contract. These increases were offset by a delay in initiating procurement of the follow-on series until late in FY 1965.

8. Justification of FY 1966 Budget Estimate: Funds requested for FY 1966 will pay for the completion of basic spacecraft development, combined systems test and launch of the first engineering test spacecraft, fund the second spacecraft through launch from systems testing, and pay for the final assembly, complete testing, and launch of the third and fourth Surveyors. The fifth, sixth, and seventh spacecraft will have completed final assembly and system functional tests by the end of FY 1966. FY 1966 funding will also cover the detailed engineering development and long-lead time procurements for the follow-on spacecraft and payloads.

FUNDING & LAUNCH SCHEDULE

PROJECT: Surveyor

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-Q	94,835	66,620	82,000	69,700	60,000	17,100	4,200	-	394,455
'66 Preview A-Q	95,432	69,657	78,000	74,300	75,000	35,000	6,000	-	433,389
'66 Budget A-Q	95,432	70,704	76,000	82,600	83,000	73,000	35,000	7,700	523,436
Launch Vehicle Allocation									
'65 Budget	16,100	32,000	54,000	66,600	45,800	11,600	-	-	226,100
'66 Preview	16,209	32,000	31,000	57,140	50,431	17,552	2,157	-	206,489
'66 Budget	15,939	32,000	47,805	50,407	48,051	32,150	2,600	-	228,952

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget		4	5	6	2		
'66 Preview		3	4	5	5		
'66 Budget		3	4	4	5	1	

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: MARINER

1. Project Objectives: To conduct flights in the vicinity of Mars and Venus to obtain information about surface and atmospheric conditions, magnetic fields, trapped radiation belts, and meteoroid flux near those planets; to learn more about the environment in interplanetary space; and to obtain information relating to the existence of life on Mars and Venus.

2. Project Content: Four Mariner spacecraft to be launched by Atlas-Agena launch vehicles, two weighing 447 pounds to Venus in 1962 and two weighing 570 pounds to Mars in 1964. Mariner spacecraft are three-axis stabilized, have a midcourse correction capability, and must operate for over 9 months in the space environment. Mariner is the only program to date to make direct measurements of another planet from space. The Mariner II spacecraft discovered that Venus had no discernible magnetic field at 21,000 miles distance and that the 800 degree temperatures measured were from the surface and not ionospheric reflection. Although Mariner II set a distance communication record of 54,000,000 miles, the Mars Mariners which fly by that planet in mid-1965, making field and particle measurements and taking pictures of the surface, will be communicating at a distance of over 100,000,000 miles.

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

a. Contractor:	FY 1964	FY 1965	FY 1966	FY 1967
JPL	700	360	60	2 direct man-years

b. NASA In-House Direct Manpower:

6. Project Procurement: Mariner is an in-house effort at the Jet Propulsion Laboratory. A prototype, two flight spacecraft and a backup were built for launch at the 1964 Mars opportunity, plus spare sets of critical subassemblies. Ground equipment associated with these spacecraft includes the ground operating equipment installed at each DSIF site and the system test equipment used to test and check out the spacecraft.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: It was necessary to cancel plans for the 1966 Mars mission because of funding and manpower restrictions. Mariner flights previously planned for 1969 have now been replaced by the Voyager missions.

b. Project Funding: FY 1964 costs increased about eight percent because of sub-contractor overruns on several subsystems. The FY 1965 decrease resulted from ending the Mariner program with the 1964 launches.

8. Justification of FY 1966 Budget Estimate: FY 1966 funds will pay for the last month of mission operations prior to planetary encounter, and for data reduction and analysis after the mission is completed.

FUNDING & LAUNCH SCHEDULE

PROJECT: Mariner ('62, '64, '66 & '69)

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget ('62,*'64,'66)	60,080	45,400	43,200	51,700	22,500	-	-	-	242,880
'66 Preview('62,* '64,'66,'69)	78,653	50,280	38,100	74,600	64,500	47,500	35,500	11,000	400,133
'66 Budget ('62, '64)	78,653	49,152	21,000	3,500	500	-	-	-	152,805
Launch Vehicle Allocation									
'65 Budget	23,312	13,700	10,900	12,300	6,000	-	-	-	66,212
'66 Preview	23,312	14,345	4,727	12,716	10,604	12,904	6,044	-	84,732
'66 Budget	31,589	10,351	2,377	178	-	-	-	-	44,495

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	2		2				
'66 Preview	2		2			2	
'66 Budget	2						

*62 Mars launched Aug. 27, 1962

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: VOYAGER

1. Project Objectives: To obtain detailed information on the nature of the planet Mars: The characteristics of its atmosphere, its meteorology, its surface and subsurface conditions, trapped radiation belts and, more importantly, detailed information on the nature of extraterrestrial life.

2. Project Content: Four Voyager spacecraft will be launched by the three stage Saturn B launch vehicle. Voyager spacecraft will be modular, with a basic Voyager bus, a retropropulsion module, and a Mars Landing Capsule. The bus will ultimately carry about 200 pounds of scientific instruments within its eventual weight of 1800 pounds, and will be designed for long lifetime: Six months in orbit around Mars in addition to the nominal nine month flight to that planet. The retropropulsion module will vary in weight from 1500 to 3000 pounds because the energy required to enter an orbit around Mars differs for each opportunity. Before the retropropulsion module inserts the bus into a Mars orbit, the capsule will separate from the bus and alter its trajectory to impact the planet. The capsule is planned to be in the 1000 pound weight class in 1971; improvements in the Voyager system would make a nominal 3000 pound capsule possible for the 1973 mission. Under this program the 1964 Mariners represent the only US attempts at flights to Mars during this decade.

Voyager is a program facing many challenging technological problems, but is freed from the weight and volume constraints which severely limited the Mariner program by utilizing the payload capability of the three stage Saturn B. The Landing capsule missions require development of sterilization processes and equipment which will ensure that terrestrial organisms do not contaminate Mars, and that the spacecraft will operate after being subjected to such procedures. The present Voyager schedule permits these processes to be well developed and integrated into the Voyager test program during the early phases of Voyager design.

3. Summary Project Schedules: (See Attached Schedule)

4. Project Funding: (See Attached Schedule)

5. Project Manpower: (direct man years)

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
JPL	15	210	490	530	540	540
(Other)	15	70	1000	2000	2500	3000

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status: Voyager is in the mission definition stage, prior to requesting proposals for a Phase I system definition and design competition. One of the phase I contractors will be selected for phase II: Development of two spacecraft for the 1971 Mars opportunity. Separate contractors will be selected for the retropropulsion module and for the capsule systems. Integration responsibility will be assigned to the bus contractor.

b. Anticipated changes:

(1) Estimated additional cost involved: Phase I - $2,000,000; Phase II - $200,000,000.

(2) Additional scope involved: Phase I: complete design competition; Phase II: design, develop, test, and deliver two flight Voyager spacecraft for launch in 1971.

(3) Estimated date changes will be negotiated: Phase I: April 1965; Phase II: mid 1966.

7. Project Changes Since FY 1965 President's Budget: Voyager was planned as an effort which would start in FY 1966 at the time the FY 1965 budget was formulated. Since then it became apparent that resources available for planetary exploration would be severely limited, and that advanced versions of Mariner and the Voyager program could not be carried on at the same time as had been previously planned. The principal

goal of the planetary program is the search for extraterrestrial life: A Voyager size spacecraft is required to carry the instruments and perform the missions needed to provide other than marginal information relating to the existence of life on Mars. Therefore, it was decided to pursue the program which offered a chance to answer the significant scientific questions as early as possible. The Mariner program, which would have produced significant information on the Martian environment and yielded indications on the existence of life, had to be abandoned, even though it would have provided an intermediate step between the present 500 pound Mariners and Voyager. Accordingly, the Mariner effort for post 1964 missions planned for FY 1965 was redirected toward the Voyager spacecraft system, resulting in no more launches to Mars in this decade.

8. Justification of FY 1966 Budget Estimates: The FY 1966 estimate provides for the bus and retropropulsion module development contract requirements, funding of the experiments selected for the 1971 mission, preliminary design of the Mars capsule, capsule advanced development, and initial funding of the earth entry capsule test program.

FUNDING & LAUNCH SCHEDULE

(In thousands of dollars)

PROJECT: Voyager

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	-	-	-	-	-	-	-	-	-
'66 Preview	-	-	-	15,000	50,000	106,000	115,000	164,000	450,000
'66 Budget	-	-	8,000	43,000	105,000	130,000	140,000	354,000	780,000
Launch Vehicle Allocation									
'65 Budget									
'66 Preview									
'66 Budget									

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							2
'66 Budget							4

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: PIONEER

1. Project Objectives: To obtain scientific information on interplanetary phenomena simultaneously at widely separated points in space, which will provide data on the interplanetary environment required for advanced missions in the planetary program; and to provide data for use in conjunction with the interplanetary portion of the Mariner-Mars 1964 mission.

2. Project Content: Spin stabilized spacecraft weighing in the vicinity of 140 pounds will be launched by the improved thrust augmented Delta launch vehicle. Pioneer will reorient its spin axis normal to the plane of the ecliptic after injection, will be capable of providing 8 bits of data per second 50,000,000 miles from Earth, and will be designed to last six months in space. Missions will alternate between those which go inward to a distance of about 0.8 AU from the sun and those which go outward to a distance of about 1.2 AU from the sun. The program consists of eleven missions with increased coverage during the period of maximum solar activity.

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
STL	200	440	440	420	300	240

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of contract: Fixed price incentive fee

(2) Cost negotiated to date: $15,830,000 target cost (Target fee is $1,735,000, bringing target price to $17,565,000; ceiling cost is $19,788,000 for the current scope of work).

(3) Scope negotiated to date: Delivery of four flight spacecraft, a backup, and a prototype, plus selected spare assemblies.

Ground operating equipment for each DSIF site, for AFETR, and for the contractors plant, plus test and checkout ground equipment, is included in the spacecraft contract.

b. Anticipated Changes:

(1) Estimated additional cost involved: Change orders with proposed target cost of $9,500,000 are being negotiated. The contract for Pioneers E-K is estimated to cost about $35,000,000.

(2) Additional scope involved: Redesign of ground operating and command equipment for the "S" band configured DSIF sites, spacecraft modifications to accommodate experiment changes, augmentation of the magnetic test program; and adjustments in the flight schedule.

(3) Estimated date changes will be negotiated: Negotiation of anticipated changes will be completed in 1964.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No change

b. Project Content: The planned program has been extended to provide coverage during the period of maximum solar activity.

c. Project Schedule: Has slipped four months due to launch vehicle changes, development difficulties and funding constraints.

d. Project Funding: FY 1965 requirements have increased because of technical problems, the later launch date, and cost overruns by experimenter contractors and cost exceeding target costs of the spacecraft contractor, as well as the additions caused by changes in scope. Launch vehicle funding requirements have increased due to use of the improved thrust augmented Delta, which will achieve closer perhelions or more distant aphelions than the basic Delta vehicle.

8. Justification of FY 1966 Budget Estimate: FY 1966 funds will pay for the final checkout and launch of the first two Pioneers, modifications to the basic Pioneer spacecraft necessary to accommodate the new payload selected for Pioneers C and D, and complete the funding of these new experiments. FY 1966 funds will also provide for initiation of procurement of spacecraft and experiments for the follow-on series of flights.

FUNDING & LAUNCH SCHEDULE

PROJECT: Pioneer

FUNDING (FY)

	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-G	2,614	13,600	13,000	14,500	5,600	1,000	-	-	50,314
'66 Preview A-K	2,614	13,600	14,700	23,430	16,757	15,009	13,000	5,000	104,110
'66 Budget A-K	2,614	13,600	14,700	21,500	24,700	19,100	12,100	7,500	115,814
Launch Vehicle Allocation									
'65 Budget	-	4,100	8,100	6,100	3,050	-	-	-	21,350
'66 Preview	-	4,100	2,500	10,300	3,300	4,600	5,300	6,600	36,700
'66 Budget	-	4,100	2,900	7,000	4,600	6,600	6,600	5,300	37,100

LAUNCH SCHEDULE (CY)

	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget		2	3	2			
'66 Preview		1	3	1	2	1	3
'66 Budget		1	2	1	2	2	3

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LUNAR ORBITER

1. Project Objectives: Photographic reconnaissance of the lunar surface to determine its topography and to select landing sites for both Surveyor Lander and Apollo is the primary objective. Selenodetic studies and investigations of environmental properties in the vicinity of the moon are secondary objectives.

2. Project Content: The lunar surface will be photographed by a series of attitude stabilized spacecraft which will be launched by Atlas-Agena, and injected into lunar orbit by an on-board propulsion system which will subsequently refine the initial orbit to a perilune of about 30 miles. The spacecraft will process the film, read it out periodically and transmit to the Deep Space Net stations where the signal will be reconverted to film. Ancillary experiments for secondary objectives will be carried as weight and other considerations permit.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Direct man-years)

a. Contractor:

	FY 1964	FY 1965	FY 1966	FY 1967
Boeing	75	643	398	114

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of contract: Cost plus incentive fee

(2) Cost negotiated to date: $80,516,000 (includes $4,736,000 target fee)

(3) Scope negotiated to date: Delivery of five flight spacecraft, three prototype test spacecraft, and three sets of components for reliability, quality assurance, and functional tests. The contract also provides for five ground equipment vans to test and checkout the spacecraft, and twelve sets of ground recording equipment for the DSIF, Boeing, and Eastman Kodak (photo subsystem).

b. Anticipated Changes:

(1) Estimated additional costs involved: The contractor has bid $7,700,000 in changes which are now being negotiated. In-house estimates put the cost of Spacecraft F-J at $57,000,000.

(2) Additional scope involved in changes in negotiation is computer programming originally planned to be done by JPL and additional equipment and manpower for ground operations beyond what was included in the original proposal. The follow-on spacecraft will differ from the first five only to the extent that modifications are necessary to accommodate instrumentation for secondary objectives not flown in the earlier development flights.

(3) Estimated dates changes will be negotiated: Negotiations of the changes to the current contract will be completed in October. The contract for Spacecraft F-J will be awarded in the latter half of FY 1966.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No changes

b. Project Content: No changes

c. Project Schedules: The launch schedule has slipped about three months because contractor selection and negotiation of an incentive contract took longer than expected. Procurement of follow-on spacecraft has been delayed one year because of Congressional cuts.

d. Project Funding: The project will cost more than was expected late in 1963: the earlier estimates had budgeted $61,000,000 for the spacecraft contractor, which was about the average of the five bids. The award was made on the basis of the best technical proposal, which had higher costs. Subsequently it was decided to shift certain activities forward in the project to permit more testing prior to launch. Placing procurements earlier led to a forward shift of obligation requirements, so that funding in the early years of the project is substantially higher than previously planned. Consequently, FY 1969 costs for spacecraft are higher. The FY 1966 decrease is attributable to deferral of follow-on procurement.

8. Justification of FY 1966 Budget Estimate: FY 1966 funds will pay for mission simulation and qualification testing of the prototype spacecraft, the assembly of all five flight spacecraft, qualification, acceptance testing, and launch of the first Lunar Orbiter, testing of the other four flight spacecraft after assembly, and will initiate procurement of spacecraft F-J.

FUNDING & LAUNCH SCHEDULE

PROJECT: Orbiter

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-J	4	20,000	33,800	45,300	30,500	13,900	2,600	-	146,104
'66 Preview A-J	4	20,000	31,500	49,600	30,500	10,900	2,600	-	145,104
'66 Budget A-J	4	20,000	41,800	39,000	61,000	17,000	8,000	1,000	187,804
Launch Vehicle Allocation									
'65 Budget	-	-	15,500	33,700	25,400	4,100	-	-	78,700
'66 Preview	10,094*	170	1,593	22,288	32,716	12,915	-	-	79,776
'66 Budget	10,094*	170	2,335	22,146	20,541	22,687	1,800	-	79,773

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget			4	4	2		
'66 Preview			3	4	3		
'66 Budget			3	2	4	1	

*Re-allocation of Ranger Block V Launch Vehicles to Lunar Orbiter

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LUNAR AND PLANETARY SUPPORTING RESEARCH AND TECHNOLOGY

1. Project Description/Justification: The Supporting Research and Technology program efforts are conducted by universities, NASA installations, and other government and non-government organizations. This work serves as the basis for determining future Lunar and Planetary flight mission objectives. There are three major areas of effort: Science, Sterilization, and Advanced Technical Development. The Science program includes theoretical and observational research as well as the development of laboratory models of flight experiments. When the feasibility of these flight instruments is demonstrated to a degree that gives a high probability of successful performance on a flight mission, they are considered for selection for approved flight projects. When selected, experiments are funded by the spacecraft project which is responsible for development of flight hardware. Advanced Technical Development is directed toward improving and developing the performance, environmental tolerance, reliability, and lifetime of components and subsystems of spacecraft in support of planned Lunar and Planetary flight programs. The Sterilization program, which is concerned with the effects of sterilization processes on spacecraft performance and lifetime, was created in response to the requirements of Planetary Quarantine, preventing contamination of other planets by terrestrial organisms.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Science	12,145	12,200	12,000
Advanced Technical Development	3,713	3,300	3,500
Sterilization	1,437	4,500	4,000
TOTAL	17,295	20,000	19,500
b. Continuation vs. New:			
Continuation of existing contracts and grants	12,510	15,000	14,600
New contracts and grants	4,785	5,000	4,900
c. University contracts and grants	6,000	5,400	5,900

3. Specific mechanisms or channels for program coordination with other interested agencies: The Office of Advanced Research and Technology has overall agency responsibility for coordination of the NASA research program. The Office is responsible for maintaining a balanced agency research program; eliminating needless duplication of effort, and for formal communication with other government agencies, such as the semiannual exchange of task descriptions with the Department of Defense. As a part of its function in overseeing the NASA research program, the Office of Advanced Research and Technology reviews each individual research task before it is approved for execution by another Program Office.

The subcommittees of the Space Science Steering Committee provide another structure, albeit an informal one, for coordinating the research effort. These subcommittees draw considerably on the scientific community in academic institutions for their membership, in addition to scientists who work in government laboratories. Scientists from the Lunar and Planetary Science program are members of the subcommittees on Fields and Particles, Planetary Atmospheres, and Planetology. This provides an informal mechanism to coordinate the general research on a national basis at the scientific program level.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LUNAR AND PLANETARY ADVANCED STUDIES

1. Project Description/Justification: To conduct conceptual design studies of advanced unmanned Lunar and Planetary flight missions in order to determine the scientific desirability, spacecraft capability, technological problems and long-lead development items, costs and other resource requirements. Analysis of these studies provides the framework for mission definition effort leading to approval of new flight projects, as in the case of Pioneer, Lunar Orbiter, Mariner, and Voyager, and indicates the general nature of the launch vehicle capability required for unmanned spacecraft missions.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Lunar Studies	-0-	150	150
Mars Studies	1,266	1,000	1,000
Venus Studies	-0-	350	350
Outer Planets	495	500	500
Interplanetary Studies	475	-0-	-0-
	2,236*	2,000	2,000

* includes 450 funded in Lunar and Planetary SR&T

b. Continuation vs. New:			
Continuation of existing contracts and grants	2,236	1,500	1,500
New contracts and grants	-0-	500	500
c. University contracts and grants	None		

3. Specific mechanisms or channels for program coordination with other interested agencies:

This project serves the advanced planning needs of the Lunar and Planetary exploration program it supports. These efforts are integrated into the overall NASA Advanced Study effort by the Planning Review Panel, on which all major program offices in the agency are represented. This group, which reports directly to agency General Management, is responsible for maintaining overall balance in the advanced study program of NASA, and for coordination of the NASA program with other government agencies. The Planning Review Panel reviews each study before the Associate Administrator approves contractual implementation.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: MANNED SPACE SCIENCE - SR&T

1. Project Description/Justification: Manned Space Science Supporting Research and Technology provides background studies and analyses for operational manned spacecraft systems. These include determination of the feasibility of presently planned manned space flight systems for scientific investigations and applications, determination of the requirements for new or modified spacecraft systems for future scientific investigations and applications, and the planning and long-leadtime development of worthwhile scientific investigations for inclusion in future manned missions. This project also provides for applied research on the space environment (e.g., the lunar surface and solar flares) to meet critical needs in the design and development of safe and reliable manned space flight systems. In addition, it includes funding of space science studies and applied research in support of the systems planning being conducted by the Office of Manned Space Flight for possible future manned planetary missions.

2. Project Funding: (Program Plan in Thousands of Dollars)

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Manned Space Flight Environmental Data Support	1,090	770	1,150
Advanced Orbital Missions	290	2,919	7,900
Planetary Missions	20	100	300
TOTAL	1,400	3,789	9,350
b. Continuation vs. New:			
Continuation of existing contracts & grants	690	1,785	7,900
New Contracts & Grants	710	2,004	1,450
c. University Contracts & Grants	110	462	1,790

3. Specific mechanisms or channels for program coordination with other interested agencies:

Coordinating Panels

National Space Station Planning Subpanel of the Manned Space Flight Panel, Aeronautics and Astronautics Coordinating Board

Purpose: To implement the DOD-NASA agreement to make maximum utilization of current and planned manned Earth orbital studies in establishing requirements and meeting the objectives of both the DOD and NASA.

OSSA role: OSSA reviews DOD science planning and provides information to DOD on NASA science planning for manned Earth orbital space systems.

Members: NASA: Mr. Willis B. Foster, OSSA
Dr. Michael I. Yarymovych, OMSF

Other Agencies: Department of Defense.

Program Areas being coordinated with other Agencies

U. S. Geological Survey, Department of the Interior

Support of lunar geologic mapping and analysis of lunar terrain features to assure development of information concerning the lunar surface that will be adequate both for design of the Apollo spacecraft and for the planning of lunar surface operations by Apollo astronauts (transfer of funds).

Defense Intelligence Agency, Department of Defense

Coordination of NASA requirements placed on the Aeronautical Chart and Information Center and Army Map Service to insure consistency with DOD plans for these agencies.

Aeronautical Chart and Information Center, U. S. Air Force, Department of Defense

Support of lunar topographic mapping to assure development of information concerning the lunar surface that will be adequate both for Apollo spacecraft design and for lunar surface operations planning (transfer of funds).

Army Map Service, Corps of Engineers, U. S. Army, Department of Defense

Support of lunar topographic mapping to assure development of information concerning the lunar surface that will be adequate both for Apollo spacecraft design and for lunar surface operations planning (transfer of funds). (NASA requirements for lunar maps from ACIC and AMS are coordinated through the Manned Space Science program to avoid duplication of effort.)

National Bureau of Standards, U. S. Department of Commerce

Development of a ground-based research system for monitoring solar radiation levels (transfer of funds).

GIMRADA, Engineering Research and Development Laboratories, Department of Corps of Engineers, U.S. Army, Department of Defense

Coordination of data handling systems relating to manned Earth orbital mapping for the geosciences; support of development of mutually satisfactory systems (transfer of funds).

U. S. Department of Defense, U. S. Department of Agriculture, U. S. Department of Commerce, U. S. Department of Interior

Support of studies to determine the value of potential applications which these agencies or their constituents might be able to make of the Manned Space Flight capabilities NASA has or is developing (transfer of funds). Encouragement of studies to be conducted by those agencies using their own resources to determine for planning purposes possible applications, relating to the responsibilities of these agencies, of potential future manned space flight systems.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: MANNED SATELLITE SCIENCE

1. Project Description: Manned Satellite Science includes the planning, design, and development of scientific in-flight investigations; fabrication, testing, and integration of flight hardware and related equipment for the Gemini, Apollo Earth-orbital and extended Apollo orbital manned missions; and analysis of the data collected from these investigations. Studies in the fields of planetology, geophysics, geochemistry, exobiology, solar physics, ionospheres, astronomy, aeronomy, meteorology, relativity and gravity, and interplanetary particles and fields are among the scientific investigations being developed for implementation on manned space missions. Participation of the scientific community in all phases of development from planning through data analysis is being solicited and encouraged through appropriate contracts and grants. Industrial firms capable of developing instrumentation that is able to meet scientific requirements and to operate reliably under space flight conditions are utilized through development contracts. Training of the astronauts in relevant general scientific disciplines and in the scientific procedures required for specific investigations is also being undertaken.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Gemini Science	1,001	587	2,000
Apollo Earth-Orbital Science	785	-0-	6,000
TOTAL	1,786	587	8,000
b. Continuation vs New:			
Continuation of existing contracts and grants	-0-	587	2,600
New contracts and grants	1,786	-0-	5,400
c. University contracts and grants	142	160	2,090

3. Specific mechanisms or channels for program coordination with other interested agencies:

Coordinating Panel

Manned Space Flight Experiments Board

Purpose: To develop coordinated experiment plans for manned space flight missions, and to recommend to the Associate Administrator for Manned Space Flight for final approval, the experiments to be conducted on each manned space mission.

OSSA Role: OSSA presents the approved NASA scientific experiments to the Board, and participates in considerations of the Board to assure that the OSSA established scientific priorities are recognized in relation to the relative priorities of the engineering and medical experiments proposed by OMSF, OART, and by the Department of Defense.

Members: NASA: Dr. George Low, OMSF, Chairman; Dr. Homer E. Newell OSSA; Dr. R. E. Bisplinghoff, OART; Dr. Bert A. Denicle, OMSF, Executive Secretary; others at invitation of Dr. George Mueller, Associate Administrator for a Manned Space Flight, NASA.
Other Agencies: Department of Defense.

Other Agencies

Weather Bureau, U. S. Department of Commerce:

Inclusion of Weather Bureau's proposed scientific experiments in the planned scientific activities for Project Gemini.

U. S. Navy, Department of Defense:

Coordination to avoid duplication of effort between agencies in planning scientific experiments for Project Gemini, especially specific experiments proposed by scientists at Navy research facilities.

A number of the agencies now coordinating with the Manned Space Science SR&T program would be involved in extended Apollo missions.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: MANNED LUNAR SCIENCE

1. Project Description: Manned Lunar Science focuses its activity on the planning, design, and development of scientific investigations and equipment; fabrication, testing, and integration of flight hardware; and data analysis to be conducted as part of manned lunar missions. The goal of manned lunar science is the development of an orderly scientific program for the exploration and study of the Moon. This includes investigations for early Apollo missions in the scientific fields of geochemistry; atmospheric, thermal and gravitational measurements; geophysics, including passive and active seismology; mineralogy and petrology; and the biosciences. For later or Post-Apollo missions, the involvement of every space science discipline is foreseen.

   Encouragement of scientific, university, and industrial participation in all pertinent phases of the development of potential investigations is being undertaken through research grants and contracts.

   Effort is also being directed to the training of the astronauts in relevant general scientific disciplines and in the scientific procedures required for planned investigations.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Apollo Science	2,434	6,924	14,100
Post-Apollo Science	-	500	950
TOTAL	2,434	7,424	15,050
b. Continuation vs. New:			
Continuation of existing contracts and grants	-0-	6,924	14,195
New contracts and grants	2,434	500	855
c. University contracts and grants	-0-	306	635

3. Specific mechanisms or channels for program coordination with other interested agencies:

Coast and Geodetic Survey, Department of Commerce

Support of assistance of NASA in preparing geodetic maps and other tools for use in manned space systems reentry and landing guidance and control (transfer of funds).

U. S. Geological Survey, Department of the Interior

Utilization of USGS personnel as instructors in the geologic (selenologic) training of astronauts for lunar missions, and as consultants in the planning of the geological selenological aspects of lunar missions (transfer of funds).

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: SUSTAINING UNIVERSITY PROGRAM

1. Project Description/Justification: The Sustaining University Program was inaugurated to increase university participation in research in aeronautical and space sciences and engineering required to ensure successful fulfillment of the national space effort. The Program's objectives are: (1) to increase the supply of scientists and engineers trained in space-related areas; (2) to assist institutions in acquiring adequate research facilities essential to the investigation of space; and (3) to encourage new, creative approaches and to develop increased capabilities for the conduct of space-related research.

   Universities are the only knowledge-creating institutions that produce more trained people than they consume and, through constructive operational methods for implementing this Program, NASA is securing their maximum direct contribution to the national space effort. By operating within the existing academic structure of the university, rather than fostering activities which tend to weaken it, we are forming partnerships with the universities in which they bear an appropriate share of responsibility to commit their material and human resources on behalf of the national space effort. Such partnerships are producing more fruitful research and useful fundamental knowledge, the highly trained manpower from which will come our investigators and program managers of tomorrow, and more laboratories to house the research necessary for the eventual conquest of space.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Training	19,812	25,000	30,000
Facilities	12,000	10,000	12,000
Research	8,188	11,000	18,000
Project Totals	40,000	46,000	60,000

b. Continuation vs. New:

Continuation of existing contracts and grants	20,485	30,465	39,000
New contracts and grants	19,515	15,535	21,000
Project Totals	40,000	46,000	60,000

c. University Contracts and Grants: 40,000 46,000 60,000

3. Specific Mechanisms or Channels for Program Coordination With Other Interested Agencies:

a. Close liaison is maintained with the PSAC and the NAS-NRC along with membership on the FCST to ensure the fullest possible coordination of activities at a high level within government.

b. Coordination with program administrators in federal agencies having substantial research, training, and facilities programs is accomplished through the following groups:

(1) Science Information Exchange
(2) AEC-NSF-NASA Group
(3) Interagency Task Force on Federal Education Programs
(4) NSF Facilities Review Panel
(5) Federal Fellowship Administrators
(6) Interagency Meetings of Physics Research Administrators
(7) Federal Chemistry Interagency Group
(8) Interagency Chemical Rocket Propulsion Agency

c. Cooperation with the following major federal sponsors of scientific and engineering research is effected by exchanging monthly lists of proposals and actions, as well as summaries of the projects supported during longer reporting periods:

(1) Army Research Office - Durham
(2) Air Force Office of Aerospace Research (including Cambridge Research Center & Office of Scientific Research)
(3) Office of Naval Research
(4) Atomic Energy Commission, Division of Research
(5) National Science Foundation
(6) National Institutes of Health

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: CENTAUR DEVELOPMENT

1. Project Objectives: The objective of this project is to develop a high performance launch vehicle, to fill the gap between the Atlas-Agena class vehicle and the Saturn I class vehicle, for NASA unmanned missions. This project is directed toward the development of a general purpose launch vehicle consisting of a modified Atlas booster and a high-energy upper stage (Centaur) utilizing liquid oxygen and liquid hydrogen technology.

2. Project Content: This project consists of eight flight tests of the Atlas-Centaur vehicle of which three have been completed. The remaining tests are planned to demonstrate proper guidance operation, direct ascent to lunar impact, the production configuration, and two-burn capabilities. Also, an extensive ground test program is in operation in support of the flight tests. The project includes eight flight Atlas-Centaur vehicles, one ground test booster, twenty-one test articles, six dynamic spacecraft models, one dummy mast, sixteen guidance sets (eight for flight articles) and 35 sets of engines (16 for flight articles). Currently included in this project is a RL-10 engine improvement program and a vehicle weight reduction program to further increase the performance capabilities of the Atlas-Centaur launch vehicle.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower:*

a. Contractor:	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968
	2,980	2,080	900	500	-

b. NASA In-House Direct Manpower:

* These totals reflect allocation of personnel to Centaur Development.

6. Project Procurement:

a. Current Status:

(1) Type of contract: A cost plus fixed fee contract (NAS 3-3232) has been negotiated with General Dynamics Astronautics. This contract includes seven development vehicles and seven procurement vehicles. The data provided below is only that portion of the contract allocable to Centaur Development.

(2) Cost negotiated to date: $234,782,000

(3) Scope negotiated to date: Present scope of the contract calls for delivery of eight flight Atlas-Centaur launch vehicles, associated launch services, and a ground testing program.

b. Anticipated Changes:

(1) Estimated additional costs involved: $9,205,000 - Total estimated authorized and anticipated changes through completion of program. Total FY 1965 changes are estimated at $4.8 million and at $3.0 million in FY 1966.

(2) Additional scope involved: None

(3) Estimated dates changes will be negotiated: Various changes in process.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No changes

b. Project Content: Development of up-rated RL-10 engine through the RL-10 engine improvement program. Extensive weight reduction program and modifications based on flight test experience.

c. Project Schedules: Difficulties experienced in the Centaur stage of the last flight test have caused a slip of two flight tests from CY 1964 to CY 1965.

d. Project Funding: None

8. Justification of FY 1966 Budget Estimate: Funding in FY 1966 is for the continuation of the development program, development of the Centaur two-burn capability, efforts to improve engine performance, reduce vehicle weight, and enhance overall reliability.

FUNDING & LAUNCH SCHEDULE

PROJECT: Centaur Development

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Vehicle Development									
'65 Budget	283,600	108,100	92,000	21,700	-	-	-	-	505,400
'66 Preview	283,600	108,100	92,000	22,000	-	-	-	-	505,700
'66 Budget	283,600	108,100	89,400	59,600	30,500	3,200	-	-	

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							
'66 Budget							

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: FLOX PROGRAM

1. Project Description: This project was initiated to develop an increased performance capability of the Atlas launch vehicle through the use of a mixture of liquid fluorine and liquid oxygen as the oxidizer. Although originally planned as a flight project, this effort has been reduced to a supporting research effort leading toward an advanced Hydrogen-Fluorine technology development.

2. Project Funding: (see attached)

   b. Analysis and Justification of Significant Changes in Project Funding:

   In order to plan a balanced program it was necessary to reduce this project to an advanced technical development program aimed toward the more advanced Hydrogen-Fluorine technology.

   The resulting reduction in Centaur payload capability will be partially offset by the RL-10 engine improvement and the weight reduction programs.

3. Justification for FY 1966 Budget Estimate:

   a. Identification of Requirements by Major Function, Activity and/or End Items Funded: No FY 1966 requirements

   b. Contractor Manpower (by year for each substantial service contract funded under the project): No contract negotiated

   c. Services of Other Government Agencies: None

   d. FY 1966 Procurement of Capital Items: None

FUNDING & LAUNCH SCHEDULE

PROJECT: FLOX

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Development									
'65 Budget	-	1,900	17,500	15,600	-	-	-	-	35,000
'66 Preview	-	1,900	17,500	17,800	-	-	-	-	37,200
'66 Budget	-	1,900	2,600	-	-	-	-	-	4,500

1964	1965	1966	1967	1968	1969	Subsequent to 1969

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LAUNCH VEHICLE SR&T

1. Project Description/Justification: The purpose of launch vehicle supporting research and technology is to conduct an active effort directed toward the development of new technology and techniques that may be required to support future unmanned missions. This effort includes the development of selected subsystems and components when a clear need, based on advanced studies or other sources, is demonstrated. This program utilizes data available from other NASA offices (OART and OMSF), other agencies (DOD and AEC), and industry to study the nature and desirability of changes to launch vehicle systems, subsystems and components which may be necessary to achieve the most economical use of launch vehicles.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Fluid Behavior Studies	480	---	---
Vehicle Systems Studies	316	1,475	1,500
Propulsion Technology	491	2,000	2,000
Applied Mathematics	433	100	500
Guidance System	---	---	1,000
Total	$1,720	$3,575	$5,000
b. Continuation vs. New:			
Continuation of existing contracts and grants	563	100	---
New contracts and grants	1,157	3,475	5,000
c. University contracts and grants	---	---	---

3. Specific mechanisms or channels for program coordination with other interested agencies:

(1) OART reviews all Supporting Research Tasks.
(2) Launch Vehicle Panel of the NASA/DOD - Aeronautics and Astronautics Coordinating Board.
(3) NASA Launch Vehicle and Propulsion Advisory Group--made up of University and Industry consultants.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LAUNCH VEHICLES - ADVANCED STUDIES

1. Project Description/Justification: Launch vehicle advanced studies are directed toward answering critical vehicle program questions and providing information required to understand future mission needs for launch vehicle support, so that they may be related to available vehicles and potential vehicle developments. A continuing mission analysis and preliminary design effort is necessary to assess and apply developments in the various areas of launch vehicle technology to the new demands placed on the space transportation system. This effort provides management a source of data for decisions as to when and what new programs are to be undertaken. It permits informed judgments on the allocation of resources among various research and development efforts.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Advanced Studies	$ 180	$ 925	$3,000
b. Continuation vs. New:			
Continuation of existing contracts and grants	-0-	500	2,200
New contracts and grants	180	425	800
c. University contracts and grants	-0-	-0-	-0-

3. Specific mechanisms or channels for program coordination with other interested agencies:
Efforts are coordinated thru:
(a) Office of Programs, Planning Review Panel NASA.

(b) Launch Vehicle Panel of NASA/DOD Aeronautics and Astronautics Coordinating Board.

(c) NASA Launch Vehicle and Propulsion Advisory Group--made up of University and industry consultants.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: OPERATIONAL VEHICLE SUPPORT

1. Project Description: The objective of Operational Vehicle Support is to provide adequate support to operational (beyond the development stage) launch vehicles. This support effort includes the correction of deficiencies uncovered during operational use of vehicles, the necessary continued minor product improvement to systems, subsystems and components, maintainance of ground support equipment, and systems engineering required for reliability studies and system coordination necessary throughout the operational lifetime of a vehicle system. This project includes the support of all launch vehicles under the management control of the Office of Space Science and Applications, specifically: Scout, Delta, Thor-Agena, Atlas-Agena, and Atlas-Centaur.

2. Project Funding: (See Attached)

   a. Analysis and Justification of Significant Changes in Project Funding:

   Project funding increases in FY 1966 reflect the addition of Centaur support requirements of operational missions.

3. Justification for FY 1966 Budget Estimate:

   a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

(In Thousands of Dollars)

	FY 1963 & PRIOR	FY 1964	FY 1965	FY 1966
Product Improvement	6,292	7,463	3,734	18,670
Scout	-0-	1,100	633	600
Delta	492	2,738	2,631	2,850
Agena	5,800	3,625	470	7,270
Centaur	-0-	-0-	-0-	7,950
Maintenance of GSE	894	1,431	3,409	6,400
Scout	-0-	300	1,432	650
Delta	894	-0-	550	1,400
Agena	-0-	1,131	1,427	1,700
Centaur	-0-	-0-	-0-	2,650

System Engineering	514	4,306	4,257	13,830
Scout	-0-	2,000	3,335	2,750
Delta	114	862	322	480
Agena	400	1,444	600	1,800
Centaur	-0-	-0-	-0-	8,800
TOTALS	7,700	13,200	11,400	38,900

b. Contractor Manpower (by year for each substantial service contract funded under the project): No significant service contracts included under this project.

c. Services of Other Government Agencies:

	(In Thousands of Dollars)		
PROJECT	FY 1964	FY 1965	FY 1966
Scout (Navy)	-0-	225	200
Delta (Navy)	30	100	-0-
Agena (Air Force)	2,602	2,053	6,350
Centaur	-0-	-0-	-0-

d. FY 1966 Procurement of Capital Items: No single major procurement of capital items are programmed in FY 1966. The items programmed are required to support the improvement of existing capabilities and normal support of launch operations. The estimated value of launch facilities utilized for OSSA missions are:

PROJECT	LAUNCH SITE	LAUNCH FACILITIES	ESTIMATED VALUE
Scout	Wallops Island	2	5.0 M
	W.T.R.	1	2.5 M
Delta	E.T.R.	2	14.0 M
Atlas-Agena	E.T.R.	2	50.0 M
Thor-Agena	W.T.R.	1	10.0 M
Atlas-Centaur	E.T.R.	2	50.0 M

FUNDING & LAUNCH SCHEDULE

PROJECT: Operational Vehicle Support

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	7,700	13,200	14,200	32,000	Continuing - - -	- - -	- - -	- - -	- - -
'66 Preview	7,700	13,200	22,500	32,200	32,000	33,500	33,500	- Continuing	- - -
'66 Budget	7,700	13,200	11,400	38,900	35,700	35,200	35,000	- Continuing	- - -

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							
'66 Budget							

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: BIOSATELLITE

1. Project Objectives: To quantitatively determine certain effects of weightlessness upon primates, small animals, plants and other biological specimens. To determine the biological effects of the combination of weightlessness and a known source of gamma radiation to find out if there are any synergistic, antagonistic or other effects, or if there are no effects. To investigate the effects on the biological rhythms of living organisms of removal from the earth's gravitational and other influences. Recent USAF and USSR space flights have resulted in indications of cardiovascular and vestibular problems in man from extended space flights. The basic research on the effects of weightlessness and radiation on primates and other living organisms is expected to provide clues and quantitative results which will assist the Office of Manned Space Flight in the solution of these problems. To obtain information on the effects of the space environment, particularly weightlessness, upon the Biosatellite life support system and upon the engineering aspects involved in its operation.

2. Project Content: A series of six launches is scheduled. Launches will consist of a spacecraft with recoverable experiment capsule placed into orbit by the Thrust Augmented Improved Delta launch vehicle. Orbital flight time will vary from 3 to 30 days, depending on the experiments aboard. The 3-day flight is to determine the synergistic, antagonistic or other effects of combined weightlessness and radiation on animals, plants, and cells, as well as general biology experiments; the 21-day flight is to investigate the effects of the space environment on biological rhythms and the effects of weightlessness on cellular processes in plants and animals; and the 30-day flight is to determine the effects of prolonged weightlessness on primates' cardiovascular systems, central nervous systems, and behavior. All of these experiments require recovery. Each flight will have a duplicate for the purpose of backup. The recovery services (training of crews, testing and conduct of six recovery missions by aerial retrieval) will be provided by the Air Force. In the event of a water landing, backup capability in the form of ships and helicopters may also be provided by the Air Force.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man-Years)

	FY 1964	FY 1965	FY 1966	FY 1967
a. Contractor: GE	34	246	152	60
b. NASA In-House Direct Manpower:				

6. Project Procurement:

a. Current Status:

(1) Type of contract: CPIF

(2) Cost negotiated to date: $24,023,000

(3) Scope negotiated to date: Design, develop, fabricate, and test six spacecraft, experiment prototype hardware, prototype spacecraft hardware, spares, and aerospace ground equipment. The prototype hardware will include those items necessary for testing, as well as attitude control system components for verification of the control constants. The aerospace ground equipment will include those items necessary for handling, transportation, field assembly, and checkout and mating of the spacecraft and its launch vehicle subsequent to the manufacturing cycle. Assist Ames Research Center in the necessary integration effort on the experiments and launch vehicles and assist in the launch and recovery operation.

b. Anticipated Changes:

(1) Estimated additional costs involved: $4,000,000

(2) Additional scope involved: Changes in the spacecraft due to the Improved Delta, the addition of instrumentation and telemetry, and other increases in the experiment requirements.

(3) Estimated dates changes will be negotiated: During FY 1965 and FY 1966.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No change

b. Project Content: The launch vehicle was changed from two Deltas and four Thrust Augmented Deltas to six Improved Thrust Augmented Deltas. This change should provide an optimum spacecraft design.

c. Project Schedules: The first flight has been deferred one quarter because of the change in vehicles to six Improved Thrust Augmented Deltas requiring a modification of the spacecraft configuration, and because of a lag in experiment development.

d. Project Funding: An additional $3,300,000 was required in FY 1965 over the $12,700,000 initially planned to provide for increased costs of the spacecraft and experiment development.

8. Justification of FY 1966 Budget Estimate: The FY 1966 budget provides continued funding of the spacecraft contract, continued experiment development and fabrication of flight-ready hardware, and funding of recovery development and operations.

FUNDING & LAUNCH SCHEDULE

PROJECT: Biosatellite

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-F	1,959	8,500	12,700	10,000	3,700	-	-	-	36,859
'66 Preview A-F	1,959	8,500	16,000	16,000	4,000	-	-	-	46,459
'66 Budget A-F	1,959	8,500	16,000	16,000	4,000	-	-	-	46,459
Launch Vehicle Allocation									
'65 Budget	-	-	6,500	11,200	-	-	-	-	17,700
'66 Preview	-	-	9,000	7,900	2,000	-	-	-	18,900
'66 Budget	-	-	9,000	12,000	-	-	-	-	21,000

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget		1	4	1			
'66 Preview		1	4	1			
'66 Budget			4	2			

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: AUTOMATED BIOLOGICAL LABORATORY (VOYAGER PAYLOAD)

1. Project Objectives: To design and develop an Automated Biological Laboratory to be used as a major payload on Voyager missions. The ABL would be a large, highly integrated set of experiments designed for long operation (2 earth years) on the surface of Mars for the purpose of detecting and describing biological and chemical evidence of life.

2. Project Content: The first phase of this project is a study effort to accomplish project definition and design work to identify the biological experiments and associated support equipment that will comprise the integrated experimental package known as the Automated Biological Laboratory. This initial study effort is scheduled for completion in August 1965. The FY 1966 period will primarily be involved with a follow-on study effort, the fabrication of feasibility test hardware, and the testing of this hardware either at the contractor plant or a NASA facility.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man-Years) FY 1965*

   a. Contractor(s): 9 (Philco)

   b. NASA In-House Direct Manpower

   *No additional manpower estimates have been provided because the scope of this project will be determined as a result of the study contract.

6. Project Procurement:

   a. Current Status:

      (1) Type of contract: CPFF (Funded from SR&T)

      (2) Cost negotiated to date: $367,000

      (3) Scope negotiated to date: A one year study effort to review objectives, define the experiments, establish vehicle and spacecraft interface requirements, and complete the preliminary design for an Automated Biological Laboratory to land on Mars and other planets, and search for and describe extra-terrestrial life.

b. Anticipated Changes:

(1) Estimated additional cost(s) involved: -- to be determined by study effort.

(2) Additional scope involved: -- See Item 2 above.

(3) Estimated date(s) change(s) will be negotiated: -- 1965

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: This project was initiated after the President's Budget for FY 1965 was prepared.

b. Project Content:

c. Project Schedules:

d. Project Funding: A study contract for $367,000 was awarded to the Philco Aeronutronics Engineering and Research Center, Newport Beach, California, in August 1964.

8. Justification of FY 1966 Budget Estimate:

In FY 1966 the stated fund requirements will be used to procure and fabricate feasibility test hardware, and to provide for appropriate testing of this hardware, The accomplishment of this phase of this project during FY 1966 is essential in order to provide a package of experiments which will interface with the limited launch opportunities which are available to the Voyager mission.

FUNDING & LAUNCH SCHEDULE

PROJECT: Automated Biological Laboratory

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	-	-	-	-	-	-	-	-	-
'66 Preview				2,000	10,000	15,000	15,000	continuing	-
'66 Budget				1,000	10,000	15,000	15,000	continuing	-

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							
'66 Budget							

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: BIOSCIENCE SUPPORTING RESEARCH AND TECHNOLOGY

1. Project Description/Justification: The Supporting Research and Technology Program provides the necessary background of theoretical and laboratory research to define the experiments to be carried out in space, to devise the techniques and instruments to be utilized, and to enable the biologists to interpret the space flight data. In addition, fundamental research is performed to provide basic understanding of earth base-line data and to determine parameters useful for the search for extraterrestial life.

2. Project Funding (Program Plan in Thousands of Dollars):

a. Funding by Project Element:	FY 1964	FY 1965	FY 1966
Exobiology	5,200	5,000	5,030
Environmental Biology	2,900	2,800	2,810
Behavioral Biology	2,100	2,100	2,160
Physical Biology	1,991	1,900	2,000
TOTAL	12,191	11,800	12,000
b. Continuation vs. new:			
Continuation of existing contracts and grants	4,962	10,251	10,000
New contracts and grants	7,329	1,559	2,000
c. University contracts and grants	6,050	5,900	6,000

3. Specific mechanisms or channels for program coordination with other interested agencies:

The Bioscience Programs Division has several mechanisms and a variety of channels for coordinating the NASA Bioscience program within NASA, with other government agencies, as well as with educational organizations. There is constant and close contact between

the program director and members of his staff with their organizational counterparts in such agencies as the Atomic Energy Commission, the National Science Foundation, the National Institutes of Health and the Department of Health, Education and Welfare.

In addition, the Bioscience Programs Division has representatives on numerous committees, councils, boards and related groups in the scientific community to insure that the bioscience program is coordinated with government and educational organizations and to enable NASA to maintain cognizance of industrial bioscience developments. Some examples of these committees are:

National Advisory Research Resources Committee
National Advisory Mental Health Council
Radiobiology Subcommittee of the National Research Council, NAS
Bioscience Subcommittee of the Space Science Steering Committee
Life Sciences Sub-Panel of the Supporting Research and Technology Panel, Aeronautics and Astronautics Coordinating Board

The close cooperation and coordination with NASA and DOD in the bioscience field is illustrated by the Life Sciences Sub-Panel of the AACB in accomplishing the review and coordination of life sciences' activities by NASA and DOD to avoid undesirable duplication and to achieve efficient utilization of available resources.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: PLANETARY QUARANTINE

1. Project Description/Justification: To develop methods and procedures for reducing the number of microorganisms to a minimum on probes to the moon and to completely sterilize capsules destined for Martian or other planetary landings in order that the planets will not be infected by terrestrial life. The techniques developed must permit optimum performance of the capsules and must produce no degradation of the reliability of the mission.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:	-0-	-0-	1,000
b. Continuation vs. New			
Continuation of existing contracts and grants	-0-	-0-	-0-
New contracts and grants	-0-	-0-	1,000
c. University contracts and grants	-0-	-0-	-0-

3. Specific mechanisms or channels for program coordination with other interested agencies: The Bioscience Programs Division has several mechanisms and channels for coordinating the Planetary Quarantine project with other interested agencies. Of these, the most important is the assignment to NASA of a Public Health Services Officer to serve as chief of the Planetary Quarantine program. This assignment has provided a direct contact with the U. S. Public Health Service and related health organizations, as well as providing a focal point for Planetary Quarantine matters.

The principal agencies involved in the coordination of the Planetary Quarantine program include the U. S. Public Health Service of the Department of Health, Education and Welfare; the Army Chemical Corps, and the World Health Organization.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: TIROS/TOS IMPROVEMENTS

1. Project Objectives: To develop the sensors and space technology to be used for the identification and tracking of storms, frontal systems, hurricanes, typhoons, etc.; provide cloud cover and earth-atmosphere heat balance with measurement of infrared and reflected solar radiation in selected spectral regions; provide limited operational data for weather analyses; and provide the technology in support of the operational meteorological satellite system (TOS).

2. Project Content: Three flight models and 1 backup spacecraft will be procured to perform the following missions:

Flight	Orbit	Configuration	Instrumentation
Tiros I (Eye)	80° retrograde circular orbit at 350 NM	Cartwheel	2 standard Tiros cameras
Tiros K and backup K'	33° Prograde-Apogee; 19,300 NM Perigee 175 NM	Spin-stabilized	2 AVCS cameras and possibly a low resolution radiometer
Tiros J	Under study		

A backup spacecraft (K') for the K launch is planned since the highly eccentric orbit is a new application of the TIROS. A launch vehicle for the K' is not being procured at this time. In support of the TIROS Operational Satellite System (TOS) the following subsystems will be developed and tested on spacecraft:

APT with Recorder
Radiometer (infrared)
Miniature 1 inch Vidicon Camera System
Nighttime APT

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower:

a. Contractor: RCA; Contract NAS 5-3173

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
190	143	27	-	-	-

b. NASA In-House Direct Manpower:

6. Project Procurement: RCA; Contract NAS 5-3173

a. Current Status:

(1) Type of contract: CPIF

(2) Cost negotiated to date: $15.1 million

(3) Scope negotiated to date: Procurement of 4 R&D and 3 operational spacecraft for the USWB.

b. Anticipated changes:

(1) Additional costs of approximately $2.5 million will be incurred for design and modification of Tiros K and K' (backup), modification of ground equipment for K missions, and extension of ground operations. In addition re-definition of Tiros J and L spacecraft configuration will be negotiated.

(2) Additional scope involved: Changes in scope include the design, fabrication, and integration of TIROS K and backup (K'), modification of ground equipment for TIROS K and backup (K') mission, extension of operations of the ground stations, and re-definition of TIROS J mission.

(3) Estimated dates changes will be negotiated:

Tiros K and backup (K') modification	2nd Qtr FY 1965
Modification of ground equipment for Tiros K missions	3rd Qtr FY 1965
Extension of ground operations	2nd Qtr FY 1966

7. Project Changes since FY 1965 President's Budget:

a. Project Objectives: Research and development activity has been increased to develop and test subsystems to support the operational meteorological satellite system.

b. Project Content: The original missions planned for TIROS J and L have been re-defined. The revised plan is to use the spacecraft originally planned for the TIROS L mission (80° retrograde) as a backup for TIROS K (high eccentric orbit). The mission for TIROS J is currently under study. The development and flight qualification of hardware in support of the TOS system were initiated in FY 1965.

c. Project Schedule: Tiros L flight has been deleted (spacecraft becomes TIROS K'), launch of J has been placed under study, and the launch of K has been slipped approximately one year.

d. Project Funding: $ 1.6 million is required in FY 1965 to support the TOS improvement developments and to reimburse the Department of Defense for Contract Administration.

8. Justification of FY 1966 Budget Estimate: The FY 1966 funds are required to complete payment on the fabrication of TIROS K and backup (K') spacecraft, launch of TIROS K, continue funding of ground operations and support costs of TIROS I (Eye), an incremental payment of ground operations and support costs for TIROS K, and to continue funding of the TOS improvements subsystems.

FUNDING & LAUNCH SCHEDULE

PROJECT: TIROS/TOS

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-L	26,578	13,000	2,500	800	-	-	-	-	42,878
'66 Preview A-L	26,578	11,501	4,197	5,000	2,053	-	-	-	49,329
'66 Budget A-K&B/U	26,578	11,506	4,100	4,800	3,600	2,000	1,500	-	54,084
Launch Vehicle Allocation									
'65 Budget	10,200	3,800	3,300	-	-	-	-	-	17,300
'66 Preview G-L	10,200	3,800	1,100	2,900	-	-	-	-	18,000
'66 Budget	10,200	3,800	1,100	-	-	-	-	-	15,100

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	2	2					
'66 Preview	1	1	2				
'66 Budget	1		1	1			

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: NIMBUS/NIMBUS FOLLOW-ON

1. Project Objectives: Block I-Nimbus A, A' and B. To conduct R&D experimentation for the advancement of space technology leading to the provision of full picture coverage of daytime cloud cover for local users; and infrared measurements of the nighttime cloud cover. Also to develop a spacecraft, flexible in design, capable of accepting a wide variety of spacecraft technological developments and satellite meteorological sensors. The spacecraft will also provide data for meteorological research and for operational use by the U. S. Weather Bureau and other foreign and domestic weather services.

   Block II - Nimbus Follow-on (C through F). Continue the development of a space meteorological observatory having adequate power and stabilization accuracy and flexibility to accommodate a variety of instrumentation. Its development is essential to the global Weather System requiring observations of pressure, temperature, wind, and water vapor at several altitudes and over the entire globe.

2. Project Content: The project consists of the following launches:

   Nimbus A' - "High Noon", nearly circular, 80° retrograde orbit of approximately 500 NM

   Nimbus B - "High Noon", nearly circular, 80° retrograde orbit of approximately 750 NM

   Nimbus C-F - Nearly circular polar orbit of approximately 750 NM

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

a. Contractor:	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
General Electric* (Integration & test; prototype controls; and flight controls)	325	150	100	-	-	-
RCA-Power Supply, (AVCS Cameras, and APT Systems)	50	-	-	-	-	-

*Estimates for current contracts only.

b. NASA In-house Direct Manpower:

6. Project Procurement:

General Electric - Integration and Test Prototype Controls and Flight Controls

a. Current Status:

(1) Type of Contract: CPFF(Integration and Test; Flight Controls)
CPFF - Cost Sharing (Prototype Controls)

(2) Cost negotiated to date: $51.3; Integration and Test ($31.6 million), Prototype controls ($10 million), Flight Controls ($9.7 million)

(3) Scope negotiated to date: One prototype and 3 flight models

b. Anticipated Changes:

(1) Estimated additional cost involved: $50 million for controls and integration and test of 4 flight models and 2 prototype spacecraft for Nimbus follow-on.

(2) Additional scope involved: Procurement of 2 prototype and 4 flight model spacecraft for Nimbus follow-on.

(3) Estimated date changes will be negotiated: FY 1966

RCA - Power Supply

a. Current Status:

(1) Type of Contract: CPFF

(2) Cost negotiated to date: $11.1 million

(3) Scope negotiated to date: Power supply for 1 prototype and 3 flight models.

b. Anticipated Changes

(1) Estimated additional costs involved: $11 million for additional power supplies for Nimbus follow-on.

(2) Additional Scope Involved: Power supply for 2 prototype and 4 flight models for Nimbus Follow-on.

(3) Estimated date changes will be negotiated: FY 1966

RCA - Cameras (AVCS and APT)

a. Current Status

(1) Type of Contract: CPFF

(2) Cost negotiated to date: $17.7 million

(3) Scope negotiated to date: 5 flight models and 1 prototype AVCS camera and 4 flight models and one prototype APT camera.

b. Anticipated Changes:

(1) Estimated additional cost involved: Camera requirements for Nimbus C through F have not been finalized.

(2) Additional scope involved: See (1) above.

(3) Estimated data change will be negotiated: Changes will be negotiated 24 months prior to launch of Nimbus C and E.

7. Project Changes Since 1965 President's Budget:

a. Project Objectives: No significant change has been made in the program objectives since the FY 1965 budget submission.

b. Project Content: A greater number and additional types of experiments are now being developed than originally planned. In addition a series of follow-on flights is now being planned which are scheduled for launch on one year centers in the 1967 to 1970 period.

c. Project Schedules: Launch of A' and B have slipped approximately one year each.

d. Project Funding: The $0.5 million increased in FY 1965 spacecraft funding is a result of additional experiments planned for Nimbus B.

8. Justification of FY 1966 Budget Estimate: In fiscal year 1966 $12.2 million is to fund for the fabrication and launching of Nimbus B, and to complete flight qualification of the meteorological experiments. The ground operations and support funding is to continue the Nimbus A' operation and pre-launch modification and checkout of the ground equipment for the Nimbus B launch. $15 million is an incremental payment to initiate development of the Nimbus C through F series.

DATE September 30, 1964

FUNDING & LAUNCH SCHEDULE

PROJECT: Nimbus

FUNDING (FY)		1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support										
'65 Budget	A,B &B/U	52,436	40,200	15,500	7,700	-	-	-	-	115,836
'66 Preview	A-F&B/U	52,436	41,678	13,803	26,900	31,000	27,000	27,000	74,000	293,817
'66 Budget	A-F&B/U	52,436	41,673	16,000	26,900	25,200	25,000	25,000	86,800	299,009
Launch Vehicle Allocation										
'65 Budget		8,800	1,000	3,400	-	-	-	-	-	13,200
'66 Preview		8,800	5,631	3,121	5,000	7,000	6,500	7,000	7,300	50,352
'66 Budget		8,120	3,516	6,358	6,200	6,200	6,200	6,200	4,390	47,184

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	1,1B/U	1					
'66 Preview	1	1	2		1		
'66 Budget	1*	1(B/U)	1	1	1	1	1

*Launched Aug. 28, 1964

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: METEOROLOGICAL FLIGHT EXPERIMENTS

1. Project Objectives: To conduct meteorological research, development, and experimentation on non-meteorological satellites and space vehicles for the advancement of technology leading to meteorological satellite applications.

2. Project Content: Camera systems and other meteorological sub-systems will be developed and procured to conduct the following:

   a. Experiments using a high and low resolution Advanced Vidicon Camera System on the Advanced Technology Satellite, stabilized at 6,000 NM altitude. Two flight model cameras (one high and one low resolution) will be procured.

   b. Experiments using a high and low resolution Advanced Vidicon Camera System (AVCS) with image motion compensation devices on the Advanced Technology Satellite, spin-stabilized at synchronous altitude. Procurement will depend on the results of image motion compensation studies currently in progress.

   c. Experiments using a low resolution vidicon camera, one high resolution Image Orthicon Camera capable of looking at selected areas of interest, and a heat budget infrared experiment on the Advanced Technology Satellite, earth-oriented at synchronous altitude. Procurement will include one flight model of the low resolution vidicon camera, a prototype and a flight model image orthicon camera, and an engineering and a flight model of the infrared radiometer.

3. Summary Project Schedules: (see attached)

4. Project Funding: (see attached)

5. Project Manpower:

   a. Contractor: No major contracts will be required.

   b. NASA In-house Direct Manpower:

6. Project Procurement: Not applicable

7. Project changes since FY 1965 President's Budget: The title of this project has been changed from "Synchronous Meteorological Satellite Experiments" to the present title consistent with current plans to fly these experiments on several flight systems.

   a. Project Objectives: No significant change

   b. Project Content: No change

   c. Project Schedules: No change

   d. Project Funding: Re-evaluation of camera requirements since the Nimbus I success has indicated that spare cameras will be available from the Nimbus project for the meteorology experiment on the ATS flight at 6,000 NM. This has resulted in a $2.0 million decrease in funding requirement for this project in FY 1965.

8. Justification of FY 1966 Budget Estimate: The Fiscal Year 1966 funds are required to procure the high and low resolution cameras, the Image Motion Compensation Devices (IMS), the Zoom lenses, and on-board data recorders for the meteorological experiments on the ATS flights, spin-stabilized at synchronous altitude.

FUNDING & LAUNCH SCHEDULE

PROJECT: Meteorology - Flight Experiments

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	-	-	3,200	5,000	5,000	3,300	-	--Continuing--	
'66 Preview	-	-	3,200	4,000	4,075	3,400	2,000	--Continuing--	
'66 Budget	-	-	1,200	4,000	5,400	5,200	5,000	--Continuing--	

1964	1965	1966	1967	1968	1969	Subsequent to 1969

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: METEOROLOGICAL SUPPORTING RESEARCH AND TECHNOLOGY

1. Project Description/Justification: These efforts include the study of, design and development of new concepts, components, subsystems, and systems which will have application to future flight programs. It also includes the analysis of flight data for input and feedback for future planning. The objectives of the effort are: (1) to develop sensors, controls, data acquisition, and data handling systems to implement and improve meteorological systems; (2) to study data from previous satellites and sounding rockets to provide a broader base for improvements; (3) to evaluate further experiments and uses for a given system; and (4) to study concepts or applications of meteorological systems for feasibility and value to the program.

2. Project Funding: (Thousands of dollars)

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element			
Synchronous Meteorological Satellites	210	100	100
Meteorological Component Development	2,790	2,214	2,694
Meteorological Sensor Development	1,342	1,546	1,471
Meteorological Atmospheric Research	2,155	2,520	2,770
Advanced Systems and Components	1,010	720	3,535
Project Totals	7,507	7,100	10,570
b. Continuation vs. New:			
Continuation of existing contracts & grants	5,034	6,080	7,475
New contracts & grants	2,473	1,020	3,095
Project Totals	7,507	7,100	10,570

	FY 1964	FY 1965	FY 1966
c. University grants & contracts	932	1,110	1,225

3. Specific mechanisms or channels for program coordination with other interested agencies: Coordination is achieved through several channels:

   a. The Interdepartmental Committee for Atmospheric Sciences which coordinates the Research and Development plans of the various agencies in the general field of atmospheric science,

   b. The Office of the Federal Coordinator for Meteorological Services and Supporting Research which coordinates the meteorological services and supporting research directed toward the immediate improvement of the meteorological services,

   c. The Meteorological Satellite Program Review Board (established under NASA-WB Agreement on January 20,1964) composed of NASA and USWB representatives for review of plans and programs in meteorological satellites, and

   d. The Advisory Group on Supporting Technology for Operational Meteorological Satellite Programs (also established under NASA-WB Agreement, January 20, 1964) consisting of members from NASA, Weather Bureau and the non-government meteorological community to assure that the contribution of the Weather Bureau and other competent agencies can be considered in the development program.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: METEOROLOGICAL SOUNDING ROCKETS

1. Project Description/Justification: The Objective is the study of the earth's atmosphere in the 30 to 100 km region. It consists of the exploration of the structure, the temporal and spatial variations, the dynamic processes, and the relation of this region to other atmospheric regions using large and small meteorological sounding rocket system for reliable, routine observations and amenable to range support, research and network requirements. The program is divided into two projects, the large meteorological sounding rocket at Goddard Space Flight Center and the small meteorological sounding rocket at Langley Research Center.

2. Project Funding:

	(Thousands of dollars) FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Large Meteorological Sounding Rocket	1,800	1,920	1,920
Small Meteorological Sounding Rocket	444	500	1,080
Project Totals	2,244	2,420	3,000
b. Continuation vs. New:			
Continuation of existing grants and contracts	1,954	2,120	2,500
New contracts and grants	290	300	500
Project Totals	2,244	2,420	3,000
c. University contracts and grants	650	700	800

3. Specific mechanisms or channels for program coordination with other interested agencies: Coordination is achieved through the following committees or groups: (a) Inter-Range Instrumentation Group/Meteorological Working Group composed of range and agency representatives for the purpose of coordinating meteorological activities among the national ranges, (b) Office of the Federal Coordinator for Meteorological Services and Supporting Research which coordinates that portion of the program directed toward the immediate improvement of the meteorological services, (c) Inter-departmental Committee for Atmospheric Sciences which coordinates the Research and Development plans of the various agencies in the general

field of Atmospheric Science, and (d) Committee on Space Research (COSPAR) which coordinates the exchange of information concerning the international sounding rocket programs which includes meteorological sounding rockets.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: EARLY GRAVITY GRADIENT

1. Project Objectives: The objective is to design, develop and flight test a gravity gradient stabilization system in support of the Defense Communications Satellite Program (DCSP).

2. Project Content: A design study, development and fabrication of a gravity gradient orientation experiment will be accomplished in support of the DCSP. Deliverable hardware is not yet determined, however, the plan is to fly one spacecraft only within the payload package of the DCSP making maximum use of DCSP ground equipment etc.

3. Summary Project Schedules: The launch schedule will be negotiated between NASA and DOD.

4. Project Funding:

See Attached.

5. Project Manpower:

   a. Contractor: not yet determined.
   b. NASA In-House Direct Manpower:

6. Project Procurement:

   a. Current Status:

      (1) Type of contracts: not determined
      (2) Cost negotiated to date: not determined
      (3) Scope negotiated to date: no contracts have been negotiated.

   b. Anticipated Changes: not applicable.

7. Project Changes since FY 1965 President's Budget: None.

8. Justification of FY 1966 Budget Estimates: No FY-66 funds required.

FUNDING & LAUNCH SCHEDULE

PROJECT: Early Gravity Gradient Experiment

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	-	-	5,000	-	-	-	-	-	5,000
'66 Preview	-	-	5,000	-	-	-	-	-	5,000
'66 Budget	-	-	5,000	-	-	-	-	-	5,000

1964	1965	1966	1967	1968	1969	Subsequent to 1969

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: COMMUNICATION AND NAVIGATION SR&T

1. Project Description/Justification: These efforts include the study, design, and development of new concepts, components, subsystems, and systems which will have application to future flight programs. Areas of effort in communications include study of advanced passive systems design and materials research, systems compatability studies, interference analysis, small mobile station design, time delay problems, and feasibility studies on future spacecraft designs and subsystems. Efforts in the navigation area include feasibility studies on data transmission via satellite to ships and aircraft, and studies on future navigation satellite designs.

2. Project Funding (In thousands of dollars):

	FY-64	FY-65	FY-66
a. Funding by Project Element:			
Navigation	25	375	375
Communications	1,884	1,925	2,625
Total	1,909	2,300	3,000
b. Continuation vs New:			
Continuation of existing contracts and grants	1,564	1,175	2,500
New contracts and grants	345	1,125	500
Total	1,909	2,300	3,000

3. Specific mechanisms or channels for program coordination with other interested agencies: Coordination mechanisms include (1) direct liaison with DOD and other U.S. government agencies, (2) the Technical Committee on Communication Satellites for exchange of technical information, (3) the ad-hoc Committee on Joint Navigation Satellites involving DOD, FAA, Commerce, Treasury, Interior and NASA, and (4) liaison is maintained with Communications Satellite Corporation for exchanging information on planned programs.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ECHO

1. Project Description - This project deals with the design, development, launch, flight testing, and evaluation of the communications capabilities of large inflatable reflective spheres applicable to passive communications. ECHO I, a 100 foot diameter sphere fabricated of mylar film with a vapor deposited coating of aluminum, was launched into orbit in August 1960. ECHO II, a 135 foot sphere made of a three-layer laminate of aluminum and mylar thus making it more rigid than ECHO I, was launched into a circular polar orbit in January 1964.

2. Project Funding:

Estimated Obligations
(In Millions of Dollars)

	Prior Years	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	Runout	Total
Spacecraft & Support									
Launch Vehicles	See Attached.								

3. Justification for FY 1966 Budget Estimates:

No funds estimated for FY 1966.

FUNDING & LAUNCH SCHEDULE

PROJECT: Echo

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	9,500	1,300	300	100	100	-	-	-	11,300
'66 Preview	9,948	1,675	221	-	-	-	-	-	11,844
'66 Budget	9,948	1,675	200	-	-	-	-	-	11,823
Launch Vehicle Allocation									
'65 Budget	9,400	1,300	-	-	-	-	-	-	10,700
'66 Preview	6,600	1,332	708	-	-	-	-	-	8,640
'66 Budget	7,952	606	-	-	-	-	-	-	8,558

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							
'66 Budget	1*						

*Launched Jan. 25, 1964

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: RELAY

1. Project Description - This project deals with the design, development, launch, flight testing for reliable lifetime, and evaluation of the communications capabilities of active communications satellites at intermediate altitudes; in addition, effects of environmental radiation on spacecraft components and environmental radiation levels are being determined. RELAY I was successfully launched in December 1962. RELAY II was successfully launched in January 1964. Successful wideband and narrowband communications including TV demonstrations have been conducted on both satellites to date. Communications ground stations in the U.S. and many foreign countries participated in communications experiments.

2. Project Funding:

Estimated Obligations
(In Millions of Dollars)

	Prior Years	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	Run-Out	Total
Spacecraft and Support	See Attached.								
Launch Vehicles									

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Acting and/or End Items Funded:

(1) The FY 1966 funds are to cover data reduction and analysis.

b. Contractor manpower: not applicable.

c. Services of the government agencies: Other governments are involved in the communications experiments, however, they fund for their own ground stations and operations. The foreign governments are the United Kingdom, France, Spain, Italy, Brazil, Japan, and Germany.

d. FY 1966 Procurement of Capital Items:

None

FUNDING & LAUNCH SCHEDULE

PROJECT: Relay

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget	31,254	2,600	1,800	250	250	-	-	-	36,154
'66 Preview	31,380	2,290	1,395	425	25	-	-	-	35,515
'66 Budget	31,380	2,590	1,200	400	100	-	-	-	35,670
Launch Vehicle Allocation									
'65 Budget	8,500	300	-	-	-	-	-	-	8,800
'66 Preview	6,000	-	-	-	-	-	-	-	6,000
'66 Budget	6,000	-	-	-	-	-	-	-	6,000

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget							
'66 Preview							
'66 Budget	1*						

*Launched Jan. 21, 1964

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: SYNCOM

1. Project Description - This project deals with the design, development, launch, flight testing for reliable lifetime and evaluation of the communications capabilities of active communications satellites at the synchronous altitude. Ground communications stations in support of the SYNCOM flights were furnished and paid for by DOD; telemetry and command stations plus range-and-range-rate systems were furnished and paid for by NASA. SYNCOM I was launched in February 1963, however, all systems went silent after firing of the apogee kick-stage (apogee kick-stage places the satellite from an elliptical orbit into a synchronous orbit by furnishing the satellite the necessary additional velocity for synchronous orbit). SYNCOM II was successfully launched in July 1963 and has demonstrated to date its capacity for conducting the communications experiments for which it was intended. SYNCOM III was successfully launched in August 1964 and to date is operating satisfactorily.

2. Project Funding:

a. Estimated Obligations (In Millions of Dollars)

	Prior Years	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	Runout	Total
Spacecraft & Support	See Attached.								
Launch Vehicles									

b. Analysis and Justification of Significant Changes in Project Funding:

The budget for FY 1964 and FY 1965 is less than the budget figures shown in the FY 1965 Presidential Budget (less by 0.7 million in FY 1964 and 1.0 million in FY 1965). This reduction is due to the elimination of a fourth SYNCOM launch.

3. Justification for FY 1966 Budget Estimates:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

(1) The FY 1966 funds are needed to continue ground operations and support such as range-and-range-rate operational support (2) telemetry and command operations and logistics support and (3) data analysis.

b. Contractor Manpower: not applicable

c. Services of Other Government Agencies:

Communications experiments are being carried out by DOD utilizing their ground stations. A number of foreign ground stations are also involved in communications experiments these being operated and paid for by the countries involved.

d. FY 1966 Procurement of Capital Items:

Not applicable

FUNDING & LAUNCH SCHEDULE

PROJECT: Syncom

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-D	18,925	3,200	2,000	1,725	200	-	-	-	26,050
'66 Preview A-C	18,875	2,385	1,027	926	575	50	-	-	23,838
'66 Budget A-C	18,875	2,586	1,000	900	600	100	-	-	24,061
Launch Vehicle Allocation									
'65 Budget	6,500	3,100	-	-	-	-	-	-	9,600
'66 Preview	9,000	2,815	-	-	-	-	-	-	11,815
'66 Budget	9,000	3,400	-	-	-	-	-	-	12,400

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	1	1*					
'66 Preview	1						
'66 Budget	1						

*Cancelled

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ADVANCED TECHNOLOGICAL SATELLITES SR&T

1. Project Description/Justification: These efforts include the study, design, and development of new concepts, components, subsystems, and systems which will have application to the ATS flight programs. Areas of effort include (1) control system studies directed at stabilization of spacecraft in orbit particularly at the higher synchronous altitudes and feasibility studies on spacecraft configurations on follow-on flights beyond the current ATS program, (2) spacecraft and capsule equipment developments to improve amplification techniques and antenna systems and increase the reliability and useful lifetimes of spacecraft materials and components and (3) wave propagation studies and investigations to determine the effect of space media and atmospheric environment on electromagnetic wave propagations in an effort to extend the useful areas of the radio frequency spectrum.

2. Project Funding (In thousands of dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Control Systems	1,165	780	410
Spacecraft and Capsule Equipment Development	475	520	1,000
Wave Propagation	175	400	590
Total	1,815	1,700	2,000
b. Continuation vs New:			
Continuation of existing contracts and grants	850	800	1,600
New contracts and grants	965	900	400
Total	1,815	1,700	2,000
c. University contracts and grants:	None		

3. Specific mechanisms or channels for program coordination with other interested agencies: There is liaison with DOD and other U.S. government agencies through the Technical Committee on Communications Satellites for the exchange of technical information and there is direct contact with representatives of these agencies on specific tasks.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: ADVANCED TECHNOLOGICAL SATELLITE

1. Project Objectives: The objectives are to (1) design, develop, fabricate, and flight test spacecraft capable of handling certain technological and scientific experiments and (2) conduct certain technological and scientific experiments.

2. Project Content: There will be five flight spacecraft developed some or all of which will contain experiments relative to gravity gradient stabilization, communications, meteorology, radiation, and other technological and scientific experiments yet to be defined. One gravity gradient stabilized spacecraft will be launched with an Atlas-Agena booster directly into a 6000 mile orbit to test the gravity gradient system, flight test the basic spacecraft and to conduct communications, meteorological, and radiation experiments. Two spin-stabilized spacecraft will be launched with Atlas-Agena boosters and spacecraft kick-stage into synchronous orbit to flight test the basic spacecraft, test a phased array antenna, test a mechanically despun antenna and to conduct communications, meteorological, radiation, and other technological and scientific experiments yet to be defined.

   Two gravity gradient stabilized spacecraft will be launched with Atlas-Agena boosters and spacecraft kick-stage into synchronous orbit to flight test the basic spacecraft, test the gravity gradient system, and to conduct communications, meteorological, radiation, and other technological and scientific experiments yet to be defined. Communications ground stations, three (3), required to support the orbital flights will be obtained by modifications of the existing stations at Mojave and Rosman, and development of a transportable station. Three (3) range-and-range-rate systems, and three (3) telemetry and command stations will also be developed.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Manpower: (Man-Years)

   a.

Contractor	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
NAS 5-3823 with Hughes Aircraft Company	132	175	242	105	65	5

   b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Contract with Hughes Aircraft Company; Contract type is CPIF and CPFF. Current contract is CPIF which converts to CPFF upon acceptance by NASA of the first prototype and certain specified hardware items to be fabricated by the contractor.

(2) Cost negotiated to date is 34.5 million (excluding fee)

(3) Scope negotiated to date includes: (1) the design, development and fabrication of five flight quality spacecraft and their subsystems, and one prototype for the 6000 mile orbit, one prototype for the synchronous orbit spin-stabilized spacecraft and one engineering model (partial spacecraft) for the synchronous gravity gradient orbit, (2) the integration of technological experiments and (3) test, launch, and post launch support.

b. Anticipated Changes: No major changes are anticipated at this time.

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: No change

b. Project Content: No change

c. Project Schedule: No change

d. Project Funding: The present FY 1964 funding calls for 15.4 million which is 1.0 million less than the figure shown in the FY 1965 President's budget for FY 1964, due to a later start on certain procurements. The FY 1965 fund requirements amount to $25 million which is $1 million above the amount shown in the FY 1965 budget. This increase is due to initial funding for the ATS experiments.

8. Justification of FY 1966 Budget Estimate: FY 1966 funds are required for obligations on the spacecraft contract, gravity gradient system, radiation experiments, spacecraft subsystems studies and development, evaluation testing, ground equipment costs and ground operations support, launch vehicles, and contract administrative costs.

FUNDING & LAUNCH SCHEDULE

PROJECT: Advanced Technological Satellites

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget A-F	-	16,400	24,000	15,000	8,800	3,000	2,200	5,500	74,900
'66 Preview A-E	-	15,350	24,800	24,000	13,225	5,525	4,075	4,800	91,775
'66 Budget A-E	-	15,377	25,000	28,100	17,900	8,700	6,900	10,900	112,877
Launch Vehicle Allocation									
'65 Budget	-	-	5,900	17,500	15,800	8,900	-	-	48,100
'66 Preview	-	-	2,557	13,244	15,844	8,165	-	-	39,810
'66 Budget	-	-	3,057	14,244	15,844	6,665	-	-	39,810

LAUNCH SCHEDULE (CY)	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget			1	2	2		
'66 Preview			1	2	2		
'66 Budget			1	2	2		

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS

PROJECT TITLE: LAUNCH VEHICLE PROCUREMENT

1. Project Objectives: The objective of the Launch Vehicle Procurement program is to provide economical and reliable launch vehicles for unmanned orbital, lunar, and planetary space missions. This program includes the purchase of the launch vehicle, mission adaptation or modification of the vehicle, and the launching with associated services. Launch vehicles included in this program which are utilized for current and future space missions are: Scout, Delta, Thor-Agena, Atlas-Agena, and Atlas-Centaur.

2. Project Content: There are no ground tests, flight tests, or deliverable hardware items for prototype included in this program. The overall mission plan for launches is as follows:

	CY 1964	CY 1965	CY 1966	CY 1967	CY 1968	CY 1969
Scout.....	9	7	7	10	5	6
Delta.....	8	6	10	12	10	10
Thor-Agena...	2	3	4	1	1	3
Atlas-Agena..	3	4	6	6	9	4
Centaur*.....	6	3	4	4	5	1
Total.....	25	23	31	33	30	24

* Does not include Centaur Development schedule.

3. Summary Project Schedules: (See Attached)

4. Project Funding: (See Attached)

5. Project Procurement: NASA procured launch vehicles are: Delta, procured through contracts with Douglas; Scout, procured through contracts with Ling Temco Vought; and Centaur, procured through contracts with General Dynamics Astronautics. Atlas and Thor vehicles and unmodified Agena stages are procured through the Department of the Air Force under its contracts. Effort is included in 1965 for Scout certification and incorporation of modification to Atlas and Agena vehicles to improve reliability.

6. Project Changes Since FY 1965 President's Budget: Changes in the vehicle procurement funding estimates reflect larger increments of funds required in FY 1966 for the procurement of Atlas-Agenas in support of the Lunar Orbiter and Advanced Technological Satellites missions. Also, there have been changes in the launch schedule which have affected the phasing of the vehicle procurement. However, there has been little change in the overall program content. The overall reduction of the funding required for vehicle procurement in FY 1966 is a result of changes in the planned flight schedule with a resultant shift in procurement requirements.

7. Justification of FY 1966 Budget Estimate: Requirements by major function are:

	FY 1963 & PRIOR	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
OSSA							
Scout	7,993	6,600	6,396	7,700	8,400	6,000	4,800
Centaur	16,209	32,000	47,805	50,407	48,051	32,150	2,600
Delta	44,089	26,700	35,911	32,000	33,200	36,350	12,100
Agena	154,440	48,200	50,788	76,493	77,766	69,313	37,888
TOTAL	222,731	113,500	140,900	166,600	167,417	143,813	57,388
OART							
Scout	8,600	1,500	1,400	-0-	1,200	1,200	1,200
Atlas(Other)	6,400	1,786	972	-0-	-0-	-0-	-0-
TOTAL	15,000	3,286	2,372	-0-	1,200	1,200	1,200
TOTAL PROC.	237,731	116,786	143,272	166,600	168,617	145,013	58,588

The funding shown above will provide the required effort to meet the mission requirements as specified in the launch schedules. This funding will provide for delivery of mission modified launch vehicles to the launch stand, mating of the spacecraft to the launch vehicle, launching of the vehicle, and associated pre-launch and post-launch services. These costs have previously been allocated to the mission.

FUNDING & LAUNCH SCHEDULE

PROJECT: Launch Vehicle Procurement

FUNDING (FY)	1963 & Prior Yrs.	1964	1965	1966	1967	1968	1969	To Completion	Total
Spacecraft & Support									
'65 Budget									
'66 Preview				NOT APPLICABLE					
'66 Budget									
Launch Vehicle Allocation									
'65 Budget	237,731	112,316	143,300	206,550	148,088	83,172	31,350	-	-
'66 Preview	237,731	116,530	136,300	191,122	154,612	88,126	28,350	-	-
'66 Budget	237,731	116,786	143,300	166,600	168,700	145,013	58,588	-	-

LAUNCH SCHEDULE (CY)*	1964	1965	1966	1967	1968	1969	Subsequent to 1969
'65 Budget	33	25	33	33	26	15	-
'66 Preview	26	25	36	30	23	17	-
'66 Budget	25	23	31	33	30	24	-

* This reflects the total number of planned launches. This does not include any launches under the Vehicle Development program (Centaur Development). See the individual mission sheets for the missions to be launched during these periods.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: RESEARCH PROGRAM

1. Project Description/Justification: Initiate, improve and administer fundamental research work in the fields of the physical and mathematical sciences and coordinate fundamental work in NASA Centers and contractor laboratories and make data available to the designers to provide the proper foundation of fundamental knowledge necessary for the rapidly advancing technology.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element			
Supporting Research and Technology			
Fluid Physics	7,867	7,830	9,100
Electrophysics	3,986	3,940	4,600
Materials	9,145	8,425	9,800
Applied Mathematics	1,200	1,305	1,500
Project Totals	22,198	21,500	25,000
b. Continuation vs New:			
Continuation of existing contracts & grants	11,496	13,468	14,843
New contracts and grants	4,150	2,224	3,362
In-house effort	6,552	5,808	6,795
Project Totals	22,198	21,500	25,000
c. University Grants and Contracts	11,303	10,442	12,155

3. Specific Mechanisms or Channels for Program Coordination with Other Interested Agencies: The Research Program is coordinated through many committees, boards, groups, etc. such as the Coordinating Committee for Materials Research and Development of the Federal Council for Science and Technology, Materials Advisory Board, Technical Committee on High Energy Physics, Special Group on Optical Masers, NATO-AGARD, and Mathematics Panel of the National Research Council - National Academy of Sciences. Members of the Research Division are active participants in all the above organizations and effect excellent coordination with the Department of Defense, National Bureau of Standards, Atomic Energy Commission, National Institutes of Health, National Science Foundation, National Academy of Sciences and the Bureau of Mines. NASA has worked out a joint reporting form with the DOD and plans to exchange tasks with the military agencies. Through these coordination efforts, the Research Program is complementary to the programs of the other government agencies and results in a truly national program.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: LIFTING BODY FLIGHT PROGRAM

1. Project Objectives:

The objectives of the Lifting Body Flight Program are (1) investigate approach and landing characteristics with particular emphasis given to realistic minimum landing L/d requirements, landing rocket augmentation, piloting procedures, and visibility constraints; (2) correlate wind-tunnel and flight characteristics, drag, basic stability and control, hinge moments and pressures; (3) evaluate general handling qualities of the lifting-body class of vehicles over a wide range of angles of attack and to subsonic speeds attainable following launch from a B-52 aircraft; (4) determine general and specific flight-control-system requirements; and (5) accelerate development of operational lifting-body-type vehicles with this project being a focal point, providing a practical application for related lifting-body analytical, wind-tunnel, and flight research activities.

2. Project Content:

This project is a coordinated research program between the Langley, Ames, and Flight Research centers and OART. Langley Research Center has the technical responsibility for developing the HL-10 aerodynamic configuration, and the Ames Research Center has the technical responsibility for developing the M-2 aerodynamic configuration. Flight Research Center will coordinate these actions and technically monitor a contractor in fabrication of the two gliders. The gliders are so designed that, if a decision is made at a later date to conduct transonic tests, a propulsion system could be installed at minimum cost. The gliders will be carried to an altitude of about 45,000 and launched from a B-52 used in the X-15 program.

3. Summary Project Schedules:

The delivery of the M-2 should be about May 1965, and the delivery of the HL-10 about October of 1965. The first flight of the M-2 is anticipated about September 1965, and the first flight of the HL-10 is anticipated about December 1965. The gliders will be thoroughly tested in the Ames Research Center full-scale wind-tunnel before flights are attempted. The two gliders do not conform to a flight schedule since they will be flown many times. Since this is a research program no other specific milestones are established.

4. Project Funding:

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968
1,200	1,500	1,000	660	200

5. Project Manpower:

a. Contractor: Not required

b. NASA In-house Direct Manpower:

6. Project Procurement: Not Required

7. Project changes Since FY 1965 President's Budget: The only approved changed is concerned with the revised funding levels for fiscal years 1964 and 1965.

8. Justification of FY 1966 Budget Estimate:

The FY 1966 funding is required for engineering changes that may be required as a result of the wind-tunnel tests, aircraft spaces and minimal aerospace ground equipment, instrumentation and operational test support.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: SPACE VEHICLE SYSTEMS (SRT)

1. Project Description/Justification: This program provides for advanced research and technology for space vehicles leading to advanced space vehicle designs of the future and improvements in existing space vehicle designs. The areas of technology include advanced design criteria, advanced vehicle concepts, space vehicle aerothermodynamics, environmental factors and technology, and space vehicle structures.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Advanced Concepts	2,369	537	550
S/C Aerothermodynamics	5,495	5,432	5,346
S/C Structures	4,817	5,115	5,560
S/V Environmental Factors	6,933	7,030	9,530
L/V Aerothermodynamics	777	1,214	1,300
L/V Structures	3,718	3,859	3,414
S/V Design Criteria	542	1,300	1,100
Project Totals	24,651	24,487	26,800
b. Continuation vs. New:			
Continuation of existing contracts and grants	9,295	10,490	10,900
New contracts and grants	8,032	6,258	7,433
In-House Program Funds	7,324	7,739	8,467
Project Totals	24,651	24,487	26,800
c. University contracts and grants (where applicable) (appropriate portion of project totals - inc. JPL)	(6,198)	(4,584)	(4,990)

3. Specific mechanisms or channels for program coordination with other interested agencies:

Day to day personal contacts with counterparts in other agencies, planned formal coordination meetings attended by representatives of industry and government.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: ELECTRONICS SYSTEMS

1. Project Description/Justification:

This program provides analytical studies in such areas as communication and information theory to improve data handling rates, along with techniques of measuring physical phenomena and methods of converting and handling such information with advanced electronic devices. Experimental effort shall encompass such areas as materials and the environmental effects thereon, identification and investigation of basic phenomena peculiar to electronic systems. The development effort will provide a means of integrating new schemes into prototype models. During the past year the basic technical feasibility of both electrostatic and cyrogenic inertial sensors has been demonstrated for space applications. Research and technology efforts will continue for several years to bring these devices to a practical state of utility warranting development for flight projects.

2. Project Funding: (Program Plan in Thousands of Dollars)

	FY 1964	FY 1965	FY 1966
(a) Funding by Project Element			
Advanced Concepts	318	400	500
Guidance Systems	4,982	4,900	6,100
Control Systems	6,302	5,780	5,900
Communications	4,851	3,900	5,800
Tracking & Data Acquisition	2,895	2,800	3,800
Data Handling & Processing	3,142	3,000	4,000
Instrumentation	3,860	3,100	3,900
Project Totals	26,350	23,880	30,000

(b) Continuation vs. New:

Continuation of existing contracts and grants	10,715	10,672	12,326
New contracts and grants	9,009	7,335	12,175
In-House Efforts	6,626	5,873	5,499
Project Totals	26,350	23,880	30,000
(c) University Contracts and Grants	3,098	2,914	2,540

3. Specific mechanisms or channels for program coordination with other interested agencies:

The program is coordinated at the task level by exchange of tasks with the armed services through the supporting research and technology panel of the Aeronautics and Astronautics Coordinating Board.

Coordination with FAA is less formal, through joint symposia, FAA membership on NASA research advisory committees, and person to person contact.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: HUMAN FACTORS SYSTEMS

1. Project Description/Justification: The human factors systems program is based upon a systems parametric approach to provide the fundamental knowledge and broad technological base necessary to proceed to advanced aerospace missions; it provides feedback for technological advances to support currently approved manned space projects. The Human Factors Systems program involves the study of man (capabilities and capacities), man-machine (life support, protective systems, bioinstrumentation, man-machine control) and man-systems integration (human factors, systems analysis and advanced concepts), in relation to the basis parameters of the environment, design requirements, bio-instrumentation, simulation, ground and flight test, and evaluation of performance.

   Ground based research is conducted to the maximum extent possible; however, small flight projects will be pursued to study man's capabilities and reactions to combined stress of space flight. An orderly multi-phased approach utilizing fixed ground based environmental and simulation facilities for test and validation of flight experiments in conjunction with aircraft, missile, satellite and manned space vehicle flights will be accomplished in order to study critical areas such as prolonged weightlessness space radiation and psycho-physiological stresses which cannot be simulated adequately on the ground.

2. Project Funding

	FY-1964	FY-1965	FY-1966
a. Funding by Project Element:			
Advanced Concepts	305	650	1000
Human Research & Perf.	4125	3570	4600
Man-System Integration	2904	2230	4200
Life Sup & Protective Systs	5866	5400	6200
Project Totals	13200	11850	16000

b. Continuation vs. New:

Continuation of Existing contracts and grants	6576	6229	8900
New contracts and grants	4541	3890	5100
In house	2083	1731	2000
Project Totals	13200	11850	16000
c. University contracts and grants	2031	1701	2508

3. Specific mechanisms or channels for program coordination with other interested agencies:

a. Intra-agency coordination is accomplished in accordance with the procedures set forth in Section IV of NPC 107, NASA Basic Administrative Processes. The interdisciplinary approach to the human factors systems program requires coordination with other OART program offices, such as Electronics, Aeronautics, Nuclear and Space Vehicles. In addition, coordination is effected with the Office of Manned Space Flight program and the Office of Space Science and Applications, as appropriate.

b. Inter-agency review and coordination is accomplished through the Life Sciences Sub-Panel of the Aeronautics and Astronautics Coordinating Board. The Life Sciences Sub-Panel is composed of a NASA Chairman, DOD Vice-Chairman, and members from Army, Navy, Air Force and NASA program offices. A method has been developed by which a detailed coordination of tasks is accomplished; 1) to make the Life Sciences organizations of DOD and NASA aware of the research being conducted; 2) to identify and eliminate unnecessary duplication of effort; and 3) to make possible identification of important areas where little or no effort is being conducted by either agency. We call this method ILSE (Interagency Life Sciences Supporting Space Research and Technology Exchange). ILSE is a coordination, planning, and management tool by which DOD and NASA life science research efforts can be identified and coordinated in such a way that manpower and funding resources are efficiently utilized. At this time, we are in the process of coordinating the FY-65 program at the task level. The ILSE coordination is an active system which is conducted throughout the year, not just once a year. In this way, we expect that new research will continue to be identified and coordinated as it is originated. Cancellations and changes to ongoing tasks will

also be identified and coordinated in the same manner. Past coordination efforts have indicated that approximately 65% to 80% of the coming year program is a continuation of past year efforts. It may therefore be said that with the completion of the FY-65 coordination that a minimum of 65% of the FY-66 program will have received coordination. As new tasks are originated they will be reviewed and coordination effected.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: SERT (SPACE ELECTRIC ROCKET TEST)

1. Project Objectives:

The objective of the current phase of the total SERT program is the evaluation and development of advanced systems for satellite attitude control and station keeping.

2. Project Content:

a. Vacuum tank tests of several systems will be conducted to permit selection of the more promising systems for further development. The systems to be studied are: contact ion engine, bombardment ion engine, resistojet, solid subliming microrocket, electrolysis rocket, bipropellant chemical rockets, and momentum wheels. The objective of the tests will be to determine minimum impulse bits and short-term reproducibility.

b. Additional vacuum tank tests will be conducted on the more promising systems. These tests will determine long-term reproducibility of impulse bits, reliability, and operating life.

c. Flight evaluation will be made with the most promising system(s). A 6-month test in low-altitude polar orbit using solar cells as a power source is anticipated.

3. Summary Project Schedules:

Complete Phase (a) by February 1965

Complete Phase (b) by February 1966

Start final spacecraft design (Phase (c)) by March 1966

Launch date, 1st spacecraft - 1968

4. Project Funding (Thousands of Dollars):

FY 65	FY 66	FY 67	FY 68	FY 69
3,000	5,000	5,000	8,000	11,000

5. Project Manpower: (Not requested)

6. Project Procurement: (Not requested)

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: Unchanged

b. Project Content:

(1) SERT I has been completed.

(2) SERT II has been delayed indefinitely. Until a particular ion engine has been selected for development to large sizes for mission application, there is not sufficient justification for a SERT II flight experiment.

(3) SERT III has been expanded to include systems in addition to ion engines.

c. Project Schedules: Unchanged

d. Project Funding: Unchanged

8. Justification of FY 1966 Budget Estimate:

During FY 1966, 2.0 million will be spent on the in-house program to evaluate and develop thrustor systems and other payload components. 3.0 million will be required for initial funding of the payload contractor and this amount of money will provide the initial design, fabrication and testing of electrical and mass dummy payloads. Additionally, it will procure long-lead-time items required for the prototype and flight model payloads.

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: SNAP-8 DEVELOPMENT PROJECT

1. Project Objectives:

The objective of this project is to develop the technology and feasibility of a long-endurance nuclear-electric power system and the processes and procedures necessary to their successful development. Successful completion of this system development activity will provide a 35 electrical kilowatt nuclear electric generating system suitable for space applications in the 1970's. The system must be capable of starting and operating continuously and without maintenance for 10,000 hours in the space environment.

2. Project Content:

SNAP-8 development is a joint National Aeronautics and Space Administration-Atomic Energy Commission program. NASA is responsible for development of the power conversion subsystem and its integration with the nuclear subsystem into a reliable electrical generating system. The nuclear subsystem, which includes the reactor, its control system and shielding, is the responsibility of the Atomic Energy Commission.

SNAP-8 utilizes a boiling mercury, turbogenerator cycle to convert thermal power developed by a compact space nuclear reactor into electrical power. The design approach places a major priority on reliability and ease of development rather than on light weight, and also considers flexibility to adapt with a minimum of change to a range of potential space missions. The program is presently planned through the ground development phase and includes at least 60,000 hours of non-nuclear and nuclear testing to develop the required reliability. Development of the space radiator required to reject waste heat from the power conversion process is deferred, pending definition of type of mission applications and associated spacecraft configurations.

3. Summary Project Schedules:

Major project milestones as planned in joint National Aeronautics and Space Administration-Atomic Energy Commission coordination meetings are as follows:

a. Complete 90 days of power conversion subsystem endurance testing utilizing prototype components in late calendar year 1965.

b. The first integration of a complete electrical generation system and the first generation of nuclear electric power by a

ground prototype SNAP-8 system at Atomic Energy Commission's Ground Prototype Test Facility in calendar year 1966.

c. Complete first 10,000 hour endurance test of prototype SNAP-8 power conversion subsystem in calendar year 1968.

d. Delivery of a flight prototype SNAP-8 system to NASA Plumbrook Space Propulsion Facility in calendar year 1968 for space simulation test.

4. Project Funding (Thousands of Dollars):

FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	Balance to Completion
15,465	17,000	16,000	12,000	9,000	6,000	1,000

5. Project Manpower (Man years):

a. Contractor - Aerojet-General Corporation

FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
369	354	240	130	45	12

b. NASA-Lewis In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of Contract - CPFF - NAS5-417
(2) Cost Negotiated to Date - $63,522,000
(3) Scope Negotiated to Date -
Completion date - 12/31/68
Hardware items delivered - 2 electric generating systems

b. Anticipated Changes:

None

7. Project Changes Since FY 1965 President's Budget:

None

8. Justification of FY 1966 Budget Estimates:

The $16,000K budget estimate for FY 1966 includes $8,000K required to fund the prime contractor, Aerojet, under Contract NAS5-417. Of the remaining $8,000K, approximately $2,000K is required to support continuation of the Lewis In-House program including environmental testing, investigation of the static and dynamic performance of components and parameters, and determination of radiator performance.

The remaining $6,000K will be used by Lewis to supplement the contractual work being done at Aerojet where technical difficulties already encountered by the contractor give indication that significant delays will occur in the successful completion of the contract within the negotiated performance schedule and financial resources. It appears that supplementary and backup efforts will be required in a number of the hardware development areas. Specifically, these include independent effort in liquid metal pumping, in turbine and turbo-alternator packaging, in stabilizing flow through the boiler and condensors during steady state and transcient operation, in radiator performance, and in assuring the capability of system operation in a space environment for at least 10,000 hours.

These efforts will be implemented only after thorough analysis by Lewis, and selection of the most efficient and expeditious means of overcoming problem areas and achieving announced goals. Such means will likely include a combination of Lewis, Aerojet and third party industrial effort.

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: NUCLEAR ELECTRIC SYSTEMS SR&T

1. Project Description/Justification:

Nuclear electric power generating systems offer the most practical sources of electric power in the kilowatt and megawatt levels for future spacecraft power. Nuclear electric propulsion systems have the highest performance potential of any system capable of development within the predictable future.

The nuclear electric program is intended to explore and evaluate the advantages and disadvantages, the limitations and problems of the various power and propulsion concepts and their sub-systems, and develop the most promising concepts for mission use.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element			
Safety Research and Development	62	75	100
Electric Propulsion	11,164	10,500	11,000
Nuclear Electric Power	14,523	13,825	14,400
Project Totals	25,749	24,400	25,500
b. Continuation vs. New			
Continuation of existing contracts and grants	13,917	13,402	15,295
New contracts & grants	6,008	6,227	4,840
In-House effort	5,824	4,771	5,365
Project Totals	25,749	24,400	25,500

	FY 1964	FY 1965	FY 1966
c. University Grants and Contracts	2,381	2,483	2,550

3. Specific Mechanisms or Channels for Program Coordination with Other Interested Agencies:

Coordination is conducted with the Department of Defense, the Atomic Energy Commission, the National Bureau of Standards, the National Science Foundation, and the National Academy of Sciences through the exchange of reports, planning and review conferences, and special boards and committees in specific areas. Examples are the Liquid Metal Corrosion Committee, the Heat Transfer Research Conferences, the Office of Critical Data of the National Academy of Sciences and the Interagency Power Group (IAPG). Task descriptions are exchanged with DOD and project descriptions in the power area are exchanged with all members of the IAPG.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: NERVA

1. Project Objectives:

The objective of the NERVA project is to develop an experimental, ground-based, nuclear rocket engine which would be suitable with further development for flight applications.

2. Project Content:

The major activity of the project presently is oriented around the design, development and testing of a series of reactors, designated "NRX." The testing of NRX reactors will lead into the testing of experimental engines, designated "XE" by approximately FY 1967.

Emphasis is also being placed on the design, development and testing of certain non-reactor components whose operating requirements place them beyond available technology. For example, components such as turbopumps, nozzles with hot bleed ports, and actuators for engine reactor control will be developed to allow satisfactory operation when exposed to such extreme environments as nuclear rocket reactor radiation levels, liquid hydrogen cryogenic temperature, and high temperature hydrogen exhaust gas.

3. Summary Project Schedules:

Major Milestones

Major milestones are reactor and experimental engine tests, the dates of which are classified and, therefore, cannot be included in this unclassified document. However, a classified list of major milestones can be submitted separately.

4. Project Funding:

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
49,538	34,261	36,968	37,000	37,000	37,000

5. Project Manpower:

a. Contractor: Aerojet-General - Contract SNP-1

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
1,274	1,012	1,016	1,016	1,016	1,016

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status: Contract SNP-1 - Aerojet-General Corporation

(1) Type of contract - CPFF (For Contract Year 1964)
(2) Cost negotiated to date (thru Mod. 10) $176,086,900
7,195,571 Fee
$183,282,471
(3) Contract provides for continuing research and development. Present completion date of the contract is 9/30/66. Specific work to be performed by the contractor, within the general scope of work, is negotiated and incrementally funded each year. Contract year runs from October 1 to September 30.

b. Anticipated Changes:

It is anticipated that the annual supplement of work covering the period October 1, 1964 to September 30, 1965, will be negotiated by November 1, 1964. The current estimate of the NASA share of the total cost for that period is approximately $26,500,000. Work to be performed will be within the general scope of the contract.

7. Project Changes Since FY 1965 President's Budget:

There has been no substantial change in project objectives, content, schedules or funding since submission of the FY 1965 President's Budget.

8. Justification of FY 1966 Budget Estimate:

In FY 1966, three NRX power tests will be conducted. All tests will be conducted at Test Cell A, with reactor assembly and disassembly operations taking place in the R-MAD Building. There will be extensive effort in FY 1966 in non-nuclear components design, research and development, and testing to upgrade quality and reliability. In FY 1965, the fabrication, assembly and checkout of the cold flow development test system will be completed, and the test program will be initiated late that fiscal year. The CFDTS test program will be completed in FY 1966. The first cold flow test of an experimental engine will be conducted in the last quarter of FY 1966 at ETS-1.

Propellants required for scheduled reactor tests, non-nuclear component tests, engine simulator tests, and engine cold flow tests will be procured in FY 1966. Over 90% of the propellants procured will be liquid hydrogen.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: NUCLEAR ROCKETS SR&T

1. Project Description/Justification:

It is generally accepted that nuclear rocket propulsion will be required in advanced missions beyond Apollo, such as very heavy deep space instrumented probes, and manned exploration of the planets.

This program provides the research, design and engineering data to assure that nuclear rocket systems can be developed at power levels, operating times, restart conditions, and specific impulse values needed in advanced space exploration missions. The supporting research and technology effort supplies four basic needs: (1) general supporting research and technological data for current projects; (2) necessary basic technology for the development of future generations of nuclear rocket engines and vehicles; (3) feasibility analyses of advanced nuclear propulsion concepts, and, (4) studies on the special safety problems of nuclear rockets.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Elements:			
Rocket reactor research	14,316	13,725	12,600
Nuclear rocket engine component research	6,910	6,775	8,900
Safety	470	500	500
Nuclear Vehicle Technology	241	1,000	1,000
Project Totals	21,937	22,000	23,000
b. Continuation vs. New:			
Continuation of existing contracts and grants	9,287	8,225	12,735
New contracts and grants	5,296	6,008	3,145
In-House effort	7,354	7,767	7,120
Project Totals	21,937	22,000	23,000
c. University Contracts and Grants:			
(portion of project totals):	425	335	300

3. Specific mechanisms or channels for program coordination with other interested agencies:

The Research and Technology Resume, NASA Form 1222, will be implemented by SNPO to allow for exchange of information for on-going and planned research and technology programs between NASA and the agencies of the Department of Defense. This exchange of resumes will provide management and research people with improved knowledge of work related to their fields.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: NUCLEAR ROCKET DEVELOPMENT STATION OPERATIONS

1. Project Description:

The mission of the Nuclear Rocket Development Station (NRDS) is to provide a site for ground static testing of the reactors and engines associated with nuclear rocket development. The major users of the Station are Aerojet-General Corporation, Westinghouse Astronuclear Laboratory, and Los Alamos Scientific Laboratory.

Funding under this project provides for NASA's share of general support and station operation.

2. Project Funding:

FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
750	739	1,032	4,000	7,000	9,500

A. Analysis and Justification of Significant Changes in Project Funding:

NASA's share of the NRDS Operations costs will increase by an amount of $293,000 in FY 1966 over FY 1965. This increase is attributable, in part, to the fact that the E-MAD Building will become operational in July 1965, and partly to the initiation of preliminary effort leading to the testing of experimental engines beginning in FY 1967.

B. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Activity:

	FY 1964	FY 1965	FY 1966
NRDS Operations	750	739	1,032
General Site Support	500	589	894
Capital Equipment	250	150	138

b. Contractor Manpower:

Pan American World Airways, Inc., under contract to the Space Nuclear Propulsion Office, is the support services contractor for the NRDS. In this capacity, Pan American provides such services as: operation and maintenance of NRDS facilities

and systems such as general shops, warehouses, water pumping stations and distribution systems, electrical distribution, sanitary sewer, and technical and common-use laboratories; photographic; rad-safe; janitorial; sanitation; other labor services; reproduction; graphic arts; technical library; mail and messenger; materials procurement and supply. Costs associated with the above services that are considered to be common or general support costs are allocated between the AEC and the NASA. Contractor manpower requirements are developed on the basis of over-all SNPO mission and responsibilities. Accordingly, the following table reflecting Pan American manpower represents total manpower without an attempt to allocate between AEC and NASA.

	FY 1964	FY 1965	FY 1966
Contractor Manpower-Pan Am	498	600	700

C. FY 1966 Procurement of Capital Items:

	FY 1964	FY 1965	FY 1966
Capital Equipment	250	150	138

The capital equipment to be procured in FY 1966 is required to supplement equipment for the Secondary Standards Lab in the Technical Shops Building to make available complete facilities to calibrate and certify standards and precision measurement equipment in the electrical, electronic, electro-mechanical, mechanical and physical measurement categories in use at NRDS.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: M-1 ENGINE DEVELOPMENT

1. Project Objectives:

To provide an optimum, high-performance engine of an appropriate size for post Saturn launch vehicles, on a time scale consistent with requirements of having a qualified man-rated system available in the 1970's. The M-1 is ideal for the second stage of post-Saturn vehicles and well suited for first stage application.

2. Project Content:

The M-1 Engine Project consists of an orderly technological development of components with final integration into an engine system and subsequent engine testing. Major components of the engine are: an axial flow, multi-stage liquid hydrogen pump; a centrifugal LOX pump; a regeneratively cooled combustion chamber; valves and control systems; and a LOX/LH_2 gas generator.

3. Summary Project Schedules:

Start Engine Cold Testing	FY 66
Start Engine Firings	FY 66
First Engine Altitude Start	FY 69
First Engine Diffuser Test	FY 70
First Full Duration Test	FY 70
PFRT	FY 71

4. Project Funding (Thousands of Dollars)

FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	Balance to Completion
24,000	24,000	25,900	26,200	28,400	42,600	81,500

5. Project Manpower (Man years):

a. Contractor: Aerojet-General Corporation

FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
1,215	960	900	890	915	870

b. NASA-Lewis In-House Direct Manpower:

6. Project Procurement:

a. Current Status:

(1) Type of contract: C.P.F.F. - NAS3-2555

(2) Cost Negotiated to Date: $225,785,301

(3) Scope Negotiated to Date:

Contract NAS3-2555 extends through FY 71, requiring a program of design, fabrication, development and testing of a 1.5 million nominal vacuum thrust, liquid hydrogen-liquid oxygen rocket engine through the completion of Preliminary Flight Rating Testing.

b. Anticipated Changes: None

7. Project Changes Since FY 1965 President's Budget:

a. Project Objectives: Unchanged

b. Project Content: Unchanged

c. Project Schedules:

Every effort will be made to maintain the schedules previously cited, however, the reduction of FY 65 funds is expected to cause a stretchout of the project schedules. The yearly funding levels through FY 68 were determined to be the minimum amounts necessary to sustain this project. Resultant project schedule slippages are not precisely determinable at this time, but it is expected that there will be some impact on near term targets, such as the first engine firing.

d. Project Funding:

The FY 65 President's Budget cited $25,000,000 as the funding required for the M-1 Engine Project; congressional appropriation reduced this figure to $24,000,000.

8. Justification of FY 1966 Budget Estimate:

During FY 1966 continuing emphasis will be placed on component testing. Effort in engine systems will be increased, preparatory to the first engine firing. Component test programs, many of which started in FY 1965, will be highlighted by testing of the Mod II LOX and LH_2 turbopumps. These pumps feature flight-type hardware within a heavy-weight housing. A small continuing effort in cold-air testing of turbines at LeRC is foreseen.

Redesign, resulting primarily from test data, is expected to be completed on the combustion chamber fuel torus, the chamber jacket, the forward chamber flange, gimbal attachment and components, and the chamber/nozzle interface flange. A phasing from theoretical studies to active design is expected for the nozzle extension. Gas Generator Injector redesign will be initiated. Cooled Combustion Chamber testing, scheduled for late FY 1965, will be accelerated during FY 1966.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: LARGE SOLID MOTOR DEMONSTRATION

1. Project Objectives:

The Large Solid Motor Demonstration Project is an advanced technology program aimed at the identification and solution of the problems associated with the development of large diameter (greater than 20 feet) solid propellant motors suitable for multi-million pound thrust launch vehicles.

2. Project Content:

Major elements in the program are static firings of 260-inch-diameter motors of various lengths. Motors to be tested will advance in complexity towards flight systems, e.g. systems for thrust vector control and incipient failure detection will be added.

3. Summary Project Schedules:

Under Phase I, four half-length motors (two by each of two contractors) are scheduled for static firing during FY 1965.

4. Project Funding (Thousands of Dollars):

FY 64 & prior	FY 65	FY 66	FY 67	FY 68	FY 69
30,000*	13,000**	20,000	20,000	20,000	20,000

Annual expenditures of 20,000 are planned for subsequent years.

* Air Force funds.
**Anticipated 8,000 overrun.

5. Project Manpower (man years):

a. Contractors: Aerojet General Corp. and Thiokol Chemical Corp., combined effort estimated through FY 65. A single contractor will be selected for subsequent effort.

FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
450	350	300	300	300	300

b. NASA-Lewis In-house Direct Manpower:

6. Project Procurement:

a. Current Status: DoD/AF funded these contracts in FY 1963 and 1964. NASA assumed funding responsibility in FY 1965, transferring funds to AF to complete phase I in this fiscal year. In FY 1966 and subsequently, NASA will be responsible for all procurement and funding actions.

(1) Type of contract:
Through FY 1965 (Air Force) CPIF
Aerojet: AF/04/695-350
Thiokol: AF/04/695-351
FY 1966 and beyond - not defined.

(2) Cost negotiated to date:
AF contracts through FY 1965: $43 million
(does not include overruns or transition)

(3) Scope negotiated to date:
Both contracts continue through two short length 260" motor firings, to be completed in FY 1965. Follow-on effort is currently being defined.

b. Anticipated Changes: A single contractor will be selected to carry out a transition phase and phase II efforts.

7. Project Changes Since FY 65 President's Budget:

a. Project Objective: No change

b. Project Content:

Following the phase I half-length firings a program will be initiated to provide a transition between the half-length motor demonstrations and the phase II program.

c. Project Schedules:

Additional half-length motor static tests will occur during FY 1966 under this transition phase.

d. Project Funding:

FY 1965 funding requirements were initially estimated at $13 million; however, additional funds totalling $8 million will be required during FY 1965 to fund contractor overruns ($5.0 million) and transition program ($3.0 million).

8. Justification of FY 1966 Budget Estimate:

FY 1966 funds will complete the transition phase and provide for the design and initial phases of fabrication of the motors to be tested in phase II.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: CHEMICAL PROPULSION SRT

1. Project Description/Justification:

Direct reaction (rocket) engines using chemical fuels and oxidizers are the basis for today's total space capability. Chemical engines are also the planned source of motivating power for all space vehicle launches in the foreseeable future. The realization of the potential for present planned missions and development of the scope of future mission capability depends primarily on increasing our knowledge of chemical propulsion processes, the investigation of new concepts and techniques and the development of a sound engineering design basis for mission engines.

Liquid rocket and solid rocket work are separated into research, including technological research, and Experimental Engine Technology.

The research includes basic studies and experiments on devices, processes or systems related to liquid and solid engines and divide into numerous specific disciplines. Technological research is the study of the application of scientific principles to useful purposes. The experimental engine technology is the design, fabrication and testing of components or systems to demonstrate their practicality and to establish their optimum operating conditions. The purpose is to prove the "state of the art" as the last step prior to a development program to establish the preliminary engineering and fabrication basis for an engine that is a candidate for a mission assignment. The experimental engine technology must draw mainly on the research knowledge and technology available at or near the start of the work. Because it is relatively high-cost work it is not the test for examining entirely new concepts.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element:			
Research and Technological Research			
Liquid Rocket Work	15,300	11,200	13,500
Solid Rocket Work	4,800	4,900	5,500

	FY 1964	FY 1965	FY 1966
Experimental Engine Technology Liquid Propellant Engines	900	6,525	8,500
Solid Propellant Motors	1,000	2,450	3,500
Project Totals	22,000	25,075	31,000

b. Continuation vs. New:

Continuation of existing contracts and grants	15,849	21,226	19,750
New contracts and grants	5,589	3,289	9,250
In-house effort	562	560	2,000
Project Totals	22,000	25,075	31,000

3. Specific mechanisms or channels for program coordination with other interested agencies:

The primary information exchange media is the Chemical Propulsion Information Agency which includes the Interagency Chemical Rocket Propulsion Group. The work covered within this Agency is sufficiently broad to apprise all members of the U.S. Government's chemical rocket propulsion program.

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: SPACE POWER PROGRAM - SRT

1. Project Description/Justification: This program initiates, improves and administers advanced technology work in the generation of electric power from solar and chemical energy sources, and coordinates space power technology work in NASA centers and contractor laboratories.

2. Project Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Project Element			
Supporting Research and Technology			
Solar Power Generation	9,348	8,379	9,919
Chemical Power Generation	4,652	4,921	5,581
Project Totals	14,000	13,300	15,500
b. Continuation vs. New:			
Continuation of existing contracts & grants	8,714	10,138	9,535
New contracts & grants	3,131	1,443	3,945
In-house effort	2,155	1,719	2,020
Project Totals	14,000	13,300	15,500
c. University Grants & Contracts	3,426	3,773	4,735

3. <u>Specific Mechanisms or Channels for Program Coordination with Other Interested Agencies:</u> The Space Power Program is coordinated through the Interagency Advanced Power Group (IAPG) which supports a Power Information Center (PIC) at the University of Pennsylvania. All contracts and grants placed by the participating agencies (Air Force, Army, Atomic Energy Commission, NASA and Navy) are reported to the PIC which distributes project briefs to interested specialists in the government, university and industry. In addition, a system that will permit a routine exchange and coordination of task descriptions between the NASA and DOD is expected to begin functioning in early 1965. In 1964, a study of the total National Space Power Program was undertaken by specialists in the NASA and DOD under the auspices of the Supporting Space Research and Technology (SSRT) Panel of the Aeronautics and Astronautics Coordinating Board (AACB). Members of the Space Power Program Office are active in the IAPG and were instrumental in the initiation and execution of the National Space Power Study. Through these efforts, the Space Power Program is complementary to the programs of the other government agencies and results in a well coordinated National Space Power Program.

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: HYPERSONIC RAMJET EXPERIMENT

1. Project Objectives: To define a practical, high-performance, Mach 3 to 8, liquid hydrogen hypersonic ramjet engine of laboratory size. To design, develop, and build this experimental research engine. To measure, in the laboratory, the performance to qualify this engine for flight. To measure the performance of this research engine in maneuvering flight, from Mach 3 to 8. To advance and crystallize the technology of hypersonic air breathing propulsion systems, and reevaluate for more effective planning the requirements for future research. To validate the technology of certain ground-based hypersonic air breathing engine test procedures; for example, the use of vitiated air in combustion experiments.

2. Project Content: The project objectives will be met by use of a laboratory scale ramjet research engine large enough to give meaningful results from experiments, yet small enough to permit testing in the laboratory and in-flight on the X-15 research vehicle. The project is planned to be executed in three phases as follows (only Phase I currently approved):

Phase I	Engine preliminary conceptual design, performance evaluation, and Phase II planning.
Phase II	Engine final design, development, fabrication, and ground testing.
Phase III	Engine system installation on the X-15 and flight testing.

3. Summary Project Schedules:

	Time from go-ahead
Phase I	9 months
Phase II	29 months
Phase III	24 months

4. Project Funding:

	FY 65	FY 66	FY 67	FY 68	FY 69
Funding (1000's dollars)	3,125	7,825	10,525	8,325	600

5. Project Manpower:

a. Contractors. (M-Y): Undetermined

b. NASA In-House Direct Manpower:

6. Project Procurement:

a. Current Status: RFP being prepared.

7. Project Changes since FY 1965 President's Budget:

New start since FY 1965 President's Budget.

8. Justification of FY 1966 budget estimate: This program is an outgrowth of recommendations made by the joint NASA-USAF Hypersonic Research Group which was established approximately two years ago to coordinate and define necessary research in this area, and reflects one year of detailed study and preparation by the research centers. The joint NASA-USAF-Navy Research Airplane Committee has approved this hypersonic ramjet propulsion experiment for inclusion in the X-15 program, while the Ad Hoc Committee on Hypersonic Lifting Vehicles with Propulsion, Dr. Floyd L. Thompson, Chairman, has indicated its endorsement with the statement that "...Such a program would serve to determine the basic feasibility of obtaining efficient propulsion with a ramjet engine up to Mach number eight, would clarify the situation that must be considered in making later decisions as to whether air-breathing propulsion is in reality a desirable and worth-while device for future applications, and would assure an essential continuity of research effort and facility utilization that will be lost without an objective program...."

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: NASA XB-70/SST FLIGHT RESEARCH PROGRAM

1. Project Objectives: To obtain advanced research information in the basic problem areas related to large supersonic aircraft. To provide research information and advanced technology for the design, development, construction, and flight test of the American prototype supersonic transport.

2. Project Content: This program will be conducted in two distinct phases. The first phase, beginning in FY 63, consisted of installation of instrumentation in the two XB-70A aircraft during manufacture and the acquisition, reduction, and analysis of data of interest for the NASA program obtained during the U.S. Air Force flight test program. The second phase, beginning in FY 66, will consist of continuation and expansion of the initial NASA program and the initiation of several additional tasks, such as aerothermoelasticity research, which could not be accommodated during the U.S. Air Force program. In the first phase of this program, NASA funded only the costs associated with the instrumentation and data acquisition required to accomplish the limited NASA program. The major cost, that of operating the aircraft, was funded by the U.S. Air Force. In the second phase, NASA will fund all of the costs associated with the NASA XB-70/SST Flight Research Program, including the cost of operating one XB-70 aircraft (approximately $17M per year).

The NASA XB-70/SST Flight Research Program comprises the following tasks:

Skin Friction and Base Drag Research

Stability and Control, and Handling Qualities Research

Structural Dynamics Research

Aerothermoelasticity Research

Internal Aerodynamics Research

SST Engine Qualification Research

Sonic Boom and Community Noise Research

SST Systems Evaluation and Simulated Airline Operation

3. Summary Project Schedules:

Phase I

Initiation of NASA in-house effort - August 1962

Initiation of contract effort - November 1962

Completion of in-house and contract effort - End of Fiscal Year 1965

Phase II

Continuation of Phase I

Initiation of NASA funding - Start of Fiscal Year 1966

Completion of in-house and contract effort - Indeterminate; related to estimated value of results of program during first year of Phase II

4. Project Funding:

	FY 1966	FY 1967	FY 1968	FY 1969
Funding (thousands of dollars)	20,000	16,000		

5. Project Manpower:

a. Contractors: Not Available

b. NASA In-House Direct Manpower (man years):

6. Project Procurement:

a. Current Status:

No contract has been initiated to date for Phase II; cost estimates have been received by the Flight Research Center and forwarded to Headquarters; preliminary discussions have taken place between NASA and the contractor

7. Project Changes Since FY 1965 President's Budget:

New start since FY 1965 President's Budget.

8. Justification of FY 1966 budget estimate: The NASA, by virtue of its statutory responsibility for aeronautical research and technology within the United States Government, has the responsibility to provide the research information and advanced technology for the design, development, construction, and flight test of the American prototype supersonic transport. This responsibility was acknowledged formally in the FAA report, "United States Development of a Commercial Supersonic Transport," signed on June 28, 1961, by the Secretary of Defense; the Administrator, National Aeronautics and Space Administration; and the Administrator, Federal Aviation Agency. Specific roles and responsibilities of the NASA and the FAA were defined more precisely in a recent memorandum of understanding between the two agencies. This memorandum, "Principles for Participation of NASA in Development and Testing of a United States Government-supported Commercial Supersonic Transport Prototype Aircraft," was signed by the NASA and FAA Administrators on December 27, 1963, and January 8, 1964, respectively. This memorandum charges NASA with the responsibility for:

(a) Conducting the necessary background research to provide the supporting technology for the design and development of the vehicle;
(b) Providing technical advice, consultation, and assistance to FAA during the evaluation, design, development and construction phases of the program;
(c) Making available the facilities and technical resources of the NASA as requested by the FAA and determined by NASA to be required and available for the solution of technical problems related to the design and development.

The XB-70 represents a useful vehicle for supersonic transport research. The NASA, with the responsibility it has to conduct aeronautical research in this country, recognizing this capability of the XB-70, has funded a program to get vitally needed information for the SST program. However, because of recent Air Force decisions a great deal more information can be obtained in a shorter time than was thought to be possible a few months ago. NASA, therefore, plans to expand the original XB-70/SST program. This change will require flight tests in fiscal years 1966 and 1967.

Additional necessary research could be done using the XB-70 until the prototype SST begins flying, and possibly for one or two years after that. Consideration will be given to funding the XB-70/SST Flight Research Program in fiscal years 1968 and 1969, also.

The Federal Aviation Agency strongly supports this NASA program and expects NASA to provide the required research information on a timely basis, in keeping with NASA's statutory responsibility.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: AERONAUTICS SR&T

1. **Program Description/Justification:**

This program provides planning, direction, execution, and evaluation of all NASA research conducted primarily to provide the technology in aircraft aerodynamics, structures and loads, air-breathing propulsion, and aircraft operating problems required to achieve United States aeronautical objectives.

2. Program Funding (Program Plan in Thousands of Dollars):

	FY 1964	FY 1965	FY 1966
a. Funding by Program Element:			
Aerodynamics	1,404	1,548	2,000
Structures and Loads	1,619	2,411	1,950
Air-Breathing Propulsion	1,078	1,620	1,725
Aircraft Operating Problems	5,094	2,728	2,625
Program Totals	9,195	8,307	8,300
b. Continuation vs. New:			
Continuation of existing Contracts and grants	1,354	1,169	975
New contracts and grants	5,893	4,898	5,500
In-House effort	1,948	2,240	1,825
Program Totals	9,195	8,307	8,300
c. University Contracts and Grants	209	100	

3. **Specific mechanisms or channels for program coordination with other interested agencies:**

NASA Research Advisory Committee on Aircraft Aerodynamics
NASA Research Advisory Committee on Aircraft Structures
NASA Research Advisory Committee on Air-Breathing Propulsion Systems
NASA Research Advisory Committee on Aircraft Operating Problems
NASA Committee on Fatigue Research and Technology
AGARD Flight Mechanics Panel
AGARD VTOL/STOL Working Panel of Subgroup H of Tripartite Technical Cooperation Programme
Aeronautics and Astronautics Coordinating Board--Aeronautics Panel
NASA-USAF-USN Research Airplane Committee
NASA-USAF X-15 Joint Program Coordinating Committee
NASA-USAF Hypersonic Research Panel
Aviation Meteorological Research and Development Working Committee
Ad Hoc Panel on Meteorological Problems of Supersonic Transport
National Fire Protection Association

In addition to the coordination provided through the above committees and panels, copies of the NASA Research and Technology Program Digest Flash Index are provided to all interested government agencies to facilitate program coordination at the task level. Informal individual contacts with personnel of other agencies are arranged, as required, to complete the overall coordination process.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: X-15 RESEARCH AIRCRAFT

1. Project Description:

Provide planning, direction, execution, and evaluation of X-15 Research Aircraft program to obtain fundamental research information under full-scale, realflow, flight conditions pertinent to the problems of future manned, maneuverable, hypersonic, high-altitude civil and military flight vehicles.

2. Project Funding (thousands of dollars):

FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
1,425	900	900	900	400

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

($ in thousands)

	FY 1964	FY 1965	FY 1966
X-15	900	1,425	900
Aerodynamics	130	78	130
Loads & Structures	-0-	13	-0-
Propulsion	-0-	-0-	-0-
Operations	770	1,334	770

b. Contractor manpower: (Not applicable)

c. Services of Other Government Agencies: (Not applicable)

d. FY 1966 Procurement of Capital Items: (Not applicable)

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: SUPERSONIC TRANSPORT

1. Project Description:

This is a research project to provide the technology and program support on a timely basis for the design and development of a safe, reliable, and economical commercial supersonic transport aircraft.

A supersonic transport must be able to operate efficiently over a wide range of speeds extending from subsonic to the cruise supersonic Mach number. The technical problems requiring solution involve the broad areas of aerodynamics, structures, materials, propulsion, and operations. The NASA is active in all these broad areas. The overall supersonic transport program is being conducted by the FAA with the support of the NASA and the DOD. The NASA participation in the program is that of providing in-house research support at the four research Centers with an out-of-house contract program in certain areas, particularly propulsion, to supplement in-house work.

2. Project Funding: (thousands of dollars)

Fiscal Year				
1965	1966	1967	1968	1969
21,943	22,000	22,000	23,000	25,000

a. Analysis and Justification of Significant Changes in Project Funding:

The substantial increase in funding for this project in FY 1965 and subsequent years is required for the NASA SST propulsion program.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

	FY 64	FY 65	FY 66
Supersonic Transport	8,795	21,943	22.000
Aerodynamics	1,202	1,514	1,325
Loads & Structures	308	157	735
Propulsion	1,605	16,842	15,515
Operations	5,680	3,430	4,425

b. Contractor manpower:

	Man-years FY 64	FY 65	FY 66
Fundamental aerodynamic research-Computer program development		10	4
Study of thermal stress design criteria			3
Engine design contracts		12	6
Overall evaluation of potential propulsion systems		18	3
Engine inlet analysis and model tests		8	4
Operation of Boeing 367-80 airplane	15		10

c. Services of Other Government Agencies: (Not applicable)

d. FY 1966 Procurement of Capital Items:

(1) Maintenance of Capability:

Numerous small items

(2) Operation:

T-38 Spares 50,000

Cambered Wing Aeroelastic model

Wing-body Interference model	100,000
SST Final Configuration model (low-speed large-scale)	200,000
SST Flutter model	250,000

(3) Increase in capability:

Turbulence measuring equipment	100,000
Aircraft control simulator	150,000
Analog computer, Electronic Associates 231R	250,000
Visual display system development	80,000
In-flight automatic data recording equipment (aircraft modification)	150,000
Rough air programming equipment	50,000
Control system modification to Convair 990 for SST control research	250,000
On-board digital computer for energy management research for SST using Convair 990	750,000
Inertial navigation system for Convair 990	200,000

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

PROJECT TITLE: V/STOL AIRCRAFT

1. Project Description: This project covers wind-tunnel, simulator, and flight research studies on new concepts aimed at producing improved, safe and economical, military and civil V/STOL and STOL aircraft. Required support of development of specific military aircraft is also covered.

2. Project Funding (thousands of dollars):

Fiscal Year				
1965	1966	1967	1968	1969
2,000	3,000	2,500	2,500	2,500

a. Analysis and Justification of Significant Changes in Project Funding:

Moderate increase in level of funding indicated reflects anticipated increase in costs associated with more sophisticated, larger-scale models required to investigate, in detail, problems of promising concepts. If it is decided that new V/STOL aircraft must be purchased to extend knowledge on flying and handling qualities, a higher, associated, level will undoubtedly be required.

3. Justification for FY 1966 Budget Estimate:

a. Identification of Requirements by Major Function, Activity and/or End Items Funded:

($ in thousands)

	FY 1964	FY 1965	FY 1966
V/STOL	2,879	2,000	3,000
Aerodynamics	516	433	1,030
Loads & Structures	557	226	500
Propulsion	948	100	270
Operations	858	1,241	1,200

b. Contractor Manpower:

	Man-years FY 1964	FY 1965	FY 1966
Study of wind-tunnel jet-boundary effects	-	4	4
Study of ground effects on jet V/STOL aircraft	-	4	4
Determine vibration combinations influencing human acceptance	-	-	4
Support of GSN-5 radar	3	3	3

c. Services of other Government Agencies: Indefinite

d. FY 1966 Procurement of Capital Items:

(1) Maintenance of Capability:

Wind tunnel and aircraft instrumentation

(2) Operation:

	(Thousands of Dollars)
Flexible, retractable rotor blade system	40
Jet driven rotor	50
STOL swept wing jet transport model	250
Supersonic V/STOL tactical aircraft model	250

(3) Increase in Capability:

Jet simulation equipment	50
Inlet simulation equipment	100
Attitude stabilization system for X-14A Aircraft	50
Modification of XV-5A aircraft for STOL studies	100
Installation of zero-zero landing system in Breguet 941 aircraft	50
Variable stability equipment for NC-130 boundary-layer-control STOL aircraft	200

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF TRACKING AND DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

The Manned Space Flight Network was originally established as part of Project Mercury and successfully supported the flights of Astronauts Glenn, Carpenter, Schirra, and Cooper. The Mercury Network consisted of 16 land stations and 2 ships. Seven of the land stations and the ships were operated by the Department of Defense.

The network is being modified and augmented for support of the Gemini program. Good progress is being made and the network is essentially ready for early flights. For Gemini, the network will consist of nine primary stations (including two ships) and six secondary stations.

Concurrently, NASA is well under way in further augmenting the network for support of the more complex Apollo program. According to present plans, the Manned Space Flight Network for support of Apollo will consist of nine stations with 30-foot antennas, three 85-foot antenna stations, three insertion/injection ships, two re-entry ships, and twelve communications relay aircraft. Back-up capability will be provided at three 85-foot antenna stations of the Deep Space Network co-located with the three 85-foot MSFN stations. In addition, receive-only capability will be provided at three existing land stations and on two range ships to ensure telemetry reception during critical mission periods.

The pages which follow show funds required to construct, equip, and operate the stations and to provide necessary network support.

OFFICE OF TRACKING AND DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK ESTIMATE

Research and Development

OPERATIONS

Station	FY-64	FY-65	FY-66
Ascension	--	--	400
Guam	--	--	400
Bermuda	842	1,100	1,500
Corpus Christi	412	540	700
Cape Kennedy - Merritt Island	239	300	700
Hawaii	400	615	950
Guaymas, Mexico	520	610	950
Antigua	--	--	325
Carnarvon	1,575	1,750	2,000
Goldstone MSFN	--	--	450
Canberra MSFN	--	--	500
Madrid MSFN	--	--	425
Goldstone DSIF	--	--	--
Madrid DSIF	--	--	--
Canberra DSIF	--	--	--
Canary Islands	463	560	600
Grand Turk Island	--	--	--
Grand Bahamas Island	--	--	--
Wallops/GSFC Training	600	725	1,100
Three (3) Insertion/Injection Ships	--	--	4,400
Two (2) Reentry Ships	--	--	800
Rose Knot Victory (Ship)	1,250	1,750	1,750
Coastal Sentry Quebec (Ship)	1,250	1,750	1,750
San Salvador Island	--	--	--
Kano, Nigeria	274	500	550
Zanzibar	252	--	--
Canton Island	295	560	600
Eglin	25	50	50
Point Arguello	285	325	350
PMR Range Tracker (Ship)	--	200	200
Aircraft	--	--	--
Control Centers	--	--	--
Calibration Aircraft	785	1,000	1,000
Logistics and Transportation	1,357	2,000	2,500
Programming and Computer Support	2,800	3,000	3,800
Network Engineering (including JPL)	3,183	4,465	5,705
Special Requirements	2,247	3,000	3,500
SUBTOTAL	19,054	24,800	37,955

OFFICE OF TRACKING AND DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK ESTIMATE
(in thousands of dollars)

Research and Development

EQUIPMENT

Station	FY-64	FY-65	FY-66
Ascension	3,140	3,637	2,928
Guam	1,683	5,033	2,428
Bermuda	3,901	6,669	1,884
Corpus Christi	3,410	1,101	1,934
Cape Kennedy - Merritt Island	2,376	4,520	2,617
Hawaii	4,803	2,471	2,428
Guaymas, Mexico	2,802	2,447	1,934
Antigua	1,488	4,303	1,884
Carnarvon	4,394	854	2,928
Goldstone MSFN		2,277	2,728
Canberra MSFN		2,176	2,728
Madrid MSFN		2,277	2,728
Goldstone DSN	2,737	1,759	1,464
Madrid DSN	266	2,197	1,464
Canberra DSN	266	2,192	1,464
Canary Islands	998	--	3,000
Grand Turk Island	1,885	--	3,000
Grand Bahamas Island	1,885	--	3,000
Wallops/GSFC Training	770	142	2,219
Three (3) Insertion/Injection Ships	--	--	--
Two (2) Reentry Ships	--	28,000	--
Rose Knot Victory (Ship)	1,043	--	3,500
Coastal Sentry Quebec (Ship)	2,679	--	3,500
San Salvador Island	1,885	--	--
Kano, Nigeria	--	--	--
Zanzibar	--	--	--
Canton Island (Operations only - DOD)	--	--	--
Eglin (Operations only - DOD)	--	--	--
Point Arguello (Operations only - DOD)	--	--	--
PMR Range Tracker (Operations only - DOD)	--	--	--
Aircraft Modification (12)	--	18,400	9,213

OFFICE OF TRACKING AND DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK ESTIMATE

Research and Development

	FY-64	FY-65	FY-66
EQUIPMENT (CONTINUED)			
Control Centers	1,495	573	1,023
Documentation	447	1,056	1,112
Test and Training	3,210	2,896	--
Network Integration and Interface Equipment	3,846	2,961	7,217
Equipment Engineering	1,656	2,000	1,700
Maintenance, Spares, Replacement	2,469	3,380	2,675
* Reserve for Reentry Ship Funding Deficiency	700	9,300	--
SUBTOTAL	56,234	112,626	74,700
TOTAL	75,288	137,426	112,655

* The OTDA FY 1966 budget assumes that the Department of Defense will provide $14.7 Million of the $24.7 Million estimated total funding deficiency for Apollo insertion/injection and reentry ships. The present $10.0 Million OTDA reserve for the ship deficiency was established by postponing certain procurements of Manned Space Flight Network equipment from FY 1965 until FY 1966. If the Department of Defense makes available a larger amount for the ships, the OTDA FY 1966 budget will be reduced by a similar amount; and procurements of Manned Space Flight Network equipment will be made in FY 1965, as originally planned.

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Ascension Island

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 790	$ 394
Command & Control Systems		1,348	694
Recording Systems		650	190
Data Processing Systems		444	120
Unified S-Band Systems	3,140	405	900
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			50
Subtotal	3,140	3,637	2,928
Operations			
Cost			400
Manpower			
Civil Service			1
Contractor			34
Foreign Nationals			
Subtotal			400
TOTAL	3,140	3,637	3,328

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Guam

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 790	$ 394
Command & Control Systems		1,348	694
Recording Systems		650	190
Data Processing Systems		444	120
Unified S-Band Systems	1,603	1,685	400
C-Band Radar Systems			
UHF/VHF Systems		121	450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			50
Subtotal	1,603	5,038	2,428
Operations			
Cost			400
Manpower			
Civil Service			1
Contractor			22
Foreign Nationals			17
Subtotal			400
TOTAL	1,603	5,038	2,828

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Bermuda

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 545	$ 790	$
Command & Control Systems	194	284	644
Recording Systems	165	390	190
Data Processing Systems	345		120
Unified S-Band Systems	2,459	305	300
C-Band Radar Systems		4,900	
UHF/VHF Systems			450
Communications Terminal Equipment	43		130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	$ 3,901	$ 6,669	$ 1,884
Operations			
Cost	842	1,100	1,500
Manpower			
Civil Service	2	2	2
Contractor	39	54	60
Foreign Nationals	45	59	65
Subtotal	842	1,100	1,500
TOTAL	$ 4,743	7,769	3,384

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Corpus Christi

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 545	$	$
Command & Control Systems		284	694
Recording Systems	150	412	190
Data Processing Systems	345		120
Unified S-Band Systems	2,177	405	300
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment	43		130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	3,410	1,101	1,934
Operations			
Cost	412	540	700
Manpower			
Civil Service			
Contractor	DOD	DOD	DOD
Foreign Nationals			
Subtotal	412	540	700
TOTAL	3,822	1,641	2,634

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Cape Kennedy

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 790	$ 394
Command & Control Systems		1,065	664
Recording Systems	120	525	192
Data Processing Systems	345	444	100
Unified S-Band Systems	1,718	1,690	400
C-Band Radar Systems			
UHF/VHF Systems			689
Communications Terminal Equipment	43	6	130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	2,376	4,520	2,617
Operations			
Cost	239	300	700
Manpower			
Civil Service			1
Contractor	18	22	74
Foreign Nationals			
Subtotal	239	300	700
TOTAL	$ 2,615	$ 4,820	$ 3,317

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Hawaii

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 1,090	$	$ 394
Command & Control Systems	1,236	284	694
Recording Systems	165	502	190
Data Processing Systems	345		120
Unified S-Band Systems	1,774	1,685	400
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment	43		130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	4,803	2,471	2,428
Operations			
Cost	400	615	950
Manpower			
Civil Service			
Contractor	DOD	DOD	DOD
Foreign Nationals			
Subtotal	400	615	950
TOTAL	5,203	3,086	3,378

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Guaymas, Mexico

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$
Command & Control Systems	582	1,065	694
Recording Systems	150	412	190
Data Processing Systems	345		120
Unified S-Band Systems	1,532	970	300
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment	43		130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	$ 2,802	2,447	1,934
Operations			
Cost	520	610	950
Manpower			
Civil Service	1	1	1
Contractor	30	34	46
Foreign Nationals	21	25	35
Subtotal	520	610	950
TOTAL	3,322	3,057	2,884

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Antigua

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 790	$
Command & Control Systems		1,348	644
Recording Systems		650	190
Data Processing Systems		444	120
Unified S-Band Systems	1,488	1,071	300
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			50
Subtotal	1,488	4,303	1,884
Operations			
Cost			325
Manpower			
Civil Service			1
Contractor			20
Foreign Nationals			14
Subtotal			325
TOTAL	1,488	4,303	2,209

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Carnarvon, Australia

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems		284	694
Recording Systems	180	365	190
Data Processing Systems	345		120
Unified S-Band Systems	3,373	205	900
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment	43		130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		50
Subtotal	$ 4,304	$ 854	$ 2,928
Operations			
Cost	$ 1,575	$ 1,750	$ 2,000
Manpower			
Civil Service			
Contractor			
Foreign Nationals	98	110	110
Subtotal	$ 1,575	$ 1,750	$ 2,000
TOTAL	$ 5,969	$ 2,604	$ 4,928

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Goldstone MSFN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 395	$ 394
Command & Control Systems			694
Recording Systems		417	190
Data Processing Systems		444	200
Unified S-Band Systems		1,021	670
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			
Subtotal		$ 2,277	$ 2,728
Operations			
Cost			$ 450
Manpower			
Civil Service			1
Contractor			49
Foreign Nationals			
Subtotal			$ 450
TOTAL		$ 2,277	$ 3,178

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Canberra MSFN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 395	$ 394
Command & Control Systems			594
Recording Systems		417	190
Data Processing Systems		444	200
Unified S-Band Systems		920	570
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			
Subtotal		$ 2,176	$ 2,728
Operations			
Cost			$ 500
Manpower			
Civil Service			
Contractor			
Foreign Nationals			50
Subtotal			$ 500
TOTAL		$ 2,176	$ 3,228

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Madrid MSFN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 395	$ 394
Command & Control Systems			694
Recording Systems		417	190
Data Processing Systems		444	200
Unified S-Band Systems		1,021	670
C-Band Radar Systems			
UHF/VHF Systems			450
Communications Terminal Equipment			130
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			
Subtotal		2,277	2,728
Operations			
Cost			425
Manpower			
Civil Service			1
Contractor			17
Foreign Nationals			27
Subtotal			425
TOTAL		2,277	3,153

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Goldstone DSN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems			
Recording Systems			190
Data Processing Systems		290	380
Unified S-Band Systems	2,737	1,094	500
C-Band Radar Systems			
UHF/VHF Systems			
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)		375	
Subtotal	$ 2,737	$ 1,759	$ 1,464
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 2,737	$ 1,759	$ 1,464

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Madrid DSN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems			
Recording Systems		310	190
Data Processing Systems			380
Unified S-Band Systems	266	1,512	500
C-Band Radar Systems			
UHF/VHF Systems			
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)		375	
Subtotal	$ 266	$ 2,197	$ 1,464
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 266	$ 2,197	$ 1,464

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Canberra DSN

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems			
Recording Systems		305	190
Data Processing Systems			380
Unified S-Band Systems	266	1,512	500
C-Band Radar Systems			
UHF/VHF Systems			
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)		375	
Subtotal	$ 266	$ 2,192	$ 1,464
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 266	$ 2,192	$ 1,464

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Canary Islands

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems	460		384
Recording Systems	150		204
Data Processing Systems	345		180
Unified S-Band Systems			1,543
C-Band Radar Systems			
UHF/VHF Systems			185
Communications Terminal Equipment	43		90
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			20
Subtotal	$ 998		$ 3,000
Operations			
Cost	$ 463	$ 560	$ 600
Manpower			
Civil Service	1	1	1
Contractor	33	36	36
Foreign Nationals	21	23	23
Subtotal	$ 463	$ 560	$ 600
TOTAL	$ 1,461	$ 560	$ 3,600

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Grand Turk Island

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 1,090	$	$ 394
Command & Control Systems			384
Recording Systems			204
Data Processing Systems	345		180
Unified S-Band Systems			1,543
C-Band Radar Systems			
UHF/VHF Systems	300		185
Communications Terminal Equipment			90
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		20
Subtotal	$ 1,885		$ 3,000
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 1,885		$ 3,000

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Grand Bahama Island

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 1,090	$	$ 394
Command & Control Systems			384
Recording Systems			204
Data Processing Systems	345		180
Unified S-Band Systems			1,543
C-Band Radar Systems			
UHF/VHF Systems	300		185
Communications Terminal Equipment			90
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		20
Subtotal	$ 1,885		$ 3,000
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 1,885		$ 3,000

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Wallops/GSFC Training

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$
Command & Control Systems		142	344
Recording Systems	132		222
Data Processing Systems	345		445
Unified S-Band Systems			1,055
C-Band Radar Systems			
UHF/VHF Systems			
Communications Terminal Equipment	43		69
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	250		84
Subtotal	770	142	2,219
Operations			
Cost	600	725	1,100
Manpower			
Civil Service			
Contractor	59	66	79
Foreign Nationals			
Subtotal	600	725	1,100
TOTAL	1,370	867	3,319

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: T-AGM-19, T-AGM-20, T-AGM-21 (Insertion/Injection Ships)

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$
Command & Control Systems			
Recording Systems			
Data Processing Systems			
Unified S-Band Systems			
C-Band Radar Systems			
UHF/VHF Systems			
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)			
Subtotal			
Operations			
Cost			$ 4,400
Manpower			
Civil Service			
Contractor			DOD
Foreign Nationals			
Subtotal			$ 4,400
TOTAL			$ 4,400

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: T-AGM-6 / T-AGM-7 (Reentry Ships)

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$ 994	$
Command & Control Systems		568	
Recording Systems		624	
Data Processing Systems			
Unified S-Band Systems		4,008	
C-Band Radar Systems		4,142	
UHF/VHF Systems			
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)		17,664	
Subtotal		28,000	
Operations			
Cost			$ 300
Manpower			
Civil Service			
Contractor			DOD
Foreign Nationals			
Subtotal			$ 300
TOTAL		$ 28,000	$ 300

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Rose Knot Victory (Ship)

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems			284
Recording Systems	150		204
Data Processing Systems			180
Unified S-Band Systems			1,343
C-Band Radar Systems			
UHF/VHF Systems			405
Communications Terminal Equipment	43		
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	850		690
Subtotal	$ 1,043		$ 3,500
Operations			
Cost	$ 1,250	$ 1,750	$ 1,750
Manpower			
Civil Service			
Contractor	DOD	DOD	DOD
Foreign Nationals			
Subtotal	$ 1,250	$ 1,750	$ 1,750
TOTAL	$ 2,293	$ 1,750	$ 5,250

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Coastal Sentry Quebec (Ship)

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$	$	$ 394
Command & Control Systems	1,236		284
Recording Systems	150		204
Data Processing Systems			180
Unified S-Band Systems			1,343
C-Band Radar Systems			
UHF/VHF Systems			405
Communications Terminal Equipment	43		
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.) [Includes ship mods.]	1,250		690
Subtotal	$ 2,679		$ 3,500
Operations			
Cost	$ 1,250	$ 1,750	$ 1,750
Manpower			
Civil Service			
Contractor	DOD	DOD	DOD
Foreign Nationals			
Subtotal	$ 1,250	$ 1,750	$ 1,750
TOTAL	$ 3,929	$ 1,750	$ 5,250

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: San Salvador

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	$ 1,090	$	$
Command & Control Systems			
Recording Systems			
Data Processing Systems	345		
Unified S-Band Systems			
C-Band Radar Systems			
UHF/VHF Systems	300		
Communications Terminal Equipment			
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	150		
Subtotal	$ 1,885		
Operations			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	$ 1,885		

OFFICE OF TRACKING & DATA ACQUISITION

MANNED SPACE FLIGHT NETWORK

Research & Development

STATION: Kano, Nigeria

	FY 1964	FY 1965	FY 1966
Equipment			
PCM Telemetry Systems	—	—	—
Command & Control Systems	—	—	—
Recording Systems	—	—	—
Data Processing Systems	—	—	—
Unified S-Band Systems	—	—	—
C-Band Radar Systems	—	—	—
UHF/VHF Systems	—	—	—
Communications Terminal Equipment	—	—	—
Identifiable Miscellaneous Equipment (i.e., test equipment, etc.)	—	—	—
Subtotal	—	—	—
Operations			
Cost	$ 274	$ 500	$ 550
Manpower			
Civil Service	(1)	(1)	(1)
Contractor	(11)	(28)	(28)
Foreign Nationals	(35)	(35)	(35)
Subtotal	274	500	550
TOTAL	274	500	550

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

SATELLITE NETWORK

The Satellite Network consists of the electronic Satellite Tracking and Data Acquisition Network (STADAN) stations operated by Goddard Space Flight Center, and the optical tracking stations operated by the Smithsonian Astrophysical Observatory. The STADAN stations provide the principal tracking and data acquisition support for unmanned earth-orbiting scientific, meteorological, and communications satellites. The network presently includes thirteen fixed operational stations and a mobile station at Darwin, Australia. An additional station is under construction at Canberra, Australia, and another mobile station is being installed in Malagasy. A mobile Range and Range Rate station is included in the FY 1966 budget.

The twelve optical stations provide a more precise orbital determination capability for use in specialized areas of geophysical research. They also provide back-up support for other networks.

The pages which follow provide detailed information on funds required to equip and operate the Satellite Network.

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK - ESTIMATE

Research & Development

	FY 1964	FY 1965	FY 1966
EQUIPMENT:			
Station			
1. Alaska	2,688	1,082	782
2. Fort Myers, Florida	98	429	223
3. Rosman, North Carolina	460	1,029	1,584
4. Mojave, California	400	621	184
5 East Grand Forks, Minnesota	30	40	10
6. Blossom Point, Maryland	392	92	10
7. Quito, Ecuador	540	242	146
8. Lima, Peru	68	--	10
9. Santiago, Chile	485	2,772	321
10. St. Johns, Newfoundland	39	--	10
11. Johannesburg, South Africa	425	60	296
12. Woomera, Australia	157	39	10
13. Canberra, Australia	290	833	844
14. Carnarvon, Australia	197	368	1,041
15. Winkfield, England	117	372	433
16. Mobile Stations	997	436	4,150
17. Project Control Centers	153	505	560
General Purpose Network Equipment	1,835	882	1,141
Equipment Engineering	1,882	1,278	1,410
Equipment Replacement	1,496	871	720
Maintenance, Spares & Repairs	2,096	1,425	2,000
Subtotal	14,845	13,376	15,885

OFFICE OF TRACKING AND DATA ACQUISITION

SATELLITE NETWORK ESTIMATE

RESEARCH AND DEVELOPMENT

	FY 1964	FY 1965	FY 1966
OPERATIONS:			
Station			
1. Alaska	2,736	2,965	3,450
2. Fort Myers, Florida	529	600	620
3. Rosman, North Carolina	1,110	1,735	2,100
4. Mojave, California	631	800	900
5. East Grand Forks, Minnesota	400	410	420
6. Blossom Point, Maryland	507	550	350
7. Quito, Ecuador	567	680	725
8. Lima, Peru	426	420	430
9. Santiago, Chile	785	630	680
10. St. Johns, Newfoundland	50	50	50
11. Johannesburg, South Africa	560	575	600
12. Woomera, Australia	460	500	600
13. Canberra, Australia	--	560	900
14. Carnarvon, Australia	--	--	--
15. Winkfield, England	50	80	80
16. Mobile Stations	190	875	1,275
17. Project Control Centers	500	1,200	1,600
18. Calibration Aircraft	390	1,100	900
Logistics & Transportation	7,720	8,450	9,595
Special Requirements	2,036	1,700	1,700
Smithsonian Astrophysical Observatory	4,000	3,800	4,200
Subtotal	23,647	27,680	31,175
Total	38,492	41,056	47,060

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Fairbanks, Alaska	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	$ 2,333	$ 250	$ 470
Satellite Automatic Tracking Antenna System	158	274	------
Timing Systems	------	195	------
PCM Systems	------	------	------
Command & Control Systems	------	96	------
Identifiable Miscellaneous Equipment	197	267	312
Subtotal	2,688	1,082	782
Operations			
Cost	2,736	2,965	3,450
Manpower			
Civil Service	(3)	(3)	(4)
Contractor	(150)	(161)	(187)
Foreign Nationals	------	------	------
Subtotal	2,736	2,965	3,450
TOTAL	5,424	4,047	4,232

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Fort Myers, Florida	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	—	269	—
Timing Systems	—	35	135
PCM Systems	—	96	25
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	98	29	63
Subtotal	98	429	223
Operations			
Cost	529	600	620
Manpower			
Civil Service	(1)	(1)	(1)
Contractor	(36)	(40)	(41)
Foreign Nationals	—	—	—
Subtotal	529	600	620
TOTAL	627	1,029	843

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Rosman, North Carolina	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System		95	960
Satellite Automatic Tracking Antenna System	209	314	
Timing Systems		95	135
PCM Systems		153	175.
Command & Control Systems		96	83
Identifiable Miscellaneous Equipment	251	276	231
Subtotal	460	1,029	1,584
Operations			
Cost	1,110	1,735	2,100
Manpower			
Civil Service	(2)	(3)	(3)
Contractor	(81)	(131)	(150)
Foreign Nationals			
Subtotal	1,110	1,735	2,100
TOTAL	1,570	2,764	3,684

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Mojave, California	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	158	269	—
Timing Systems	—	45	135
PCM Systems	—	153	25
Command & Control Systems	—	96	—
Identifiable Miscellaneous Equipment	242	58	24
Subtotal	400	621	184
Operations			
Cost	631	800	900
Manpower			
Civil Service	(2)	(2)	(2)
Contractor	(66)	(80)	(90)
Foreign Nationals	—	—	—
Subtotal	631	800	900
TOTAL	1,031	1,421	1,084

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: East Grand Forks, Minn.	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	—	—	—
Timing Systems	—	—	—
PCM Systems	—	—	—
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	30	40	10
Subtotal	30	40	10
Operations			
Cost	400	410	420
Manpower			
Civil Service	—	—	—
Contractor	(32)	(32)	(32)
Foreign Nationals	—	—	—
Subtotal	400	410	420
TOTAL	430	450	430

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Blossom Point, Maryland	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	323	50	—
Timing Systems	—	—	—
PCM Systems	—	—	—
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	69	42	10
Subtotal	392	92	10
Operations			
Cost	507	550	350
Manpower	—	—	—
Civil Service	—	—	—
Contractor	(41)	(45)	(25)
Foreign Nationals	—	—	—
Subtotal	507	550	350
TOTAL	899	642	360

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Quito, Ecuador	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	258	57	—
Timing Systems	—	145	—
PCM Systems	—	—	—
Command & Control Systems	—	—	25
Identifiable Miscellaneous Equipment	282	40	121
Subtotal	540	242	146
Operations			
Cost	567	680	725
Manpower			
Civil Service	(2)	(2)	(2)
Contractor	(30)	(34)	(38)
Foreign Nationals	(54)	(54)	(54)
Subtotal	567	680	725
TOTAL	1,107	922	871

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Lima, Peru	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	—	—	—
Timing Systems	—	—	—
PCM Systems	—	—	—
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	68	—	10
Subtotal	68	—	10
Operations			
Cost	426	420	430
Manpower			
Civil Service	(1)	(1)	(1)
Contractor	(5)	(5)	(5)
Foreign Nationals	(48)	(46)	(46)
Subtotal	426	420	430
TOTAL	494	420	440

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Santiago, Chile	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	2,297	—
Satellite Automatic Tracking Antenna System	250	290	—
Timing Systems	—	145	—
PCM Systems	—	—	175
Command & Control Systems	—	—	25
Identifiable Miscellaneous Equipment	235	40	121
Subtotal	485	2,772	321
Operations			
Cost	785	630	680
Manpower			
Civil Service	(2)	(2)	(3)
Contractor	(32)	(33)	(36)
Foreign Nationals	(50)	(52)	(55)
Subtotal	785	630	680
TOTAL	1,270	3,402	1,001

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: St. Johns, Newfoundland	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	—	—	—
Timing Systems	—	—	—
PCM Systems	—	—	—
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	39	—	10
Subtotal	39	—	10
Operations			
Cost	50	50	50
Manpower	—	—	—
Civil Service	—	—	—
Contractor	—	—	—
Foreign Nationals	(30)	(30)	(30)
Subtotal	50	50	50
TOTAL	89	50	60

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Johannesburg, South Africa	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	120	—	—
Timing Systems	—	20	—
PCM Systems	—	—	175
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	305	40	121
Subtotal	425	60	296
Operations			
Cost	560	575	600
Manpower	—	—	—
Civil Service	—	—	—
Contractor	—	—	—
Foreign Nationals	(53)	(53)	(55)
Subtotal	560	575	600
TOTAL	985	635	896

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Woomera, Australia	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	30	—	—
Timing Systems	—	10	—
PCM Systems	—	—	—
Command & Control Systems	—	—	—
Identifiable Miscellaneous Equipment	127	29	10
Subtotal	157	39	10
Operations			
Cost	460	500	600
Manpower	—	—	—
Civil Service	—	—	—
Contractor	—	—	—
Foreign Nationals	(40)	(42)	(42)
Subtotal	460	500	600
TOTAL	617	539	610

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Canberra, Australia	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	233	363	—
Timing Systems	—	30	135
PCM Systems	—	154	175
Command & Control Systems	—	97	300
Identifiable Miscellaneous Equipment	57	189	234
Subtotal	290	833	844
Operations			
Cost	—	560	900
Manpower	—	—	—
Civil Service	—	(1)	(1)
Contractor	—	—	—
Foreign Nationals	—	(40)	(70)
Subtotal	—	560	900
TOTAL	290	1,393	1,744

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Carnarvon	FY 1964	FY 1965	FY 1966
Equipment			
Range & Range Rate System		125	975
Satellite Automatic Tracking Antenna System	197	95	
Timing Systems			
PCM Systems			
Command & Control Systems			
Identifiable Miscellaneous Equipment		148	66
Subtotal	197	368	1,041
Operations (See Manned Space Flight Network)			
Cost			
Manpower			
Civil Service			
Contractor			
Foreign Nationals			
Subtotal			
TOTAL	197	368	1,041

OFFICE OF TRACKING & DATA ACQUISITION

SATELLITE NETWORK

Research & Development

STATION: Winkfield, England	FY 1964	FY 1965	FY 1966
Equipment:			
Range & Range Rate System	—	—	—
Satellite Automatic Tracking Antenna System	—	269	—
Timing Systems	—	45	135
PCM Systems	—	—	150.
Command & Control Systems	—	—	84
Identifiable Miscellaneous Equipment	117	58	64
Subtotal	117	372	433
Operations			
Cost	50	80	80
Manpower	—	—	—
Civil Service	—	—	—
Contractor	—	—	—
Foreign Nationals	(26)	(30)	(30)
Subtotal	50	80	80
TOTAL	167	452	513

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

DEEP SPACE NETWORK

The Deep Space Network supports lunar flights such as the Ranger, Surveyor, and Lunar Orbiter, and planetary missions such as Mariner and Pioneer. Operated by the Jet Propulsion Laboratory, the network currently consists of a complex of three 85-foot antennas at Goldstone, California, and single 85-foot antenna facilities at Woomera, Australia, and Johannesburg, South Africa.

Additional 85-foot antenna facilities are under construction at Canberra, Australia, and Madrid, Spain, and are expected to become operational in late 1964 and mid-1965, respectively.

Also under construction at Goldstone is the first of three planned 210-foot antennas. The other two 210-foot antenna facilities, to be located in Spain and Southeast Australia, are included in the FY 1966 budget.

Funds required to operate and to provide equipment and facilities for the Deep Space Network are set forth in the pages which follow.

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK ESTIMATE

Research & Development

	FY 1964	FY 1965	FY 1966
EQUIPMENT			
Station			
Goldstone Complex	$ 3,023	$ 4,899	$ 4,165
Madrid, Spain	508	660	660
Woomera, Australia	1,633	365	1,045
Johannesburg, South Africa	2,330	451	755
Canberra, Australia	1,023	204	750
Cape Kennedy	--	22	120
Mobile Facility	--	619	--
General Purpose Network Equipment	630	790	950
Equipment Engineering	884	1,275	1,325
Space Flight Operations Facility	447	835	3,280
Maintenance, Spares & Replacement	1,526	1,880	2,200
Subtotal	$12,004	$12,000	$ 15,250
OPERATIONS			
Station			
Goldstone Complex	$ 4,209	$ 4,322	$ 5,300
Madrid, Spain	201	600	1,100
Woomera, Australia	525	650	700
Johannesburg, South Africa	626	680	725
Canberra, Australia	300	800	1,100
Cape Kennedy	--	--	200
Special Operations		400	1,100
Network Engineering	3,873	3,818	3,900
JPL Logistics & Engineering Support	1,517	1,819	1,930
Space Flight Operations Facility	215	511	8,645
Subtotal	$ 11,466	$ 13,600	$ 24,700
TOTAL	$ 23,470	$ 25,600	$ 39,950

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Goldstone Complex

	FY 1964	FY 1965	FY 1966
Equipment			
Unified S-Band	$ 902	$ 1,260	$ 290
PCM Systems	180	650	1,160
Antenna Systems	150	745	1,020
Command & Control Systems	840	460	265
Receiver Systems	582	471	200
Recording & Monitoring Systems	250	395	390
Identifiable Miscellaneous Equipment	119	918	840
Subtotal	$ 3,023	$ 4,899	$ 4,165
Operations			
Cost	$ 4,209	$ 4,322	$ 5,300
Manpower			
Civil Service			
Contractor	176	182	250
Foreign Nationals			
Subtotal	$ 4,209	$ 4,322	$ 5,300
TOTAL	$ 7,232	$ 9,221	$ 9,465

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Madrid, Spain

	FY 1964	FY 1965	FY 1966
Equipment:			
Unified S-Band	$ --	$ 100	$ 70
PCM Systems	130	350	265
Antenna Systems	--	40	--
Command & Control Systems	53	57	75
Receiver Systems	232	40	25
Recording & Monitoring Systems	70	50	140
Identifiable Miscellaneous Equipment	23	23	85
Subtotal	$ 508	$ 660	$ 660
Operations:			
Cost	$ 201	$ 600	$ 1,100
Manpower			
Civil Service			
Contractor	13	43	20
Foreign Nationals		12	45
Subtotal	$ 201	$ 600	$ 1,100
TOTAL	$ 709	$ 1,260	$ 1,760

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Woomera, Australia

	FY 1964	FY 1965	FY 1966
Equipment:			
Unified S-Band	$ 682	$ 50	$ 90
PCM Systems	142	--	395
Antenna Systems	245	65	285
Command & Control Systems	103	39	50
Receiver Systems	276	73	40
Recording & Monitoring Systems	68	90	100
Identifiable Miscellaneous Equipment	117	48	85
Subtotal	$ 1,633	$ 365	$ 1,045
Operations			
Cost	$ 525	$ 650	$ 700
Manpower			
Civil Service			
Contractor	1	1	1
Foreign Nationals	34	37	37
Subtotal	$ 525	$ 650	$ 700
TOTAL	$ 2,158	$ 1015	$ 1,745

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Johannesburg, South Africa

	FY 1964	FY 1965	FY 1966
Equipment:			
Unified S-Band	$ 1,186	$ 50	$ 90
PCM Systems	172	--	265
Antenna Systems	318	150	250
Command & Control Systems	103	39	50
Receiver Systems	273	74	40
Recording & Monitoring Systems	160	90	--
Identifiable Miscellaneous Equipment	118	48	60
Subtotal	$ 2,330	$ 451	$ 755
Operations			
Cost	$ 626	$ 680	$ 725
Manpower			
Civil Service			
Contractor	1	1	1
Foreign Nationals	51	59	64
Subtotal	$ 626	$ 680	$ 725
TOTAL	$ 2,956	$ 1,131	$ 1,480

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Canberra, Australia

	FY 1964	FY 1965	FY 1966
Equipment:			
Unified S-Band	$ 75	$ --	$ 70
PCM Systems	455	--	265
Antenna Systems	--	40	100
Command & Control Systems	153	17	75
Receiver Systems	232	73	40
Recording & Monitoring Systems	70	51	140
Identifiable Miscellaneous Equipment	38	23	60
Subtotal	$ 1,023	$ 204	$ 750
Operations			
Cost	$ 300	$ 800	$ 1,100
Manpower			
Civil Service			
Contractor	1	1	1
Foreign Nationals	17	59	64
Subtotal	300	800	1,100
TOTAL	$ 1,323	$ 1,004	$ 1,850

OFFICE OF TRACKING & DATA ACQUISITION

DEEP SPACE NETWORK

Research & Development

STATION: Cape Kennedy

	FY 1964	FY 1965	FY 1966
Equipment:			
Unified S-Band	$	$	$
PCM Systems			
Antenna Systems			
Command & Control Systems			75
Receiver Systems			
Recording & Monitoring Systems			
Identifiable Miscellaneous Equipment		22	45
Subtotal	$	$ 22	$ 120
Operations			
Cost	$	$	$ 200
Manpower			
Civil Service			
Contractor			20
Foreign Nationals			
Subtotal			$ 200
TOTAL	$	$ 22	$ 320

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

OTHER RANGES AND INSTRUMENTATION

This category provides funds for equipping and operating the Aero-dynamic Test Range of the NASA Flight Research Center, Edwards Air Force Base, California. Also included are funds to meet instrumentation requirements of Langley Research Center, and to provide ground support of sounding rocket flights launched from Wallops Station, Wallops Island, Virginia, and the Churchill Research Range at Fort Churchill, Canada.

	FY 1964	FY 1965	FY 1966
Equipment	4,690	5,400	5,500
Operations	5,800	6,100	6,800
Construction	-	-	-
Total	10,490	11,500	12,300

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

DATA PROCESSING

	FY 1964	FY 1965	FY 1966
Equipment			
Goddard	10,555	6,300	12,200
Langley	510	500	500
Total	11,065	6,800	12,700
Operations			
Goddard	6,373	7,700	8,600
Wallops	100	100	100
Total	6,473	7,800	8,700

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

COMMUNICATIONS

	FY 1964	FY 1965	FY 1966
Equipment			
Goddard	3,653	2,800	3,235
Jet Propulsion Laboratory	500	600	2,730
Total	4,153	3,400	5,965
Operations			
Goddard	11,666	14,368	18,100
Jet Propulsion Laboratory	260	250	1,470
Wallops	100	100	100
Total	12,026	14,718	19,670

OFFICE OF TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT

SUPPORTING RESEARCH AND TECHNOLOGY

Program Justification

NASA flight programs generate ground support requirements which, for the most part, can be met using existing network capabilities. Our existing capabilities, however, cannot fully support all currently approved programs nor can they meet the requirement of theplanned long range programs. The SRT program is planned for supporting specific needs by the application of advanced technology to problems at hand. Several general problems involving SRT are of a continuing nature; for example, simultaneous tracking and data acquisition support of increasing numbers of space flights; improving space communication performance by means which do not penalize the spacecraft; meeting the demands of flight safety and real-time control for manned craft; optimizing the cost and complexity of data handling and control resources to match increasing requirements. The SRT effort can help solve these problems through the development of hardware necessary for support of NASA flight programs.

Funding requirements (total OTDA)

FY 1964	FY 1965	FY 1966
$12,890,000	$13,500,000	$14,500,000

Funds for continuation of prior year contracts

$8,700,000	$10,400,000	$10,300,000

In-house versus out-of-house funding

	FY 1964	FY 1965	FY 1966
In-house (includes JPL)	$6,130,000	6,650,000	6,700,000
Out-of-house	6,760,000	6,850,000	7,800,000

Coordination with other agencies

Mutual assistance between NASA and the DOD virtually covers all phases of the activities of NASA. In the area of development, the Space Flight Ground Environment Panel of the Aeronautics and Astronautics Coordinating Board is the focal point for coordination of planning for ground equipment development. Plans of the NASA Centers and themilitary agencies are described in the digest of NASA SRT/ART forms and the DOD DD613 forms which are provided to all concerned. An example of an area in SRT where NASA has agreed to under-

take a study which will be of equal benefit to the DOD is that of the study on economic trade-offs involved in using "flip ships" for tracking and data acquisition support outside or near land masses. NASA has depended fully on military development for the radars used in the manned flight programs.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF TECHNOLOGY UTILIZATION AND POLICY PLANNING

PROJECT TITLE: TECHNOLOGY UTILIZATION

1. Project Description:

The primary objectives of the Technology Utilization program is to accelerate the transfer of the technology generated by NASA research and development into the civilian/industrial sectors of our economy; to develop better methods for management of large scale research and development programs; and, to improve our understanding of the implications of the space program.

2. Project Funding: (In Millions

	No.	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69
Identification & Dissemination	141	2.6	3.85	4.0	4.0	4.0	4.0
Socio-Economic Studies	143	0.9	0.9	1.0	1.0	1.0	1.0
Project Totals		3.5	4.75	5.0	5.0	5.0	5.0

3. Activities:

a. Identification: Teams of specialists at NASA Headquarters and field installations with the help of universities, research institutions and private industry search through the whole range of NASA scientific and technical programs for those areas in which NASA has made significant advances in the state-of-the-art. Reports of these technology surveys are prepared and made available to scientists and engineers in the scientific, industrial and academic communities.

b. Evaluation: Research organizations whose services are primarily directed toward industrial clients make preliminary appraisals of all innovations reported to NASA, in-depth analysis of the industrial feasibility of selected innovations and prepare industry-oriented reports describing these technological advances.

c. Dissemination: Universities and research institutions are employed to establish regional resources to store, retrieve, interpret and adapt to industry the technology generated by NASA. These information centers strengthen our national technical resources through localized application of the technology generated by NASA scientific research programs.

d. Socio-Economic Studies: Grants to universities support research in the management of large scale research and development programs; the conditions under which the transfer of new technology takes place in the economy; and, the implications of the space program especially those matters related to the growth of science and technology.

e. University Grants and Contracts: The following amounts (in millions) represent that portion of the project totals estimated for Research Grants and Contracts with universities:

	FY 65	FY 66	FY 67	FY 68	FY 69
Project Totals	4.8	5.0	5.0	5.0	5.0
Universities	(1.9)	(2.0)	(2.0)	(2.0)	(2.0)