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National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1964

Volume V

SUPPLEMENTAL DATA

RESEARCH AND DEVELOPMEMT PROGRAMS AND PROJECTS

CONSTRUCTION OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Fiscal Year 1964 Estimates

INDEX

Volume V		Page
Summary of Research and Development Programs		3
Office of Manned Space Flight		
Manned Spacecraft Systems	RDO 1	4
Launch Vehicle and Propulsion Systems	RDO 2	7
Aerospace Medicine	RDO 3	14
Integration and Checkout	RDO 4	15
Systems Engineering	RDO 5	16
Office of Applications		
Meteorological Satellites	RDO 6	17
Communications Satellites	RDO 7	21
Advanced Application Satellites	RDO 8	24
Industrial Applications	RDO 9	25
Office of Space Sciences		
Geophysics and Astronomy	RDO 10	26
Lunar and Plantary Exploration	RDO 11	33
Bioscience	RDO 12	38
Launch Vehicle Development	RDO 13	40
Facility, Training and Research Grants	RDO 14	44

Volume V

		Page
Office of Advanced Research and Technology		
Space Vehicle Systems	RDO 15	48
Electronic Systems	RDO 16	52
Human Factor Systems	RDO 17	54
Nuclear-Electric Systems	RDO 18	56
Nuclear Rockets	RDO 19	59
Chemical Propulsion	RDO 20	61
Space Power	RDO 21	63
Aeronautics	RDO 22	65
Office of Tracking and Data Acquisition		
Tracking and Data Acquisition	RDO 23	68
Summary of Construction of Facilities projects	SUM 5	74

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Fiscal Year 1964 Estimates

Summary of Research and Development Programs

		1962	1963	1964
RDO	Manned Spacecraft Systems....	$ 166,801,000	$ 708,521,000	$1,556,600,000
RDO	Launch Vehicle and Propulsion Systems.....	386,153,000	734,057,000	1,168,500,000
RDO	Aerospace Medicine.....	7,854,000	7,000,000	16,700,000
RDO	Integration and Checkout.....	1,250,000	38,500,000	153,000,000
RDO	Systems Engineering.....	992,000	26,500,000	37,000,000
RDO	Meteorological Satellites....	34,433,000	57,315,000	63,700,000
RDO	Communication Satellites.....	33,105,000	43,715,000	51,100,000
RDO	Advanced Applications Satellites.....	---	800,000	1,000,000
RDO	Industrial Applications.....	300,000	2,370,000	3,500,000
RDO	Geophysics and Astronomy.....	97,775,000	144,500,000	194,400,000
RDO	Lunar and Planetary Exploration.....	161,784,000	221,179,000	322,600,000
RDO	Bioscience.....	3,048,000	21,000,000	35,200,000
RDO	Launch Vehicle Developments.....	85,661,000	108,000,000	130,700,000
RDO	Facility, Training and Research Grants.....	12,961,000	30,600,000	55,000,000
RDO	Space Vehicle Systems.....	20,762,000	45,931,000	61,962,000
RDO	Electronic Systems.....	4,933,000	20,696,000	30,362,000
RDO	Human Factor Systems.....	2,404,000	10,060,000	18,200,000
RDO	Nuclear-Electric Systems.....	20,458,000	43,531,000	68,768,000
RDO	Nuclear Rockets.....	26,776,000	71,826,000	96,687,000
RDO	Chemical Propulsion.....	7,003,000	14,469,000	22,497,000
RDO	Space Power.....	6,302,000	10,859,000	16,524,000
RDO	Aeronautics.....	2,954,000	18,078,000	16,200,000
RDO	Tracking and Data Acquisition.....	67,302,000	135,842,000	231,500,000
	Total Direct R&D Costs.....	$1,151,011,000	$2,515,349,000	$4,351,700,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

MANNED SPACECRAFT SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOLUME II, PAGE RDO 1-1 TO 1-26)

Spacecraft supporting technology (SR&T)

	1962	1963	1964
Advanced concepts.....	$ 338,000	$ 257,000	$ 3,810,000
Spacecraft aerothermodynamics.....	3,098,000	550,000	990,000
Spacecraft loads and structures.....	610,000	742,000	2,450,000
Space vehicle environmental factors.....	---	250,000	1,050,000
Space vehicle design criteria.....	---	40,000	450,000
Guidance system.....	100,000	603,000	2,350,000
Navigation.....	---	120,000	230,000
Control systems.....	---	1,150,000	895,000
Communications.....	113,000	448,000	1,090,000
Tracking and data acquisition.....	---	355,000	435,000
Data handling and processing.....	80,000	525,000	1,150,000
Instrumentation.....	---	381,000	1,360,000
Landing and recovery techniques.....	191,000	809,000	1,000,000
Liquid propulsion program..	223,000	1,342,000	1,900,000
Solar power generation.....	---	53,000	400,000
Chemical power generation..	---	250,000	400,000
Space chemistry.....	---	---	250,000
Geodesy and celestial mechanics.....	---	150,000	590,000
Human performance and behavior.....	---	75,000	---
Meteorites and micrometeorites.....	---	---	100,000
Planetary spectroscopy.....	---	---	100,000
Physical biology.....	---	---	100,000
Mercury ATD.....	411,000	---	---
Total Spacecraft supporting technology.....	$ 5,164,000	$ 8,100,000	$ 21,100,000

SEE RDO 1-4
VOLUME II

	1962	1963	1964
Mercury	$ 14,600,000	$ 3,342,000	$ ---
			SEE RDO 1-25 VOLUME II
One-day mission	16,460,000	17,957,000	---
			SEE RDO 1-26 VOLUME II
Gemini			
Spacecraft			
Reentry module	22,667,000	94,267,000	97,300,000
Adapter module	3,175,000	29,140,000	18,800,000
Aerospace ground equipment	1,858,000	17,100,000	32,400,000
Other	2,629,000	13,393,000	47,700,000
Total Spacecraft	$ 30,329,000	$153,900,000	$196,200,000
Operations			
Flight	---	700,000	1,700,000
Recovery	---	400,000	10,900,000
Crew	---	5,200,000	2,000,000
Total Operations	$ ---	$ 6,300,000	$ 14,600,000
Launch vehicles			
Gemini launch vehicle (Titan II)	22,391,000	59,280,000	46,900,000
Gemini target vehicle (Agena)	2,000,000	9,900,000	32,000,000
Atlas	---	400,000	15,900,000
Total Launch vehicles	$ 24,391,000	$ 69,580,000	$ 94,800,000
Supporting development	$ 239,000	$ 3,058,000	$ 700,000
Total Gemini	$ 54,959,000	$232,838,000	$306,300,000
			SEE RDO 1-5 VOLUME II

	1962	1963	1964
Apollo			
Spacecraft			
Command and service module.	$ 60,000,000	$269,224,000	$ 661,200,000
Lunar excursion module.....	---	32,000,000	230,000,000
Guidance and navigation system.....	7,932,000	45,000,000	130,700,000
Instrumentation and scientific equipment.....	1,937,000	3,900,000	9,500,000
Total Spacecraft.....	$ 69,869,000	$350,124,000	$1,031,400,000
Operations			
Flight operations.....	---	640,000	5,000,000
Recovery operations.....	---	310,000	9,000,000
Crew operations.....	---	50,000	2,000,000
Total Operations.....	$ ---	$ 1,000,000	$ 16,000,000
Launch vehicles			
Little Joe II.....	1,250,000	4,500,000	5,000,000
Saturn.....	950,000	55,221,000	75,000,000
Saturn B.....	---	---	55,000,000
Total Launch vehicles....	$ 2,200,000	$ 59,721,000	$ 135,000,000
Supporting development.....	1,257,000	5,000,000	25,000,000
R&D facilities.....	2,292,000	19,939,000	---
Total Apollo.....	$ 75,618,000	$435,784,000	$1,207,400,000
			SEE RDO 1-10 VOLUME II
Mission control center operations	$ ---	$ 10,500,000	$ 21,800,000
			SEE RDO 1-21 VOLUME II
Total Direct R&D costs.....	$166,801,000	$708,521,000	$1,556,600,000
			SEE RDO 1-1 VOLUME II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

LAUNCH VEHICLE AND PROPULSION SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 2-1 TO 2-32)

	1962	1963	1964
Launch vehicle supporting technology (SR&T)			
Launch vehicle studies	$	$ 2,100,000	$ 2,000,000
Launch vehicle aerothermodynamics		130,000	800,000
Launch vehicle loads and structures		4,329,000	6,000,000
Space vehicle design criteria		650,000	2,000,000
Guidance systems		641,000	1,500,000
Navigation		50,000	1,300,000
Control systems		580,000	1,800,000
Communications		320,000	1,500,000
Total Launch vehicle supporting technology	$ 6,719,000 1/	$ 8,800,000	$ 16,900,000
Propulsion supporting technology (SR&T)			
Solid	3,298,000	1,700,000	6,500,000
Liquid	1,409,000	6,250,000	16,000,000
Total Propulsion supporting technology	$ 4,707,000	$ 7,950,000	$ 22,500,000
		SEE RDO 2-3 VOL. II	
Launch operations supporting technology (SR&T)			
Launch facilities studies	502,000	1,100,000	2,150,000
Launch ground support equipment studies	660,000	983,000	3,700,000
Launch operations techniques	---	50,000	420,000
Launch site hazards studies	---	717,000	1,120,000
Space fragment hazards studies	---	150,000	210,000
Total Launch operations supporting technology	$ 1,162,000	$ 3,000,000	$ 7,600,000
		SEE RDO 2-7 VOL. II	

Saturn I (Saturn)

	1962	1963	1964
S-I stage			
Design and development.....	$	$ 9,680,000	$ 9,000,000
Hardware procurement..		46,807,000	9,500,000
Assembly and checkout.....		7,666,000	7,000,000
Tooling and special equipment.....		3,247,000	1,000,000
R&D facilities.....		1,657,000	---
Total S-I stage...	$83,284,000 1/	$ 69,057,000	$ 26,500,000
S-IV stage			
Design and development.....		19,200,000	15,000,000
Hardware procurement..		13,100,000	2,200,000
Assembly and checkout.....		9,600,000	7,500,000
Tooling and special equipment.....		1,800,000	800,000
Total S-IV stage..	$52,191,000 1/	$ 43,700,000	$ 25,500,000
Vehicle instrument unit	$ 404,000	$ 1,280,000	$ 3,000,000
Guidance systems			
Design and development.....		1,010,000	---
Hardware procurement..		10,875,000	2,000,000
Tooling and special equipment.....		366,000	---
Total Guidance systems..	$16,050,000 1/	$ 12,251,000	$ 2,000,000
H-1 engine (procurement)	$10,250,000	$ 7,900,000	$ 2,800,000
RL-10 engine (procurement)	$11,918,000	$ 12,650,000	$ 3,400,000
System integration			
Design and development.....		10,795,000	10,000,000
Hardware procurement..		27,465,000	14,600,000
Assembly and checkout.....		2,612,000	2,000,000
Tooling and special equipment.....		1,000,000	---
Launch operations.....		2,000,000	4,000,000

	1962	1963	1964
Total System integration...	$19,229,000 1/	$43,872,000	$30,600,000
Total Saturn I....	$193,326,000	$190,710,000	$93,800,000
		SEE RDO 2-9 VOL. II	
Saturn IB (Saturn B)			
S-I stage			
Design and development.....	---	3,600,000	7,000,000
Hardware procurement.....	---	---	4,500,000
Assembly and checkout.....	---	---	1,000,000
Tooling and special equipment.....	---	---	1,000,000
Total S-I stage.....	---	$ 3,600,000	$13,500,000
S-IV stage			
Design and development.....	---	9,800,000	10,000,000
Hardware procurement.....	---	---	9,100,000
Tooling and special equipment.....	---	200,000	---
Total S-IV B stage....	---	$ 10,000,000	$19,100,000
Vehicle instrument unit	---	$ ---	$ 6.000.000
Guidance system	---	$ ---	$ 5.200,000
H-1 engine (procurement)	---	$ 1.700.000	$ 3.700,000
J-2 engine (procurement)	---	$ 2.050,000	$ 4.200.000
Systems integration			
Design and development.....	---	1,400,000	10,900,000
Hardware procurement.....	---	---	5,000,000
Launch operations.....	---	---	1,000,000
Total Systems integration.....	---	$ 1,400,000	$16,900,000
Total Saturn IB.....	---	$ 18,750,000	$68,600,000
		SEE RDO 2-12 VOL. II	

Saturn V (Advanced Saturn)

	1962	1963	1964
S-1C stage			
Design and development.....	$	$ 53,424,000	$117,400,000
Hardware procurement..		38,120,000	87,000,000
Assembly and checkout.		7,679,000	43,400,000
Tooling and special equipment.....		44,673,000	40,000,000
Stage support.....		604,000	3,800,000
Total S-1C stage....	$ 22,575,000 1/	$144,500,000	$291,600,000
S-II stage			
Design and development.....		30,915,000	86,914,000
Hardware procurement..		35,007,000	60,000,000
Assembly and checkout.		1,261,000	14,086,000
Tooling and special equipment.....		13,982,000	15,400,000
Stage support.....		11,335,000	5,000,000
Total S-II stage....	$ 19,284,000 1/	$ 92,500,000	$181,400,000
S-IV B stage			
Design and development.....		15,187,000	46,023,000
Hardware procurement..		6,892,000	17,377,000
Assembly and checkout.		929,000	6,082,000
Tooling and special equipment.....		9,014,000	10,100,000
Stage support.....		78,000	2,718,000
Total S-IV B stage..	$ 2,500,000 1/	$ 32,100,000	$ 82,300,000
Vehicle instrument unit			
Design and development.....	---	1,200,000	10,500,000
Hardware procurement..	---	900,000	3,500,000
Assembly and checkout.	---	100,000	1,500,000
Tooling and special equipment.....	---	400,000	1,500,000
Total Vehicle instrument unit.....	---	$ 2,600,000	$ 17,000,000

	1962	1963	1964
Saturn V (Cont.)			
Guidance system			
Design and development.....	$	$ 9,500,000	$ 8,000,000
Hardware procurement...		1,500,000	5,000,000
Assembly and checkout..		---	1,800,000
Tooling and special equipment.....		---	1,200,000
Total Guidance system	$ 7,590,000 1/	$ 11,000,000	$ 16,000,000
F-1 engine (procurement)	$ 3,400,000	$ 21,600,000	$ 53,100,000
J-2 engine (procurement)	$ 1,700,000	$ 9,800,000	$ 16,600,000
Support			
Design and development.....		9,000,000	41,225,000
Hardware procurement...		2,300,000	17,225,000
Tooling and special equipment.....		1,200,000	12,370,000
Other support.....		2,000,000	4,180,000
Total Support.....	$ 326,000 1/	$ 14,500,000	$ 75,000,000
Total Saturn V.....	$ 57,375,000	$328,600,000	$733,000,000
		SEE RDO 2-16 VOL. II	
M-1 engine			
Engine development.....	4,100,000	23,100,000	33,300,000
Special test equipment.....	7,100,000	9,200,000	5,700,000
Facilities.....	5,494,000	1,200,000	---
Propellants.....	11,000	1,500,000	6,000,000
Total M-1 engine.....	$ 16,705,000	$ 35,000,000	$ 45,000,000
		SEE RDO 2-22 VOL. II	
H-1 engine			
Engine development.....	4,950,000	4,510,000	4,500,000
Special test equipment...	---	---	---
Facilities.....	---	100,000	---
Propellants.....	712,000	650,000	700,000
Total H-1 engine.....	$ 5,662,000	$ 5,260,000	$ 5,200,000
		SEE RDO 2-23 VOL. II	

	1962	1963	1964
RL-10 engine			
Engine development.....	$ 11,157,000	$ 22,330,000	$ 25,300,000
Special test equipment....	3,125,000	1,427,000	---
Facilities.....	---	238,000	---
Propellants.....	2,050,000	8,650,000	7,300,000
Total RL-10 engine.....	$ 16,332,000	$ 32,645,000	$ 32,600,000
F-1 engine			SEE RDO 2-24, VOLUME II
Engine development.....	44,284,000	42,500,000	43,500,000
Special test equipment....	---	---	3,000,000
Facilities.....	1,000,000	---	---
Propellants.....	3,036,000	8,300,000	7,600,000
Total F-1 engine.....	$ 48,320,000	$ 50,800,000	$ 54,100,000
			SEE RDO 2-26 VOL. II
J-2 engine			
Engine development.....	31,597,000	35,542,000	38,550,000
Special test equipment....	---	---	1,400,000
Facilities.....	---	---	---
Propellants.....	2,038,000	9,000,000	8,250,000
Total J-2 engine.....	$ 33,635,000	$ 44,542,000	$ 48,200,000
			SEE RDO 2-28 VOL. II
Range instrumentation			
Advanced instrumentation..	---	---	3,300,000
Design, data and measurement.....	---	---	4,800,000
Safety instrumentation....	---	---	3,450,000
Launch support instrumentation.....	---	---	3,890,000
Range telemetry expansion for MILA.....	---	---	4,560,000
Total Range instrumentation.....	---	---	$ 20,000,000
			SEE RDO 2-29 VOL. II
Range support			
AF salaries and related expense.....	524,000	759,000	1,000,000
Range contractor support..	1,483,000	3,100,000	10,000,000
Equipment, supplies and material.....	83,000	2,739,000	6,400,000
Maintenance, repair and alteration.....	120,000	1,402,000	3,600,000

	1962	1963	1964
Range support: (Cont.)			
Total Range support.....	$ 2,210,000	$ 8,000,000	$ 21,000,000
		SEE RDO 2-31 VOL. II	
Total direct R&D costs	$386,153,000	$734,057,000	$1,168,500,000

1/ New accounting codes and procedures initiated in FY 1963 make possible a recording of expenditures on a sub-project basis that was not possible in all cases for preceeding years.

SEE RDO 2-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

AEROSPACE MEDICINE

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II PAGES RDO 3-1 TO 3-3)

	1962	1963	1964
Experimental studies			
Radiation	$2,812,000	$1,035,000	$ 2,535,000
Physiological stresses	2,077,000	792,000	1,100,000
Crew performance	394,000	407,000	900,000
Flight crew requirements	---	100,000	1,000,000
Bioinstrumentation	105,000	200,000	275,000
Life support systems	439,000	402,000	2,315,000
Total Experimental studies	$5,827,000	$2,936,000	$ 8,125,000
Crew systems			
Radiation	---	307,000	400,000
Flight crew requirements	539,000	300,000	500,000
Bioinstrumentation	16,000	335,000	300,000
Life support systems	379,000	2,672,000	2,750,000
Total Crew systems	$ 934,000	$3,614,000	$ 3,950,000
Biomedical in-flight experiments			
Crew performance	---	100,000	2,625,000
Life support systems	889,000	150,000	500,000
Total Biomedical in-flight experiments	$ 889.000	$ 250,000	$ 3,125,000
Medical operations	204,000	200,000	1,500,000
Total direct R&D costs	$7,854,000	$7,000,000	$16,700,000

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SEE RDO 3-1
VOLUME II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

INTEGRATION AND CHECKOUT

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 4-1 TO 4-3)

	1962	1963	1964
Integration			
Engineering effort	$ 200,000	$ 4,800,000	$23,000,000
Computer time.....	---	1,200,000	3,000,000
Total Integration.....	$ 200,000	$ 6,000,000	$26,000,000
Checkout			
Engineering effort.....	825,000	20,000,000	54,000,000
Hardware	---	6,500,000	47,000,000
Total Checkout.....	$ 825,000	$26,500,000	$101,000,000
Reliability assessment			
Engineering effort.....	225,000	5,300,000	23,000,000
Computer time.....	---	700,000	3,000,000
Total Reliability.....	$ 225,000	$ 6,000,000	$26,000,000
Total direct Research and Development cost.....	$ 1,250,000	$38,500,000	$153,000,000

SEE RDO 4-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

SYSTEMS ENGINEERING

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOLUME II, PAGES RDO 5-1 TO 5-3)

Systems engineering and studies	1962	1963	1964
General mission support.....	$992,000	$ 9,000,000	$12,700,000
Engineering and studies.....	---	1,100,000	2,000,000
Advanced studies.....	---	7,900,000	11,300,000
Lunar logistics system studies.....	---	5,000,000	6,000,000
Nova study.....	---	3,500,000	5,000,000
Total direct R&D costs.....	$992,000	$26,500,000	$37,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

METEOROLOGICAL SATELLITES

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 6-1 to 6-9)

Supporting research and technology	1962	1963	1964
Synchronous meteorological satellite			
Preprototype component development.....	---	---	$400,000
Systems studies.....	---	$300,000	50,000
Preprototype systems development.....	---	---	500,000
Total Synchronous meteorological satellite	---	$300,000	$950,000
Advanced meteorological sensor development			
Precipitation radar equipment.....	---	---	150,000
Day/night television development.....	---	280,000	500,000
Dielectric tape camera development.....	$400,000	350,000	1,500,000
Solar constant detector development.....	---	70,000	410,000
Development of radiation sensors and techniques...	400,000	250,000	490,000
Small meteorological sounding rocket sensor development.....	---	---	150,000
Total Advanced meteorological sensor development.....	$300,000	$950,000	$3,200,000

SEE RDO 6-4
VOL. II

	1962	1963	1964
Meteorological systems research			
Composition of atmospheric trace constituents.....	$200,000	---	---
Meteorological satellite data analysis and transmission.....	---	$150,000	$450,000
Advanced systems studies..	1,286,000	300,000	300,000
Studies of radiation characteristics of atmospheric gases.....	100,000	50,000	150,000
Meteorological satellite radiation studies.....	650,000	650,000	800,000
Analysis and interpretation of radiation data..	150,000	100,000	250,000
Data systems studies.....	250,000	200,000	500,000
Small meteorological sounding rocket system studies.....	---	200,000	---
Total Meteorological systems research.....	$ 2,636,000	$1,650,000	$2,450,000
Advanced meteorological system component development			
Control development.....	---	125,000	500,000
Video recorder development	---	200,000	250,000
Mechanical instrumentation development.....	---	500,000	950,000
Electronic component development.....	---	75,000	150,000
Electronic instrumentation development.....	---	700,000	1,600,000
Small meteorological sounding rocket component development.....	---	---	150,000
Total Advanced meteorological system component development.....	---	1,600,000	3,600,000
Total Supporting research and technology.....	$3,436,000	$4,500,000	$10,200,000

SEE RDO 6-4
VOL. II

	1962	1963	1964
Flight Program			
TIROS			
Spacecraft and subsystems.	$5,304,000	$5,500,000	$2,000,000
Data acquisition.....	330,000	4,100,000	1,600,000
Engineering utilization of data.....	1,041,000	1,400,000	1,300,000
Launch vehicles.....	---	10,200,000	2,300,000
Total TIROS	$ 6,675,000	$ 21,200,000	$ 7,200,000

SEE RDO 6-6
VOL. II

NIMBUS			
Spacecraft and subsystems			
Integration, structure and test.....	5,711,000	5,000,000	12,565,000
Power supply.....	1,223,000	2,100,000	2,850,000
Controls subsystem.....	3,826,000	5,900,000	6,500,000
PCM telemetry.....	1,264,000	750,000	850,000
Command clock.....	411,000	350,000	570,000
Camera subsystems.....	2,708,000	5,450,000	5,300,000
Radiometers.....	541,000	495,000	800,000
Tape recorders.....	508,000	195,000	270,000
Transmitters.....	35,000	90,000	425,000
Spectrometers.....	---	---	300,000
Scientific experiments..	---	---	525,000
Support			
Reliability program.....	224,000	200,000	---
Launch support.....	---	300,000	500,000
In-house support.....	130,000	410,000	95,000
Total Spacecraft and subsystems and Support	16,581,000	21,240,000	31,550,000
Data acquisition	---	2,450,000	4,050,000
Launch vehicles	7,300,000	6,600,000	8,200,000
Total NIMBUS	$23,881,000	$30,290,000	$43,800,000

SEE RDO 6-7
VOL. II

	1962	1963	1964
Meteorological sounding rocket systems			
Experiments, equipment and support for large rockets			
Rocket grenade experiments.	$150,000	$175,000	$250,000
Sodium vapor experiments...	---	175,000	250,000
Pitot static tube experiments.....	---	125,000	300,000
Field services and support.	291,000	315,000	640,000
Total Experiments, equipment and support for large rockets.....	$ 441,000	$ 790,000	$ 1,440,000
Large rockets	---	270,000	360,000
Small rocket systems	---	265,000	700,000
Total Meteorological sounding rocket systems.....	$ 441,000	$ 1,325,000	$ 2,500,000
Total Flight program...	$30,997,000	$52,815,000	$53,500,000
Total direct R&D costs.....	$34,433,000	$57,315,000	$63,700,000

SEE RDO 6-9
& 6-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

COMMUNICATIONS SATELLITES

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOLUME II, RDO 7-1 TO 7-10)

Supporting research and technology

	1962	1963	1964
Advanced synchronous satellite studies	$1,000,000	$5,000,000	---
High gain reflective structures	126,000	450,000	$ 200,000
Advanced passive satellite studies	4,113,000	2,750,000	1,200,000
Intermediate altitude satellite studies	---	2,000,000	2,000,000
Electronically steerable antennas	---	234,000	100,000
Isotope thermoelectric power supply studies	---	100,000	200,000
Technical and operational studies:			
Technological studies	551,000	480,000	350,000
Range and range rate systems	875,000	---	---
Directivity patterns for antennas and measurement of radio transmission losses due to scattering objects	534,000	---	---
Attitude stabilization techniques	162,000	---	---
Development of satellite materials and components	117,000	---	---
Earth pointing sensor	---	200,000	---
Wideband receiver studies	---	380,000	---
Simulation of communications satellite techniques	---	131,000	---
Economic implications of communications satellites	---	142,000	100,000
Technological and operational factors related to active and passive communications satellites	---	375,000	300,000
Modulation techniques	---	150,000	100,000
Materials development	---	100,000	100,000
Low noise spacecraft receiver	---	250,000	200,000
RF to RF conversion	---	234,000	150,000
Total Technical and operational studies	$2,239,000	$2,442,000	$1,300,000

SEE RDO 7-3 VOL. II

	1962	1963	1964
Total Supporting research and technology.....	$ 7,478,000	$12,976,000	$ 5,000,000
		See RDO 7-3 Volume II	

Flight Program

Echo(rigidized sphere)

Thor launch vehicle (one ballistic flight).....	1,000,000	---	---
Thor-Agena launch vehicle (one orbital flight).....	4,800,000	---	---
Sphere development and procurement.....	75,000	306,000	---
Canisters and spacecraft environmental tests.....	65,000	400,000	---
Beacons.....	163,000	245,000	---
Test, evaluation and documentation services.....	---	34,000	---
Data reduction and analysis..	---	450,000	200,000
	$ 6,103,000	$ 1,435,000	$ 200,000
		See RDO 7-5 Volume II	

Relay

Spacecraft.....	3,409,000	3,000,000	---
Ground station equipment.....	376,000	1,603,000	---
Radiation experiments.....	245,000	115,000	---
Ground station operations....	833,000	1,680,000	1,150,000
Command and control stations..	2,049,000	1,085,000	---
Coordination planning and documentation.....	---	1,210,000	350,000
Communications rentals.....	---	100,000	175,000
Data reduction and analysis..	---	275,000	225,000
Thor-Delta launch vehicles (two orbital flights and one backup).....	---	---	---
Total Relay.....	$ 6,912,000	$ 9,068,000	$ 1,900,000

See RDO 7-6
Volume II

	1962	1963	1964
Syncom			
Thor-Delta launch vehicles (two orbital flights and one backup).....	2,500,000	5,000,000	---
Apogee motor development(JPL)	475,000	250,000	
Backup traveling wave tube...	132,000	50,000	---
Spacecraft.....	6,668,000	3,445,000	500,000
Range and range rate equipment.....	1,571,000	785,000	410,000
Ground station support and environmental test.....	236,000	3,481,000	2,215,000
T&C stations.....	830,000	400,000	---
Communication rentals.....	---	330,000	---
Data reduction and analysis..	---	865,000	875,000
Total Syncom.....	$12,412,000	$14,606,000	$ 4,000,000
		See RDO 7-8 Volume II	
Advanced Synchronous Communications Satellites			
Atlas-Agena launch vehicles (three orbital flights and one backup).....	200,000	2,200,000	12,500,000
Spacecraft.....	---	2,330,000	16,640,000
Equipment for ground stations	---	1,100,000	4,960,000
Ground station operations....	---	---	1,000,000
Reliability studies.....	---	---	500,000
Switching circuit.....	---	---	300,000
Telemetry and command stations.....	---	---	600,000
Range and range rate equipment.....	---	---	2,000,000
Services and rentals.....	---	---	500,000
Data reduction and analysis..	---	---	1,000,000
Total Advanced Synchronous communication satellites	$ 200,000	$ 5,630,000	$40,000,000
Total Flight Program....	$25,627,000	$30,739,000	$46,100,000
Total direct research and development costs	$33,105,000	$43,715,000	$51,100,000
			SEE RDO 7-9 VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

ADVANCED APPLICATIONS SATELLITES

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 8-1 TO 8-2)

Supporting research and technology	1962	1963	1964
Future applications requirements studies	---	---	$ 100,000
Future applications feasibility and design studies	---	---	200,000
Navigation requirements studies	---	$ 25,000	25,000
Investigation of navigation techniques	---	125,000	100,000
Navigation receiver prototype procurement	---	200,000	300,000
Navigation computer development	---	345,000	75,000
Navigation time signal receiver development	---	---	100,000
Requirements study for data collection satellite	---	17,000	---
Feasibility and design study for data collection by satellite	---	88,000	100,000
Total direct R&D costs	---	$800,000	$1,000,000

SEE RDO 8-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

INDUSTRIAL APPLICATIONS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 9-1 TO 9-2)

Industrial applications	1962	1963	1964
Identification, documentation and dissemination.....	$300,000	$1,270,000	$1,900,000
Planning and evaluation.....	---	1,100,000	1,600,000
Total direct R&D costs.....	$300,000	$2,370,000	$3,500,000

SEE RDO 9-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

GEOPHYSICS AND ASTRONOMY

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOLUME II, PAGE RDO 10-1 TO 10-14)

Supporting research and technology	1962	1963	1964
Geophysics			
Planetary atmospheres	$ 1,110,700	$ 1,791,700	$ 1,900,000
Space chemistry	111,000	935,700	1,000,000
Meteorites/micrometeorites	367,300	744,800	800,000
Energetic particles	1,353,500	4,052,500	3,000,000
Magnetodynamics	85,000	909,500	900,000
Ionospheric/radio physics	587,200	1,726,800	1,600,000
Geodesy and celestial mechanics	---	---	300,000
Total Geophysics	$ 3,614,700	$ 10,161,000	$ 9,500,000
Solar physics	405,000	1,335,000	2,000,000
Astronomy			
Astronomy	391,100	1,293,400	2,800,000
Astrophysics	58,000	135,600	200,000
Total Astronomy	$ 449,100	$ 1,429,000	$ 3,000,000
Interdisciplinary space science	731,200	775,000	700,000
Total Supporting research and technology	$ 5,200,000	$ 13,700,000	$ 15,200,000

SEE RDO 10-4 VOLUME II

Flight projects			
Geophysics			
Explorers and monitors			
Energetic particles explorers			
Spacecraft	371,000	2,502,000	---
Experiments	289,600	959,000	150,000
Ground operations	---	672,800	625,000
Test and support	174,400	366,200	25,000
Total spacecraft and support	$ 835,000	4,500,000	800,000
Delta launch vehicles	---	6,000,000	---
Total Energetic particles explorers	$ 835,000	$ 10,500,000	$ 800,000
Interplanetary monitor			
Spacecraft	1,433,900	1,309,000	2,276,000
Experiments	400,500	454,000	1,164,000

Geophysics (Con't)	1962	1963	1964
Ground operations.....	$ ---	$ 425,000	$ 500,000
Test and support.....	31,600	112,000	160,000
Total Spacecraft and support.....	$ 1,866,000	$ 2,300,000	$ 4,100,000
Delta launch vehicles.....	---	2,700,000	7,300,000
Total Interplanetary monitor	$ 1,866,000	$ 5,000,000	$ 11,400,000
Atmosphere explorers and monitors			
Spacecraft.....	332,600	688,400	1,920,000
Experiments.....	135,000	500,000	800,000
Ground operations.....	208,800	195,300	300,000
Test and support.....	281,600	116,300	180,000
Total Spacecraft and support.....	$ 958,000	$ 1,500,000	$ 3,200,000
Delta launch vehicles.....	---	2,500,000	500,000
Total Atmosphere explorers and monitors.....	$ 958,000	$ 4,000,000	$ 3,700,000
Ionosphere explorers			
Spacecraft and experiments...	338,000	500,000	250,000
Ground operations.....	---	398,600	250,000
Test and support.....	186,000	101,400	200,000
Total Spacecraft and support.....	$ 524,000	$ 1,000,000	$ 700,000
Scout launch vehicle.....	---	---	1,000,000
Total Ionosphere explorers.....	$ 524,000	$ 1,000,000	$ 1,700,000
Ionosphere monitors			
Spacecraft.....	---	---	2,200,000
Experiments.....	---	---	500,000
Ground operations.....	---	---	150,000
Test and support.....	---	---	150,000
Total Spacecraft and support.....	---	---	$ 3,000,000
Total Ionosphere monitors.....	---	---	$ 3,000,000

Geophysics (Con't)

	1962	1963	1964
Electron density probe			
Experiments.....	$ 300,000	$ ---	$ ---
Total Spacecraft and support.....	$ 4,483,000	$ 9,300,000	$ 11,800,000
Launch vehicles.....	---	11,200,000	8,800,000
Total Explorers and monitors.....	$ 4,483,000	$ 20,500,000	$ 20,600,000
Orbiting geophysical observatories			
Spacecraft			
System development.....	14,252,400	14,444,200	13,689,000
Experiment integration.....	688,500	1,114,500	1,223,000
Total Spacecraft.....	$ 14,940,900	$ 15,558,700	$ 14,912,000
Experiments.....	$ 4,186,200	$ 7,138,400	$ 14,950,600
Ground operations			
Range and range rate stations	318,300	800,000	1,600,000
Data processing instrumentation.....	---	150,000	150,000
Telemetry equipment consoles.	---	1,280,000	940,000
Programmer and telemetry routines.....	54,000	690,000	120,000
Magnetic tapes and data reduction.....	---	442,000	5,283,000
Total Ground operations....	$ 372,300	$ 3,362,000	$ 8,093,000
Test and support			
Reliability control.....	95,000	140,000	50,000
Studies and analyses.....	650,600	461,200	386,700
Test and evaluation.....	168,200	672,700	1,020,700
Field support.....	---	115,000	130,000
General support.....	215,800	52,000	57,000
Total Test and support.....	$ 1,129,600	$ 1,440,900	$ 1,644,400
Total Spacecraft and support.....	$ 20,629,000	$ 27,500,000	$ 39,600,000

Geophysics (Con't)

	1962	1963	1964
Atlas-Agena launch vehicles..	$ 5,100,000	$ 5,500,000	$ 11,900,000
Thor-Agena launch vehicles...	---	5,500,000	10,300,000
Total Launch vehicles.....	$ 5,100,000	$ 11,000,000	$ 22,200,000
Total Orbiting geophysical observatories.....	$ 25,729,000	$ 38,500,000	$ 61,800,000
Geodesy			
Spacecraft and experiments...	---	---	2,500,000
Ground operations.....	---	---	700,000
Test and support.....	---	---	200,000
Total Spacecraft and support.....	---	---	3,400,000
Delta launch vehicles.....	---	---	2,800,000
Total Geodesy.....	$ ---	$ ---	$ 6,200,000
Total Geophysics.....	$ 30,212,000	$ 59,000,000	$ 88,600,000

SEE RDO 10-5
VOLUME II

Solar physics

Orbiting solar observatories			
Spacecraft.....	1,649,900	2,520,700	4,820,100
Experiments.....	1,128,700	3,732,100	4,706,000
Ground operations.....	---	100,000	318,000
Test and support.....	163,400	397,200	255,900
Total Spacecraft and support.....	$ 2,942,000	$ 6,750,000	$ 10,100,000
Delta launch vehicles.....	2,500,000	2,700,000	4,800,000
Total Orbiting solar observatories.....	$ 5,442,000	$ 9,450,000	$ 14,900,000
Advanced orbiting solar observatories			
Spacecraft.....	300,000	1,000,000	1,600,000
Experiments.....	---	800,000	800,000
Test and support.....	---	100,000	100,000
Total Spacecraft and support.....	$ 300,000	$ 1,900,000	$ 2,500,000
Total Advanced orbiting solar	$ 300,000	$ 1,900,000	$ 2,500,000

Solar physics (Con't)

	1962	1963	1964
Total Spacecraft and support	$ 3,242,000	$ 8,650,000	$ 12,600,000
Launch vehicles	2,500,000	2,700,000	4,800,000
Total Solar physics	$ 5,742,000	$ 11,350,000	$ 17,400,000

SEE RDO 10-9
VOLUME II

Astronomy

Orbiting astronomical observatories			
Spacecraft			
System development	29,106,400	25,800,000	27,300,000
Startracker backup	509,000	190,000	100,000
Total Spacecraft	$ 29,615,400	$ 25,990,000	$ 27,400,000
Experiments	$ 3,812,200	$ 4,000,000	$ 7,500,000
Ground operations			
Computer	238,000	---	---
Command receivers	60,100	---	---
Communications and data handling	122,000	160,000	280,000
Instruments for control system	5,000	75,000	25,000
Magnetic tapes	---	---	200,000
Total Ground operations	$ 425,100	$ 235,000	$ 505,000
Test and support			
Reliability control	---	25,000	200,000
Studies and analyses	188,300	495,000	405,000
Test and evaluation	528,000	935,000	640,000
Contractor ground support	---	---	1,000,000
General support	252,000	120,000	150,000
Total Test and support	$ 968,300	$ 1,575,000	$ 2,395,000
Total Spacecraft and support	$ 34,821,000	$ 31,800,000	$ 37,800,000
Atlas-Agena launch vehicles	3,400,000	4,300,000	15,100,000
Total Astronomy	$ 38,221,000	$ 36,100,000	$ 52,900,000

SEE RDO 10-11
VOLUME II

	1962	1963	1964
International satellites			
United Kingdom #1 (Ariel)			
Spacecraft	$ 945,400	$ ---	---
Experiments	---	193,800	---
Ground operations	---	296,200	---
Test and support	166,600	10,000	---
Total Spacecraft and support	$ 1,112,000	$ 500,000	---
Total United Kingdom #1	$ 1,112,000	$ 500,000	---
United Kingdom #2			
Spacecraft	1,220,000	1,120,000	300,000
Ground operations	---	41,000	---
Test and support	113,000	139,000	---
Total Spacecraft and support	$ 1,333,000	$ 1,300,000	$ 300,000
Scout launch vehicles	---	2,000,000	---
Total United Kingdom #2	$ 1,333,000	$ 3,300,000	$ 300,000
Alouette (Canada)			
Spacecraft and support	40,000	100,000	---
Thor-Agena launch vehicles	6,100,000	1,800,000	---
Total Alouette (Canada)	$ 6,140,000	$ 1,900,000	---
Polar ionosphere beacon			
Spacecraft and support	800,000	400,000	200,000
Scout launch vehicles	1,250,000	750,000	---
Total Polar ionosphere beacon	$ 2,050,000	$ 1,150,000	$ 200,000
Italian satellite			
Scout launch vehicles	$ ---	$ 6,000,000	$ 2,500,000
Follow-on international satellites			
Spacecraft and support	$ ---	$ ---	$ 1,000,000

International satellites (Con't)

	1962	1963	1964
Scout launch vehicles.....	$ ---	$ ---	$ 3,000,000
Total Follow-on international satellites.....	$ ---	$ ---	$ 4,000,000
Total Spacecraft and support.....	$ 3,285,000	$ 2,300,000	$ 1,500,000
Launch vehicles.....	7,350,000	10,550,000	5,500,000
Total International satellites.....	$ 10,635,000	$ 12,850,000	$ 7,000,000

SEE RDO 10-12
VOLUME II

Sounding rockets and geoprobes

Experiments			
Planetary atmospheres.....	1,057,500	1,250,000	1,400,000
Space chemistry.....	---	139,500	232,900
Energetic particles.....	194,800	146,000	223,300
Magnetodynamics.....	---	256,000	342,000
Ionospheric/radio physics....	1,207,900	1,212,500	1,361,400
Solar physics.....	199,200	337,600	377,600
Astronomy.....	441,000	418,300	468,100
Astrophysics.....	26,600	303,500	481,000
Geoprobe experiments.....	---	335,000	518,200
Total Experiments.....	$ 3,127,000	$ 4,398,400	$ 5,404,500
Rocket procurement.....	$ 1,845,000	$ 3,623,500	$ 3,756,000
Rocket development.....	$ 300,000	315,000	365,000
Engineering support.....	$ 1,609,000	$ 2,562,700	$ 2,873,000
Ground instrumentation.....	$ 884,000	$ 600,400	$ 901,500
Total Sounding rockets and geoprobes.....	$ 7,765,000	$ 11,500,000	$ 13,300,000
Total Geophysics and astronomy flight projects.....	$ 92,575,000	$130,800,000	$179,200,000
TOTAL direct R&D costs...	$ 97,775,000	$144,500,000	$194,400,000

SEE RDO 10-2
VOLUME II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

LUNAR AND PLANETARY PROGRAMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 11-1 TO 11-5)

Supporting research and technology	1962	1963	1964
Lunar			
Geodesy and photography	$ ---	$198,000	$200,000
Topographic mapping	---	190,000	200,000
Geology and geophysics studies	127,000	861,000	937,000
Studies of meteorite impact sites on earth	---	215,000	575,000
Surface simulations	47,000	342,000	275,000
Radio and radar studies of lunar surface	31,000	308,000	328,000
Development of scientific instrumentation for lunar landing	227,000	1,210,000	825,000
Systems analysis and preliminary design	300,000	109,000	---
Spacecraft propulsion systems	150,000	---	---
Spacecraft structures and configuration	300,000	50,000	---
Spacecraft power systems	100,000	50,000	---
Spacecraft guidance and control systems	150,000	75,000	---
Spacecraft telemetry and command	300,000	180,000	155,000
Spacecraft instrumentation and circuitry	726,000	40,000	---
Spacecraft integration and assembly	105,000	---	---
Test equipment and techniques	210,000	60,000	---
Advanced concepts	---	304,000	200,000
Supporting studies for current programs	---	312,000	200,000
Prospector study	100,000	---	---
Total Lunar	$2,873,000	$4,504,000	$3,895,000
Planetary and Interplanetary			
Geology and geophysics studies	$ ---	$203,000	$380,000
Ground-based astronomy	351,000	463,000	1,050,000
Balloon-based astronomy	100,000	860,000	500,000
Theoretical astronomy	---	753,000	625,000

See RDO 11-4
Volume II

Planetary and Interplanetary (Cont.)	1962	1963	1964
Radio and radar planetary studies..	$ 114,000	$ 637,000	$ 715,000
Radio and radar instrument development.....	---	952,000	500,000
Planetary atmospheres.....	184,000	1,380,000	1,196,000
Interplanetary particles and fields	364,000	1,872,000	2,050,000
Meteorites and tektites.....	221,000	1,157,000	1,090,000
Systems Analysis and preliminary design.....	1,000,000	531,000	100,000
Spacecraft propulsion systems.....	350,000	100,000	200,000
Spacecraft structures and configuration.....	600,000	130,000	210,000
Spacecraft power systems.....	400,000	80,000	200,000
Spacecraft guidance and control systems.....	550,000	365,000	500,000
Spacecraft telemetry and command...	1,000,000	1,480,000	2,000,000
Spacecraft instrumentation and circuitry.....	1,774,000	280,000	225,000
Spacecraft integration and assembly	242,000	30,000	---
Capsule technology.....	---	284,000	460,000
Sterilization.....	---	901,000	1,309,000
Test equipment and techniques.....	290,000	300,000	300,000
Reliability.....	100,000	430,000	295,000
Advanced concepts.....	---	1,288,000	900,000
Supporting studies for current programs.....	---	563,000	400,000
Voyager study.....	330,000	701,000	900,000
Total Planetary and Interplanetary	$ 7,970,000	$15,740,000	$16,105,000
Total SR&T	$10,843,000	$20,244,000	$20,000,000

Flight projects

SEE RDO 11-4
VOL. II

Ranger

Project management.....	369,000	307,000	270,000
Systems analysis	3,400,000	5,838,000	5,750,000
Lunar capsule contract.....	4,787,000	2,372,000	10,500,000
Impact TV systems contract.....	7,200,000	9,950,000	3,300,000
Scientific experiments.....	2,834,000	3,480,000	3,940,000
Telecommunications.....	3,634,000	6,140,000	6,390,000
Guidance and control.....	3,805,000	6,035,000	7,670,000
Spacecraft structures.....	2,782,000	3,659,000	3,420,000
Spacecraft propulsion systems.....	345,000	394,000	390,000
Engineering support.....	3,374,000	5,247,000	4,800,000
Space flight operations facility equipment.....	---	748,000	1,870,000
Total Spacecraft	$32,530,000	$44,170,000	$48,300,000
Atlas-Agena launch vehicles	30,900,000	34,800,000	41,700,000
Total Ranger	$63,430,000	$78,970,000	$90,000,000

SEE RDO 11-6
VOL. II

Surveyor lander	1962	1963	1964
Project management.....	$ 379,000	$ 477,000	$ 200,000
Systems analysis.....	1,077,000	667,000	740,000
Spacecraft development contract..	28,317,000	38,573,000	26,000,000
Scientific experiments.....	4,972,000	4,624,000	6,500,000
Telecommunications.....	91,000	105,000	85,000
Guidance and control.....	70,000	29,000	25,000
Spacecraft structures.....	122,000	156,000	75,000
Spacecraft propulsion systems....	69,000	68,000	50,000
Engineering support.....	532,000	818,000	825,000
Space flight operations facility equipment.....	---	2,779,000	3,000,000
Total Lander spacecraft	$35,629,000	$48,296,000	$37,500,000
Atlas-Centaur launch vehicle	2,309,000	11,700,000	31,800,000
Total Surveyor lander.....	$37,938,000	$59,996,000	$69,300,000

SEE RDO 11-8
VOL. II

Surveyor orbiter			
Project management.....	---	---	500,000
Spacecraft development contract..	---	363,000	13,500,000
Scientific experiments.....	1,196,000	1,337,000	2,000,000
Visual instrumentation subsystem.....	---	---	2,000,000
Total Surveyor orbiter	$ 1,196,000	$ 1,700,000	$18,000,000
Atlas-Centaur launch vehicle	---	---	10,200,000
Total Surveyor orbiter	$ 1,196,000	$ 1,700,000	$28,200,000
Total Surveyor lander and orbiter.....	$39,134,000	$61,696,000	$97,500,000

SEE RDO 11-8
VOL. II

Mariner

Mariner A

Project management.....	33,000	---	---
Systems analysis.....	81,000	---	---
Scientific experiments.....	2,125,000	---	---
Telecommunications.....	1,903,000	---	---
Guidance and control.....	591,000	---	---
Spacecraft structures.....	301,000	---	---
Spacecraft propulsion systems....	55,000	---	---
Engineering support.....	637,000	---	---
Total Mariner A	$ 5,726,000	---	---

SEE RDO 11-10
VOL. II

Venus fly-by	1962	1963	1964
Project management.....	$ 179,000	$ 78,000	---
Systems analysis.....	2,041,000	1,255,000	---
Scientific experiments.....	1,591,000	1,265,000	---
Telecommunications.....	2,203,000	1,464,000	---
Guidance and control.....	2,549,000	1,787,000	---
Spacecraft structures.....	1,979,000	1,410,000	---
Spacecraft propulsion systems	76,000	109,000	---
Engineering support.....	2,608,000	1,728,000	---
Total Venus fly-by spacecraft	$13,226,000	$ 9,096,000	---
Atlas-Agena launch vehicle...	17,000,000	---	---
Total Venus fly-by.....	$30,226,000	$ 9,096,000	---
Mars fly-by			
Project management.....	---	194,000	$ 628,000
Systems analysis.....	---	1,458,000	4,495,000
Scientific experiments.....	---	3,402,000	3,883,000
Telecommunications.....	---	5,003,000	6,280,000
Guidance and control.....	---	5,452,000	5,966,000
Spacecraft structures.....	---	4,174,000	4,810,000
Spacecraft propulsion systems	---	486,000	314,000
Engineering support.....	---	4,131,000	5,024,000
Total fly-by spacecraft....	---	$24,300,000	$ 31,400,000
Atlas-Agena launch vehicle...	---	5,100,000	15,600,000
Total Mars fly-by.....	---	$29,400,000	$ 47,000,000
Venus/Mars lander			
Project management.....	---	50,000	600,000
Systems analysis.....	$ 729,000	$ 4,745,000	$ 4,441,000
Scientific experiments.....	3,058,000	3,810,000	6,806,000
Telecommunications.....	2,256,000	2,059,000	9,042,000
Guidance and control.....	3,587,000	2,376,000	8,354,000
Spacecraft structures.....	2,062,000	1,786,000	6,037,000
Spacecraft propulsion systems	194,000	361,000	1,903,000
Engineering support.....	539,000	3,086,000	6,017,000
Space flight operations facility equipment.....	---	---	200,000
Total lander spacecraft....	$12,425,000	$18,273,000	$ 43,400,000
Atlas Centaur launch vehicle.	---	---	9,700,000
Total Venus/Mars lander....	$12,425,000	$18,273,000	$ 53,100,000
Total Mariner.....	$48,377,000	$56,769,000	$100,100,000

SEE RDO 11-10 and 11
VOL. II

Pioneer	1962	1963	1964
Project management....	$ ---	$ 85,000	$ 200,000
System analysis.....	---	280,000	1,400,000
Scientific experiments	---	350,000	1,300,000
Telecommunications....	---	805,000	2,000,000
Guidance and control..	---	825,000	1,900,000
Spacecraft structures.	---	700,000	1,600,000
Engineering support...	---	455,000	1,600,000
Total Pioneer	---	$ 3,500,000	$ 10,000,000
Thor-Delta launch vehicle	---	---	5,000,000
Total Pioneer	---	$ 3,500,000	$ 15,000,000
			SEE RDO 11-14 VOL. II
Total direct R&D costs.....	$161,784,000	$221,179,000	$322,600,000

SEE RDO 11-2
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

BIOSCIENCE

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II PAGES RDO 12-1 TO 12-5)

Supporting research and technology	1962	1963	1964
Effects of the space environment on behavior	$ ---	$ 217,000	$ 248,000
Neurological and biochemical bases of behavior	---	562,000	650,000
Biological information, control and communication systems	---	852,000	825,000
Experimental analysis of behavior	---	369,000	328,000
Development of experiments for studies of space flight environmental effects on organisms	---	310,000	423,000
Ground studies of space flight environmental effects on organisms	123,000	1,973,000	1,806,000
Biological analysis of terrestial environmental extremes	---	192,000	148,000
Effects of simulated extraterrestrial environments on earth organisms	89,000	369,000	425,000
Studies of biological materials and systems for use in space	74,000	244,000	258,000
Evolutionary and theoretical biology	1,012,000	2,098,000	2,010,000
Instrumentation for detection of extraterrestrial life and life-related compounds	344,000	1,448,000	1,430,000
Spectroscopic studies of planetary atmospheres and surfaces	771,000	275,000	940,000
Extraterrestrial sample collection and analysis	376,000	720,000	670,000
Sterilization of spacecraft	126,000	421,000	639,000
Total Supporting research and technology	$2,915,000	$ 10,050,000	$10,800,000

SEE RDO 12-2
VOL. II

Flight program

	1962	1963	1964
Biosatellite			
BIOS I sounding rocket probe.....	$ 133,000	---	---
Spacecraft development contract.....	---	$ 6,250,000	$ 7,700,000
Scientific experiments.....	---	2,000,000	3,000,000
Recovery operations.....	---	500,000	1,000,000
Total spacecraft.....	$ 133,000	$ 8,750,000	$ 11,700,000
Launch vehicles.....	---	2,200,000	12,700,000
Total flight program.....	$ 133,000	$ 10,950,000	$ 24,400,000
Total direct R&D costs...	$3,048,000	$21,000,000	$35,200,000

SEE RDO-12-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

LAUNCH VEHICLE DEVELOPMENT

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II PAGE RDO 13-1 AND 13-7)

Supporting research and technology	1962	1963	1964
Vehicle system studies.....	---	$ 2,000,000	
Solid state technology research and testing.....	---	---	500,000
Propulsion feed system analysis	---	---	500,000
Vehicle operational analysis...	---	---	500,000
Guidance system analysis.....	---	---	1,300,000
Thrust chamber dynamics.....	---	---	1,000,000
Liquid kick standard stages....	---	---	1,000,000
Launch procedures criteria.....	---	--	200,000
Total Supporting research and technology.....	---	$ 2,000,000	$5,000,000
		SEE RDO-13-2 VOL. II	
Scout development.....	$ 4,700,000	4,200,000	---
Delta development.....	5,255,000	---	---
		SEE RDO-13-7 VOL. II	
Centaur development			
Vehicle development			
Design, test and fabrication of Centaur stage.....	48,010,000	82,317,000	93,618,000
Engines for Centaur stage (engine development)			
RL-10A-3 development.....	15,395,000	570,000	---
Engine procurement.....	3,616,000	2,159,000	570,000
Engine product improvements	---	---	4,500,000
Total engines for Centaur stage.....	$19,011,000	$ 2,729,000	$ 5,070,000
		SEE RDO-13-3 VOL. II	

	1962	1963	1963
Support services			
NASA field center support.....	$ 800,000	$ 910,000	$ 540,000
DOD support.....	722,000	475,000	475,000
Contractor support.....	5,248,000	6,469,000	10,997,000
Total support services.....	$ 6,770,000	$ 7,854,000	$ 12,012,000
Total Centaur development.	$73,791,000	$ 92,900,000	$110,700,000

SEE RDO-13-3
VOL. II

Operational support			
Product improvement and production test			
Scout			
Improvement to X-258	---	---	500,000
Improvement to X-259	---	---	800,000
Total Scout.....	---	---	$ 1,300,000
Delta			
3rd Stage destruct system.....	---	100,000	150,000
X-258 motor adaption.....	---	250,000	50,000
Explosive bolts.....	---	100,000	150,000
Fairing extension to vehicle..	---	50,000	250,000
Ignition system rework.....	---	---	200,000
3rd stage telemetry.....	---	---	300,000
Total Delta.....	---	$ 500,000	$ 1,100,000
Agena			
Improvements to Atlas, Thor and Agena.....	---	---	4,700,000
Minor construction improvements to launch pad	---		500,000
Standard shroud for various spacecraft missions.....	---	1,000,000	1,500,000
Total Agena.....	---	$ 1,000,000	$ 6,700,000

SEE RDO-13-5
VOL.II

	1962	1963	1964
Centaur			
LOX recirculation improvements	---	---	$ 200,000
Guidance repackaging	---	---	500,000
Fiberglass H_e bottles	---	---	100,000
P&W instrumentation repackage	---	---	20,000
Alternate inertial components	---	---	980,000
Combined system test stand	---	$ 6,200,000	---
Total Centaur	---	$ 6,200,000	$ 1,800,000
Total Product improvement and production test	---	$ 7,700,000	$ 10,900,000

SEE RDO-13-5
VOL. II

Maintenance of ground support equipment			
Scout			
Support equipment and replacements to allow for upkeep of (3) installations	---	---	$ 1,000,000
Delta			
Refurbishing and support of (2) launch facilities	---	$ 1,000,000	$ 600,000
Agena			
Catastrophic spares	1,915,000	200,000	250,000
AGE support	---	---	250,000
Total Agena	$ 1,915,000	$ 200,000	$ 500,000
Total Maintenance of ground support equipment	$ 1,915,000	$ 1,200,000	$ 2,100,000
System engineering			
Scout			
Engineering support and system analysis	---	---	1,100,000

SEE RDO-13-1
VOL. II

	1962	1963	1964
Delta			
Engineering support and system analysis.....	---	---	$ 900,000
Total System engineering....	---	---	$ 2,000,000
Total, Operational support	$ 1,915,000	$ 8,900,000	$ 15,000,000
Total direct R&D costs..	$85,661,000	$108,000,000	$130,700,000

SEE RDO-13-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

FACILITY, TRAINING, AND RESEARCH GRANTS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 14-1 TO 14-9)

	1962	1963	1964
Facilities grants			
California, University of (Berkeley)	$1,990,000	---	---
Chicago, University of	1,775,000	---	---
Iowa, State University of	610,000	---	---
Rensselaer Poly. Institute	1,500,000	---	---
Stanford University	535,000	---	---
Under Consideration	190,000	---	---
Negotiations in process with 8 universities	---	$10,000,000	---
Approximately 11 additional university research facilities	---	---	$18,000,000
Total facilities grants	$6,600,000	$10,000,000	$18,000,000
Training grants			
Alabama, University of	---	192,000	---
Arizona State University	---	79,200	---
Arizona, University of	---	177,000	---
Arkansas, University of	---	144,000	---
Auburn University	---	147,600	---
Brooklyn, Polytechnic Inst. of	---	216,000	---
California Institute of Technology	---	268,900	---
California, University of, Los Angeles, California	132,000	128,700	---
Carnegie Institute of Technology	---	169,500	---
Case Institute of Technology	---	203,700	---
Catholic University	---	165,900	---
Chicago, University of	222,000	333,000	---
Cincinnati, University of	---	141,100	---
Clemson College	---	75,600	---
Colorado, University of	---	176,600	---
Colorado State University	---	91,800	---

SEE RDO 14-1
VOL. II

Training grants (cont'd)	1962	1963	1964
Columbia University	$106,100	$228,000	---
Connecticut, University of	---	106,900	---
Cornell University	---	177,000	---
Delaware, University of	---	109,600	---
Denver, University of	---	100,800	---
Duke University	---	177,000	---
Florida State University	---	131,200	---
Florida, University of	---	177,000	---
George Washington University	---	109,800	---
Georgia Institute of Technology	192,000	230,400	---
Houston, University of	---	177,000	---
Illinois Institute of Technology	---	188,700	---
Illinois, University of	---	212,400	---
Indiana University	---	143,100	---
Iowa, State University of	169,500	175,500	---
Iowa State University	---	171,000	---
Johns Hopkins University	---	156,000	---
Kansas State University	---	142,200	---
Kansas, University of	---	143,300	---
Kent State University	---	25,500	---
Lehigh University	---	153,600	---
Louisiana State University	---	131,500	---
Maryland, University of	192,000	192,000	---
Massachusetts Institute of Technology	---	310,500	---
Michigan State University	---	144,000	---
Michigan University of	177,000	265,500	---
Minnesota, University of	192,000	288,000	---
Missouri, University of	---	152,900	---
Missouri School of Mines and Metal	---	76,400	---
Nevada, University of	---	40,600	---
New Mexico, University of	---	113,900	---
New York University	---	220,600	---
North Carolina, University of	---	132,000	---
North Carolina State College	---	142,000	---
Northeastern University	---	50,900	---
Northwestern University	---	187,200	---
Notre Dame, University of	---	153,600	---
Ohio State University	---	112,000	---
Oklahoma State University	---	120,000	---
Oklahoma, University of	---	177,000	---
Oregon State University	---	149,400	---
Pennsylvania State University	---	177,000	---
Pennsylvania, University of	---	192,000	---
Pittsburgh, University of	---	180,000	---
Princeton University	---	230,400	---
Purdue University	---	223,200	---

SEE RDO 14-1
VOL. II

Training grants (cont'd)	1962	1963	1964
Rennsselaer Polytechnic Inst.....	$177,000	$192,000	---
Rhode Island, University of.....	---	70,800	---
Rice University.....	192,000	192,000	---
Rochester, University of.....	---	183,000	---
Saint Louis University.....	---	140,400	---
Southern California, University of....	---	152,400	---
Stanford University.....	---	230,800	---
Stevens Institute of Technology.....	---	108,000	---
Syracuse University Research Inst.....	---	141,600	---
Tennessee, University of.....	---	141,600	---
Texas, Agricultural and Mechanical College.....	220,400	192,000	---
Texas Technological College.....	---	101,600	---
Texas, University of.....	---	132,000	---
Tulane University.....	---	158,400	---
Utah State University.....	---	56,000	---
Utah, University of.....	---	141,600	---
Vanderbilt University.....	---	153,600	---
Vermont, University of.....	---	48,700	---
Virginia Polytechnic Institute.....	---	177,000	---
Virginia, University of.....	---	153,400	---
Washington University (St. Louis).....	---	154,800	---
Washington, University of.....	---	150,200	---
West Virginia University.....	---	143,100	---
Western Reserve University.....	---	141,600	---
Wisconsin, University of.....	---	183,000	---
Yale University.....	---	205,500	---
American Mathematical Society.....	---	50,000	---
Columbia University.....	---	64,400	---
Final selection of grantees pending...	---	931,300	---
Approximately 1,250 pre-doctoral trainees in space-related fields at about 110 universities.....	---	---	$25,000,000
Total training grants.....	$1,972,000	$15,000,000	$25,000,000

Research grants			
A. A. A. S.....	181,000	---	---
California, University of (Berkeley).....	500,000	$250,000	---
California, University of (Los Angeles).....	500,000	500,000	---
Columbia University.....	100,000	---	---
Denver Research Institute.....	56,745	---	---

SEE RDO 14-1
VOL. II

Research grants (cont'd)	1962	1963	1964
Grad. Research Center of the S. W.....	$923,000	$500,000	---
Kansas, University of.....	100,000	50,000	---
M. I. T.....	113,566	1,300,000	---
Midwest Research Institute.....	345,972	---	---
Mississippi State University.....	92,615	---	---
National Academy of Sciences.....	154,000	---	---
National Science Foundation.....	40,000	---	---
Ohio State University.....	58,781	---	---
Oklahoma State University.....	10,800	---	---
Pennsylvania, University of.....	250,000	75,000	---
S. W. Research Institute.....	55,432	---	---
Technical Operations, Inc.....	70,000	---	---
Texas A & M.....	100,000	50,000	---
Wisconsin, University of.....	700,000	400,000	---
Adelphi College.....	---	160,000	---
Alabama, University of.....	---	600,000	---
Cornell University.....	---	200,000	---
CUCOSS.....	---	60,000	---
Maine, University of.....	---	61,250	---
Maryland, University of.....	---	700,000	---
New York University.....	---	33,450	---
Pittsburgh, University of.....	---	500,000	---
Rice University.....	---	50,000	---
Xavier University.....	---	7,000	---
Under consideration.....	37,089	103,300	---
New research projects (approx. $8M) and continuation of those started in FY 1962 and 1963 (approx. $4M)...	---	---	$12,000,000
Total research grants.....	$4,389,000	$5,600,000	$12,000,000
Total direct R&D costs.....	$12,961,000	$30,600,000	$55,000,000

SEE RDO 14-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

SPACE VEHICLE SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 15-1 TO 15-17)

Supporting research and technology	1962	1963	1964
Advanced concepts			
Mission analysis and operations....	$930,000	$1,345,000	$2,650,000
Spacecraft concepts.....	550,000	1,005,000	920,000
Launch vehicle concepts.....	---	75,000	550,000
Total advanced concepts.....	$1,480,000	$2,425,000	$4,120,000
Spacecraft aerothermodynamics			
Atmospheric entry heating and heat transfer.....	490,000	714,000	1,200,000
Configuration aerodynamics, performance, stability and control.....	2,650,000	3,269,000	3,550,000
Landing and recovery.....	430,000	847,000	1,100,000
Total spacecraft aerothermodynamics.....	$3,570,000	$4,830,000	$5,850,000
Spacecraft loads and structures			
Advanced structures and structural materials application.....	390,000	1,395,000	1,720,000
Structures for space hazards control.....	120,000	416,000	830,000
High-temperature structures.....	745,000	1,362,000	1,550,000
Structural loads.....	125,000	174,000	300,000
Structural dynamics.....	190,000	658,000	1,070,000
Structural mechanics.....	100,000	278,000	574,000
Structural fabrication techniques..	---	100,000	100,000
Total spacecraft loads and structures.....	$1,670,000	$4,383,000	$6,144,000

SEE RDO 15-4
VOL. II

	1962	1963	1964
Space vehicle environmental factors			
High-energy radiation effects and shielding	$780,000	$1,754,000	$3,160,000
Meteoroid environment and impact hazard	690,000	1,238,000	2,820,000
Zero-gravity fluid behavior	120,000	130,000	350,000
High-vacuum technology	423,000	789,000	1,380,000
Thermal radiation effects and temperature control	460,000	1,144,000	1,850,000
Total space vehicle environmental factors	$2,473,000	$5,055,000	$9,560,000
Launch vehicle aerothermodynamics			
Aerodynamic forces, steady loads, stability and control	780,000	1,373,000	1,625,000
Vehicle and base heating	580,000	1,754,000	2,075,000
Launch vehicle recovery	---	150,000	190,000
Acoustic noise propagation	190,000	313,000	550,000
Total launch vehicle aerothermodynamics	$1,550,000	$3,590,000	$4,440,000
Launch vehicle loads and structures			
Advanced structures and structural materials application	410,000	995,000	1,330,000
Structures for space hazards control	110,000	210,000	440,000
High-temperature structures	107,000	307,000	402,000
Structural loads	220,000	555,000	900,000
Structural dynamics	620,000	1,323,000	1,100,000
Structural mechanics	410,000	1,004,000	1,476,000
Structural fabrication techniques	---	100,000	500,000
Total launch vehicle loads and structures	$1,877,000	$4,494,000	$6,148,000
Space vehicle design criteria	---	500,000	1,500,000
Total supporting research and technology	$12,620,000	$25,277,000	$37,762,000

Flight projects	1962	1963	1964
Scout reentry heating			
Spacecraft and support services....	$(815,000)	$400,000	$500,000
Launch vehicle.....	3,000,000	1,000,000	1,000,000
Total scout reentry heating.....	$3,000,000	$1,400,000	$1,500,000
FIRE			
Reentry vehicle and support services.....	1,346,000	5,500,000	3,400,000
Terminal velocity vehicle.....	223,000	2,500,000	600,000
Launch vehicle.....	2,400,000	4,000,000	---
Total FIRE.....	$3,969,000	$12,000,000	$4,000,000
Advanced FIRE			
Spacecraft and support services....	---	---	5,600,000
Velocity package.....	---	---	1,200,000
Launch vehicle.....	---	---	1,700,000
Total Advanced FIRE.....	---	---	$8,500,000
Scout launched meteoroid satellites			
Spacecraft and support services....	78,000	1,620,000	450,000
Launch vehicle.....	800,000	1,500,000	500,000
Total scout launched meteoroid satellites.....	$878,000	$3,120,000	$950,000
Saturn launched meteoroid experiments			
Spacecraft and support.....	---	2,430,000	4,250,000
			SEE RDO 15-10 through 14 VOL. II
Space vehicle recovery			
Flight vehicles and support services	---	---	950,000
			SEE RDO 15-15 through 17 VOL. II

	1962	1963	1964
Secondary environmental experiments			
Experiments and support services....	---	---	$550,000
Small space vehicle flight experiments			
Behavior and handling of cryogenic propellants at zero g.....	---	$ 800,000	1,650,000
Wind shear measurements.....	---	114,000	600,000
Meteor simulation.....	---	600,000	600,000
Trailblazer reentry project.....	---	100,000	200,000
Meteoroid penetration probe.....	$ 295,000	90,000	450,000
Total small space vehicle flight experiments.....	$295,000	$1,704,000	$3,500,000
Total flight projects.....	$8,142,000	$20,654,000	$24,200,000
Total direct R&D costs.....	$20,762,000	$45,931,000	$61,962,000

SEE RDO 15-15
THROUGH 17
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

ELECTRONICS SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 16-1 TO 16-13)

Supporting research and technology	1962	1963	1964
Guidance systems			
Inertial sensors and systems.....	$543,000	$1,390,000	$1,815,000
Passive electromagnetic sensors and systems.....	---	610,000	1,137,000
Active electromagnetic devices and systems.....	75,000	680,000	875,000
Computers and displays.....	---	605,000	855,000
System and trajectory analysis...	282,000	1,305,000	1,138,000
Total Guidance systems.....	$900,000	$4,590,000	$5,820,000
Control systems			
Manned flight control systems....	---	1,214,000	735,000
Flight displays.....	---	661,000	735,000
Automatic flight control systems.	831,000	843,000	1,120,000
Advanced control theory.....	59,000	400,000	588,000
Advanced components technology...	135,000	409,000	550,000
Simulator technology.....	---	---	1,200,000
Total Control systems.....	$1,025,000	$3,527,000	$4,928,000
Communication systems			
Information theory.....	39,000	460,000	175,000
Communication techniques and components.....	907,000	2,295,000	2,953,000
Advanced electric devices.....	274,000	1,197,000	1,457,000
Total Communication systems..	$1,220,000	$3,952,000	$4,585,000
Tracking and data acquisition systems			
Information theory.....	31,000	190,000	200,000
Tracking and data acquisition techniques and components.....	393,000	1,285,000	2,222,000
Advanced electronic devices.....	116,000	455,000	1,066,000
Total Tracking and data acquisition systems.....	$540,000	$1,930,000	$3,488,000

SEE RDO 16-3
VOL. II

	1962	1963	1964
Instrumentation			
Astrophysical instrumentation.	$ 626,000	$ 1,035,000	$ 1,803,000
Bio-medical instrumentation...	---	513,000	530,000
Flight engineering instrumentation.....	32,000	1,121,000	1,919,000
Total Instrumentation.....	$ 658,000	$ 2,669,000	$ 4,252,000
Data handling and processing			
Flight readiness and launch systems.....	21,000	220,000	561,000
Data processing systems.....	505,000	1,238,000	1,658,000
Advanced computing devices....	64,000	720,000	1,320,000
Total Data handling and processing.....	$ 590,000	$ 2,178,000	$ 3,539,000
Total Supporting research and technology.....	$4.933.000	$18,846,000	$26.612.000
Small flight projects			
Radio attenuation measurements (RAM).....	(1,635,000)	1,750,000	2,000,000
Scanner.....	---	---	1,750,000
Spacecraft orientation control system.....	---	100,000	---
Total Small flight projects.	($1,635,000)	$ 1,850,000	$ 3,750,000
Total direct R&D costs....	$4,933,000	$20,696,000	$30,362,000

SEE RDO-16-11
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

HUMAN FACTOR SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 17-1 to 17-7)

	1962	1963	1964
Supporting research and technology			
Advanced concepts			
Systems analyses.....	---	$ 640,000	$ 425,000
Human analogs.....	---	---	250,000
Bionics.....	---	---	225,000
Total Advanced concepts..	---	$ 640,000	$ 900,000
Human research and performance			
Body systems.....	$ 200,000	240,000	650,000
Environmental physiology...	1,500,000	1,737,000	2,090,000
Biomedicine and personnel selection.....	84,000	110,000	675,000
Psycho-physiology and behavioral sciences.....	200,000	330,000	1,075,000
Habitability.....	---	40,000	410,000
Total Human research and performance.....	$ 1,984,000	$ 2,457,000	$ 4,900,000
Man system integration			
Systems research.....	---	1,060,000	1,000,000
Personnel subsystems.....	---	586,000	1,450,000
Simulation, test and evaluation.....	---	699,000	3,150,000
Total Man system integration.....	---	$ 2,345,000	$ 5,600,000
Life support and protective systems			
Environmental & atmospheric control.....	---	1,787,000	2,330,000
Food and water control.....	---	40,000	330,000
Hygienic and sanitation control.....	---	586,000	390,000
Anthropometric and non-anthropometric suits.....	---	831,000	925,000
Repair facilities.....	---	70,000	175,000
Bioengineering.....	---	969,000	2,205,000
Personal equipment.....	---	220,000	445,000
Total Life support and protective systems.....	---	$4,503,000	$ 6,800,000

SEE RDO 17-4
VOL. II

	1962	1963	1964
Total Supporting research and technology....	$1,984,000	$ 9,945,000	$18,200,000
Projects.....	$ 420,000	$ 115,000	---
Total direct R&D costs.....	$2,404,000	$10,060,000	$18,200,000

SEE RDC-17-4
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

NUCLEAR-ELECTRIC SYSTEMS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 18-1 TO 18-21)

Supporting research and technology	1962	1963	1964
Nuclear-electric power			
Basic properties			
Alkali metal heat transfer.....	$ 300,000	$ 1,120,000	$ 1,100,000
Engineering and transport properties.....	227,000	300,000	470,000
Thermionic physics.....	---	250,000	300,000
Total Basic properties.....	$527,000	$1,670,000	$1,870,000
System components			
Turbines, pumps, separators....	90,000	2,850,000	2,900,000
Bearings and seals.....	---	325,000	600,000
Radiator, boiler and condenser	152,000	580,000	950,000
Alternators, power conditioning switchgear.....	---	605,000	750,000
Thermionic diodes.....	148,000	430,000	500,000
Total System components.....	$ 390,000	$ 4,790,000	$ 5,700,000
Materials and environmental effects			
Corrosion.....	572,000	950,000	900,000
Welding, creep testing, cavitation damage.....	---	650,000	797,000
Alloy development.....	100,000	215,000	490,000
Electrode properties, seals, insulators, conductors.....	---	300,000	1,500,000
Meteoroid impact emissivity....	309,000	313,000	275,000
Total Materials and environmental effects.....	$ 981,000	$ 2,428,000	$ 3,962,000
Advance concepts and system studies.....	$1,802,000	$ 1,203,000	$ 1,000,000

SEE RDO-18-3
VOL. II

	1962	1963	1964
Subsystem evaluation.....	---	---	$ 600,000
Electric propulsion			
Electrostatic propulsion			
Ion generation.....	$ 640,000	$ 633,000	450,000
Ion beam diagnostics.....	507,000	380,000	300,000
Propellant storage and feed systems.....	222,000	100,000	200,000
Advanced systems.....	862,000	720,000	950,000
Total Electrostatic propulsion.....	$ 2,231,000	$ 1,833,000	$ 1,900,000
Electrothermal propulsion			
Cryogenic propellant storage and feed.....	175,000	146,000	100,000
AC arc stability.....	140,000	300,000	---
Thermal and kinetic energy analysis.....	558,000	87,000	100,000
Bi-propellant arc jet.....	40,000	70,000	100,000
Advance systems.....	---	---	200,000
Total Electrothermal propulsion.....	$ 913,000	603,000	$ 500,000
Electromagnetic propulsion			
Pulsed thrustors.....	647,000	467,000	750,000
Steady state thrustors.....	---	255,000	500,000
Plasma diagnostics.....	---	252,000	250,000
Fluid dynamics research.....	719,000	740,000	886,000
Total Electromagnetic propulsion.....	$1,366,000	$ 1,714,000	$ 2,386,000
Mission analysis.....	---	383,000	400,000
Component technology			
Power conditioning.....	---	---	800,000
Radiation shielding.....	---	---	200,000
System integration.....	---	439,000	500,000
Power supply.....	---	---	200,000
Total Component technology.	---	$ 439,000	$ 1,700,000
Total supporting research and technology.....	$8,210,000	$15,068,000	$20,018,000

Development and flight projects

	1962	1963	1964
SNAP-8 development	$ 6,103,000	$15,100,000	$15,000,000
SNAP-8 flight evaluation			
Spacecraft design development.	---	518,000	5,500,000
Supporting research and development.....	---	200,000	1,000,000
Ground and launch support.....	---	125,000	2,000,000
Thor launch vehicles.....	---	---	500,000
Total SNAP-8 flight evaluation.....	---	$ 843,000	$ 9,000,000
Small nuclear electric propulsion and power flight-project MECCA	---	$ 1,850,000	$ 1,400,000
Electric engine development projects			
Large ion engines.....	1,975,000	3,800,000	6,000,000
Large arc jet engines.....	600,000	500,000	500,000
Small arc and ion engines.....	---	1,200,000	1,500,000
Total Electric engine development projects.....	$ 2,575,000	$ 5,500,000	$ 8,000,000
Space electric rocket test (SERT)			
Spacecraft design, development and support.....	2,070,000	4,570,000	8,650,000
Launch vehicles.....	1,500,000	600,000	6,700,000
Total SERT.....	$ 3,570,000	$ 5,170,00	$15,350,000
Total Development and flight projects.....	$12,248,000	$28,463,000	$48,750,000
Total direct R&D costs..	$20,458,000	$43,531,000	$68,768,000

SEE RDO 18-11, 18-13, 18-15, 18-16, 18-19 VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

NUCLEAR ROCKETS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 19-1 to 19-18)

	1962	1963	1964
Supporting research and technology			
Rocket reactor research			
Materials development.....	---	$785,000	$1,000,000
Conceptual studies and design analysis.....	---	415,000	850,000
Neutronics design and development.....	---	82,000	100,000
Shielding development.....	---	23,000	50,000
Reactor test support.....	$900,000	5,300,000	5,300,000
Propellants.....	---	940,000	1,700,000
Fundamental reactor research	154,000	515,000	1,187,000
Total Rocket reactor research.....	$ 1,054,000	$ 8,060,000	$ 10,187,000
Nuclear rocket engine systems			
Flow components.....	---	1,020,000	2,900,000
Turbomachinery.....	---	104,000	800,000
Controls and instrumentation	---	907,000	2,200,000
Design and analysis.....	---	115,000	500,000
Radiation effects.....	400,000	800,000	700,000
Nozzles.....	100,000	815,000	2,900,000
Bearings, seals and lubrication.....	83,000	125,000	700,000
Fluid property research.....	---	425,000	500,000
Fundamental engine systems research.....	154,000	515,000	---
Total Nuclear rocket engine systems.....	$ 737,000	$ 4,826,000	$ 11,200,000
Safety	---	200,000	500,000
Vehicle technology			
Propellant heating.....	---	100,000	600,000
Mission analysis.....	---	25,000	---
Radiation effects.....	---	128,000	200,000
Total Vehicle technology..	---	$ 253,000	$ 800,000
Total Supporting research and technology.....	$1,791,000	$13,339,000	$22,687,000

SEE RDO 19-3
VOL. II

Projects	1962	1963	1964
KIWI			
Reactor test support components	$4,529,000	$2,400,000	---
Propellants	140,000	1,670,000	$1,000,000
Total, KIWI	$4,669,000	$ 4,070,000	$1,000,000
NERVA			
Engine systems development	3,817,000	4,983,000	11,000,000
Component and subsystem development	5,258,000	19,348,000	30,000,000
Ground test and operations support	10,229,000	12,690,000	13,000,000
Propellants	12,000	6,196,000	6,000,000
Total, NERVA	$19,316,000	$ 43,217,000	$60,000,000
RIFT			
System technology	500,000	2,336,000	1,750,000
Subsystem technology	500,000	3,119,000	9,000,000
System integration	---	5,245,000	1,250,000
Total, RIFT	$ 1,000,000	$10,700,000	$ 12,000,000
Nuclear rocket development station operations			
General site support	---	300,000	600,000
Facility checkout and maintenance	---	100,000	350,000
Capital equipment	---	100,000	50,000
Total, NRDS operations	---	$ 500,000	$ 1,000,000
Total Projects	$ 24,985,000	$ 58,487,000	$74,000,000
Total direct R&D costs	$26,776,000	$71,826,000	$96,687,000

SEE RDO 19-8, 19-9,
19-13 and 19-16
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

CHEMICAL PROPULSION

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 20-1 TO 20-5)

	1962	1963	1964
Supporting research and technology			
Chemical propulsion analysis, aerothermochemistry and materials			
Aerothermochemistry.....	$1,803,000	$3,375,000	$4,960,000
Materials.....	341,000	1,784,000	1,865,000
Analysis.....	---	300,000	700,000
Total Chemical propulsion analysis, aerothermochemistry and materials.....	$2,144,000	$5,459,000	$7,525,000
High-energy propellants			
Liquid propellants.....	1,263,000	1,709,000	2,006,000
Solid propellants.....	340,000	711,000	800,000
Storage and environmental effects	141,000	398,000	500,000
Total High-energy propellants::	$1,744,000	$2,818,000	$3,306,000
Advanced launch vehicle engine technology			
Liquid rocket components.....	75,000	250,000	2,000,000
Liquid rocket systems.....	1,062,000	1,050,000	1,874,000
Solid rocket components.....	45,000	91,000	150,000
Solid rocket systems.....	140,000	216,000	450,000
Total Advanced launch vehicle engine technology.....	$1,322,000	$1,607,000	$4,474,000
Advanced spacecraft engine technology			
Liquid rocket components.....	75,000	1,328,000	2,618,000
Liquid rocket systems.....	1,526,000	2,137,000	2,400,000
Solid rocket components.....	45,000	91,000	150,000
Solid rocket systems.....	147,000	479,000	450,000
Total Advanced spacecraft engine technology.....	$1,793,000	$4,035,000	$5,618,000

SEE RDO-20-2 AND
20-3 VOL. II

	1962	1963	1964
Experimental high-energy engine			
Systems	---	$ 300,000	$ 1,574,000
Total Experimental high-energy engine	---	300,000	1,574,000
Total Supporting research and technology	$7,003,000	$14,219,000	$22,497,000
Small flight project	---	250,000	---
Total direct R&D costs	$7,003,000	$14,469,000	$22,497,000

SEE RDC-20-2 AND 20-3
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

SPACE POWER

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II PAGES RDO 21-1 TO 21-7)

Supporting research and technology	1962	1963	1964
Solar cells			
Photovoltaic	$1,510,000	$ 2,409,000	$ 3,350,000
Total Solar cells	$1,510,000	$ 2,409,000	$ 3,350,000
Thermionic power technology			
Thermionics	1,310,000	1,909,000	3,293,000
Solar concentrators	400,000	610,000	700,000
Total Thermionic power technology	$1,710,000	$ 2,519,000	$ 3,993,000
Solar engine technology			
Solar dynamics	950,000	1,750,000	2,500,000
Thermal energy storage	110,000	314,000	638,000
Total Solar engine technology	$1,060,000	$ 2,064,000	$ 3,138,000
Batteries and fuel cells			
Batteries	560,000	775,000	945,000
Fuel cells	560,000	1,372,000	1,600,000
Total Batteries and fuel cells	$1,120,000	$ 2,147,000	$ 2,545,000
Chemical engines			
Engines	150,000	200,000	700,000
Electrical distribution and control	200,000	320,000	1,168,000
Total Chemical engines	$ 350,000	$ 520,000	$ 1,868,000

SEE RDO-21-3
VOL. II

	1962	1963	1964
Thermoelectric, magnetohydrodynamics, and advanced concepts			
Thermoelectric.....	$ 227,000	$ 300,000	$ 575,000
Magnetofluid dynamics.....	325,000	650,000	555,000
Analysis.....	---	250,000	500,000
Total Thermoelectric, magnetohydrodynamics, and advanced concepts.....	$ 552,000	$ 1,200,000	$ 1,630,000
Total direct R&D costs.....	$6,302,000	$10,859,000	$16,524,000

SEE RDO 21-3
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

AERONAUTICS

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOL. II, PAGES RDO 22-1 to 22-10)

Supporting research and technology	1962	1963	1964
Aircraft aerodynamics			
Fundamental aerodynamics...	$130,000	$296,000	$407,000
Aerodynamic efficiency, stability and control at:			
Subsonic and transonic speeds.....	---	120,000	150,000
Supersonic speeds.....	---	275,000	500,000
Hypersonic speeds.....	---	188,000	850,000
Total Aircraft aerodynamics.....	$130,000	$ 879,000	$1,907,000
Aircraft loads and structures			
Loads.....	---	122,000	310,000
Structural dynamics.....	---	329,000	375,000
Fatigue.....	---	245,000	520,000
Structural design.....	---	220,000	395,000
Materials research.....	762,000	694,000	850,000
Total Aircraft loads and structures.....	$762,000	$1,610,000	$2,450,000
Air-breathing propulsion			
Subsonic and transonic propulsion systems.....	---	430,000	400,000
Supersonic propulsion systems.....	---	85,000	500,000
Hypersonic propulsion systems.....	---	834,000	800,000
Fundamentals of combustion.	104,000	114,000	153,000
Rocket flight tests of hypersonic inlets.....	---	250,000	1,200,000
Total Air-breathing propulsion.....	$104,000	$1,713,000	$3,053,000

SEE RDO 22-3
VOL. II

	1962	1963	1964
Aircraft operating problems			
Variable stability airplane.....	---	$ 1,325,000	$ 450,000
Flying and handling qualities.....	---	196,000	400,000
Flight safety.....	---	65,000	150,000
Noise and sonic boom.....	---	348,000	700,000
Operational techniques.....	---	578,000	400,000
Operating environments.....	($1,426,000)1/	460,000	400,000
Total Aircraft operating problems.....	---	$ 2,972,000	$ 2,500,000
Total Supporting research and technology	$ 996,000	$ 7,174,000	$ 9,910,000
Projects			
X-15A research aircraft			
Aerodynamics.....	(29,000)	35,000	70,000
Loads and structures.....	(53,000)	60,000	140,000
Propulsion.....	(10,000)	10,000	40,000
Operating problems.....	(447,000)	5,475,000	650,000
Total X-15A research aircraft.....	($539,000)1/	$5,580,000	$ 900,000
		SEE RDO 22-7, VOLUME II	
Supersonic transport			
Aerodynamics.....	1,842,000	492,000	700,000
Loads and structures.....	(195,000)1/	886,000	590,000
Propulsion.....	(104,000)1/	442,000	1,300,000
Operating problems.....	116,000	2,467,000	1,200,000
Total Supersonic transport.....	$1,958,000	$ 4,287,000	$ 3,790,000
		SEE RDO 22-8 VOL. II	
Vertical/short take-off and landing (V/STOL) aircraft			
Aerodynamics.....	(89,000)	562,000	820,000
Loads and structures.....	(4,000)	9,000	55,000
		SEE RDO 22-9 VOL. II	

	1962	1963	1964
Vertical/short take-off and landing (V-STOL) aircraft (cont'd)			
Propulsion	$ (21,000)	$ 136,000	$ 175,000
Operating problems	(68,000)	330,000	550,000
Total Vertical/short take-off and landing (V/STOL aircraft)	$ (182,000)	1/ $1,037,000	$ 1,600,000
		SEE RDO-22-9 VOL. II	
Total Projects	$1,958,000	$10,904,000	$ 6,290,000
Total direct R&D costs	$2,954,000	$18,078,000	$16,200,000

1/Amount provided for direct project effort in Operation of Installations in FY 1962.

SEE RDO-22-1
VOL. II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

TRACKING AND DATA ACQUISITION

RESEARCH AND DEVELOPMENT SUPPLEMENTAL DATA
(SEE VOLUME II, PAGES RDO 23-1 TO 23-19)

Supporting research and technology	1962	1963	1964
Integrated systems study, development and test			
Trajectory, orbit determination and data requirements analyses..	$ 358,000	$ 400,000	$ 600,000
Systems parametric studies.....	225,000	200,000	225,000
Conceptual systems studies.....	250,000	225,000	275,000
Developmental systems tests.....	625,000	825,000	900,000
Total Integrated systems study, development and test.....	$ 1,458,000	$ 1,650,000	$ 2,000,000
Improvements to existing systems			
Telemetry data conditioning, extracting and display equipment.....	1,125,000	1,350,000	1,975,000
Data acquisition receiving equipment.....	1,650,000	2,260,000	2,685,000
Electronic tracking equipment.....	937,000	1,750,000	2,250,000
Data handling and processing equipment.....	175,000	225,000	565,000
Command generation equipment.....	120,000	175,000	300,000
Antenna servo drive units.....	290,000	350,000	490,000
Antenna structure and microwave optics.....	605,000	925,000	920,000
Antenna feeds.....	695,000	850,000	1,050,000
Calibration equipment and techniques.....	110,000	122,000	175,000
Timing and frequency standards equipment.....	150,000	200,000	350,000
Spacecraft and vehicle transponder equipment.....	250,000	325,000	425,000
Circuit elements.....	150,000	200,000	315,000
Total Improvements to existing systems.....	$ 6,257,000	$ 8,732,000	$ 11,500,000

	1962	1963	1964
New systems development			
Telemetry data conditioning, extracting and display equipment	$ 242,000	$ 325,000	$ 720,000
Electronic tracking equipment	900,000	1,350,000	2,050,000
Optical tracking equipment	---	80,000	150,000
Data handling and processing equipment	100,000	200,000	250,000
Command and control generation equipment	80,000	163,000	180,000
Spacecraft and vehicle transponder equipment	60,000	100,000	150,000
Total New systems development	$ 1,382,000	$ 2,218,000	$ 3,500,000
Total Supporting research and technology	$ 9,097,000	$ 12,600,000	$ 17,000,000

SEE RDO 23-2
VOLUME II

Network operations			
Satellite network	9,374,000	11,760,000	17,000,000
Manned flight network	15,183,000	16,260,000	24,000,000
Deep space network	6,743,000	7,860,000	10,000,000
Launch area instrumentation	500,000	3,850,000	5,000,000
Aerodynamics test range	---	450,000	800,000
Network communications	8,393,000	10,760,000	16,000,000
Data processing and handling	1,660,000	4,570,000	7,700,000
Total Network operations	$41,853,000	$ 55,510,000	$ 80,500,000

SEE RDO 23-6
VOLUME II

Equipment and components			
Satellite network			
Maintenance, spares and replacement	1,411,000	2,515,000	5,500,000
Expansion of network capability			
Medium-gain antenna systems	1,290,000	2,950,000	860,000
136-mc self-tracking antenna systems	105,000	2,060,000	1,156,000
Satellite command systems	270,000	695,000	675,000

	1962	1963	1964
Satellite network (Con't)			
PCM station telemetry systems...	$ 864,000	$ 680,000	$ 2,075,000
Real-time telemetry readout equipment.....	---	320,000	300,000
Portable telemetry stations.....	---	365,000	2,329,000
400-mc receiver systems.....	---	120,000	120,000
Station data handling and conditioning equipment.....	---	500,000	2,240,000
Station microwave terminal equipment.....	---	150,000	250,000
Station data control and monitoring systems.....	---	145,000	1,155,000
Portable range and range-rate tracking stations.....	---	---	3,400,000
Payload simulation equipment....	---	---	540,000
Collimation and test optics.....	---	---	250,000
Timing system output equipment..	---	---	400,000
Launch area spacecraft checkout equipment.....	---	---	750,000
Total Satellite network.....	$ 3,940,000	$ 10,500,000	$ 22,000,000
Manned flight network			
Maintenance, spares and replacement.....	1,649 300	2,500,000	4,000,000
Expansion of network capability			
Augmentation of voice communications systems.....	621,500	---	---
Automatic telemetry readout and decommutation.....	99,500	---	---
Radar system modifications.....	894,700	---	---
Telemetry ship modifications....	940,000	---	---
Tracking ship modifications.....	1,250,000	---	---
Computer reprogramming.....	800,000	---	---
Network station equipment integration and test.....	1,798,000	---	---
Data terminal equipment at computer center and Bermuda.....	1,900,000	---	---
Command remote systems.....	100,000	---	---
PCM telemetry station systems...	---	9,329,000	---
Digital command encoders.....	---	4,875,000	---
RF command systems.....	---	1,764,000	---
Intrasite communications equipment.....	---	434,000	---
Mobile MPS-26 radar system.....	---	550,000	---
Acquisition aid antenna systems.	---	1,600,000	---
Installation and station modifications.....	---	2,800,000	---

	1962	1963	1964
Manned flight network (Con't)			
Data handling and alpha numeric display systems	$ ---	$ 1,800,000	$ 24,000,000
Unified S-band station systems	---	12,000,000	21,000,000
Deep space station Apollo S-band compatibility subsystems	---	2,000,000	4,000,000
Engineering and systems integration	---	3,050,000	4,000,000
In-orbit checkout data conditioning systems	---	---	9,000,000
In-orbit checkout data handling equipment	---	---	7,000,000
In-orbit checkout display and status monitoring system	---	---	8,000,000
Landing area instrumentation	---	---	3,000,000
Total Manned flight network	$10,253,000	$ 42,702,000	$ 84,000,000
Deep space network			
Maintenance, spares and replacement	---	1,060,000	1,775,000
Expansion of network capability			
Atomichron and synchronization equipment	---	300,000	---
S-band receiver systems	---	385,000	---
Microwave standards	---	150,000	---
Prototype improved S-band RF performance components	---	440,000	---
Antenna, servo, and transmitter modifications	---	1,126,000	450,000
S-band transmitters and components	---	711,000	1,170,000
Klystron and maser amplifiers	---	358,000	1,425,000
S-band ranging systems	---	639,000	375,000
Data transmission and processing equipment	---	1,026,000	930,000
Digital data and instrumentation systems	---	460,000	535,000
Test transponders and calibration equipment	---	601,000	150,000
Remote collimation equipment	---	250,000	320,000
S-band acquisition aids and equipment	---	---	480,000
Mobile S-band range and doppler station	---	---	1,330,000

	1962	1963	1964
Deep space network (Con't)			
Magnetic tape recorders.....	$ ---	$ ---	$ 460,000
Automatic test and checkout equipment.....	---	---	600,000
Total Deep space network.....	$ ---	$ 7,506,000	$ 10,000,000
Launch area instrumentation			
Maintenance, spares and replacement.....	457,000	810,000	1,975,000
Expansion of existing capability			
Photographic processing equipment.....	100,000	150,000	220,000
Range camera equipment.....	175,000	200,000	250,000
Aircraft calibration and test instrumentation.....	100,000	120,000	160,000
Antenna systems modifications...	60,000	120,000	240,000
Tuning equipment.....	---	---	75,000
Range ship instrumentation.....	---	---	80,000
Total Launch area instrumentation.....	$ 892,000	$ 1,400,000	$ 3,000,000
Aerodynamic test range			
Maintenance, spares and replacement.....	---	210,000	250,000
Expansion of network capability			
Prototype PCM telemetry system..	---	500,000	---
FPS-16 radar refurbishment.....	---	---	750,000
Total Aerodynamic test range..	$ ---	$ 710,000	$ 1,000,000
Communications network			
Maintenance, spares and replacement.....	398,700	494,000	550,000
Expansion of network capability			
Shipboard tuneable RF filters...	40,200	---	---
40 KW radio transmitters.....	---	538,000	200,000
Data terminal equipment.....	77,300	80,000	400,000
Teletype and voice equipment....	139,700	262,000	100,000
Switching center equipment.....	283,900	150,000	150,000

	1962	1963	1964
Communications network (Con't)			
Test and evaluation equipment...	$ 27,200	$ 200,000	$ 250,000
Mobile communications vans.....	---	250,000	250,000
South American communications system modifications.....	---	240,000	300,000
Solid state switching system....	---	---	1,800,000
Total Communication network...	$ 967,000	$ 2,214,000	$ 4,000,000
Data processing and handling			
Maintenance, spares and replacement.....	85,200	412,000	1,305,000
Expansion of existing capability			
PFM data processing system.....	214,800	---	---
Prototype telemetry tape signal recovery system.....	---	340,000	---
Data monitoring and control consoles.....	---	400,000	---
Satellite telemetry automatic reduction systems (STARS).....	---	1,548,000	2,535,000
Telemeter off-line processing system.....	---	---	3,793,000
Special purpose data processors.	---	---	1,190,000
Automatic analog data tape evaluation equipment.....	---	---	477,000
High speed plotter printer.....	---	---	700,000
Total Data processing and handling.....	$ 300,000	$ 2,700,000	$ 10,000,000
Total Equipment and components.....	$16,352,000	$ 67,732,000	$134,000,000
Total Direct R&D costs.....	$67,302,000	$135,842,000	$231,500,000

SEE RDO 23-11
VOLUME II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1964 ESTIMATES

REVISED SUMMARY OF CONSTRUCTION OF FACILITIES PROGRAM BY LOCATION 1/

	Fiscal Year 1962	Fiscal Year 1963	Fiscal Year 1964
Ames Research Center.....	$6,564,000	$14,200,000	$13,076,000
Flight Research Center.....	110,000	1,697,000	4,081,000
Goddard Space Flight Center.....	12,170,000	17,556,250	20,932,000
Jet Propulsion Laboratory.....	4,063,800	10,003,200	7,000,000
Langley Research Center.....	6,942,500	8,861,000	9,768,000
Launch Operations Center.....	116,291,400	326,974,400	312,855,000
Lewis Research Center.....	1,835,000	43,485,000	25,835,000
Manned Spacecraft Center.....	66,688,600	45,282,700	37,736,000
Marshall Space Flight Center.....	30,318,000	43,559,500	38,496,000
Michoud Plant.....	10,723,000	18,294,000	10,003,000
Mississippi Test Facility.....	18,990,000	73,200,000	111,690,000
Nuclear Rocket Development Station.	22,930,000	17,470,000	20,490,000
Pacific Launch Operations Office...	975,000	-	-
Various Locations 2/.....	47,874,000	99,901,000	176,038,000
Wallops Station.....	11,714,000	4,160,750	2,000,000
Facility Planning and Design 3/.....	700	4,684,000	10,000,000
Reserved for Allocation Under Reprogramming Authority.....	-	8,096,200	-
Total Plan.....	$358,190,000	$737,425,000	$800,000,000

1/ This revised summary corrects error in tabulation as shown in Vol. IV, Page SUM 5. The correct FY 1963 amount for Various Locations is $99,901,000 instead of $99,721,000 and $4,684,000 instead of $4,864,000 for Facility Planning and Design.

2/ Excludes amounts appropriated for facilities at Various Locations in fiscal years 1962 and 1963 which are now identified as part of specific NASA installations.

3/ Amounts appropriated in fiscal years 1962 and 1963 are reflected by location on the basis of current allocations.

SEE SUM 5
VOL. III