NASA
National Aeronautics and
Space Administration

Budget Supplemental

FISCAL YEAR 1979

Research and Development

BUDGET SUPPLEMENTAL
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 1979 ESTIMATES
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1979

GENERAL STATEMENT

Supplemental Appropriation for Space Shuttle Program

A Supplemental Appropriation of $185.0 million is requested to provide the additional funding required for the Space Shuttle program. The Space Shuttle is the key element of a versatile, economical space transportation system that will provide a wide variety of national and international users with round trip access to space beginning in the 1980's. This Supplemental Appropriation, when added to the $1,443.3 million appropriated for FY 1979 would provide a total of $1,628.3 million for the Space Shuttle program within the Research and Development Appropriation.

The need for the additional funds results from technical problems encountered in development, manufacturing and testing of Space Shuttle systems; the need for design changes and weight reductions: and the requirements of prime contractors and subcontractors for increased engineering and manufacturing effort to fabricate hardware and conduct test activities. Intensive development and testing activity is proceeding in FY 1979 with the first orbital flight targeted for late 1979. Consistent with the Conference Report on the FY 1379 Appropriation, funding is being applied to Design, Development, Test and Evaluation activities at a rate which supports this plan; orbiter production activities are proceeding on a constrained basis; and the FY 1973 Supplemental Appropriation is being requested to restore funding for production activities. If the requested Supplemental Appropriation is not approved, it will be necessary to rebalance the program plan by adjusting the FY 1979 development and test activities with a resultant delay of several months in first orbital flight and by delaying production activities with a resultant six to twelve month delay in delivery of the second, third, and fourth orbiter vehicles. The effect of such a delay on overall Space Shuttle proqram costs is estimated at $400–600 million.

The following table presents a comparison of the funding plan for Space Shuttle Research and Development contained in the FY 1979 Budget Request with the current plan including the requested Supplemental Appropriation:

	Millions of Dollars
FY 1979 Budget Request	**$1,439.3**
Amount added by Congress to FY 1979 Authorization and Appropriation for procurement of long lead time items for a fifth orbiter	**4.0**
Total Amount Authorized and Appropriated for FY 1979	**$1,443.3**
Total Current Estimate	**$1,628.3**
Requested Supplemental Authorization and Appropriation	$185.0

Appropriation summary tables, proposed language for the requested authorization and appropriation, and a more specific narrative statement of program requirements follow.

BUDGET SUPPLEMENTAL

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

BUDGET **SUMMARY**

(Thousands of Dollars)

	Budget Plan				
		FY 1979			FY 1980
	FY 1978 Actual	Presently Available	Proposed Supplemental	Revised Estimate	Budget Estimate
SPACE TRANSPORTATION SYSTEMS	1,751,500	1,824,500	185,000	2,009,500	1,904,000
Space shuttle	1,349,200	1,443,300	185,000	1,628,300	1,366,000
Space flight operations	267,800	309,700	---	309,700	467,300
Expendable launch vehicles	134,500	71,500	---	71,500	70,700
SPACE SCIENCE	404,700	505,400	---	505,400	601,600
Physics and astronomy	224,200	282,900	---	282,900	337,500
Planetary exploration	147,200	182,400	---	182,400	220,200
Life sciences	33,300	40,100	---	40,100	43,900
SPACE AND TERRESTRIAL APPLICATIONS	243,900	283,900	---	283,900	344,400
Space applications	234,800	274,800	---	274,800	332,300
Technology utilization	9,100	9,100	---	9,100	12,100
AERONAUTICS AND SPACE TECHNOLOGY	333,200	376,400	---	376,400	419,700
Aeronautical research and technology	228,000	264,100	---	264,100	300,300
Space research and technology	97,700	107,300	---	107,300	116,400
Energy technology	7,500	5,000	---	5,000	3,000
SPACE TRACKING AND DATA SYSTEMS	278,300	302,000	---	302,000	332,800
TOTAL RESEARCH AND DEVELOPMENT	3,011,600	3,292,200	185,000	3,477,200	3,602,500
OUTLAYS	2,988,697	3,148,500	163,200	3,311,700	3,475,700

BUDGET SUPPLEMENTAL

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Research and Development
Budget Summary By Subfunction

	Subfunction		1978 Actual	FY 1979 Presently Available	FY 1979 Proposed Supplemental	FY 1979 Revised Estimate	FY 1980 Budget Estimate
253	Space flight	BA	1,751,500	1,824,500	185,000	2,009,500	1,904,000
		0	1,835,428	1,770,800	163,200	1,934,000	1,906,200
254	Space science, applications and technology	BA	753,800	901,600	---	901,600	1,065,400
		0	668,576	837,000	---	837,000	974,800
255	Supporting space activities	BA	278,300	302,000	---	302,000	332,800
		0	272,445	297,100	---	297,100	313,400
250	Subtotal, General Science, Space and Technology	BA	2,783,600	3,028,100	185,000	3,213,100	3,302,200
		0	2,776,449	2,904,900	163,200	3,068,100	3,194,400
402	Air Transportation	BA	228,000	264,100	---	264,100	300,300
		0	212,248	243,600	---	243,600	281,300
	Total	BA	3,011,600	3,292,200	185,000	3,477,200	3,602,500
		0	2,988.697	3,148.500	163.200	3,311,700	3.475.700

BA -- Budget Authority
0 -- Outlays

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AUTHORIZATION BILL

A BILL

To authorize a supplemental appropriation to the National Aeronautics and Space Administration for Research and Development.

Paragraph (1) of subsection 1(a) of the National Aeronautics and Space Administration Authorization Act, 1979 (Public Law 95-401), is amended by striking out "$1,443,300,000" and inserting in lieu thereof "$1,628,300,000."

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APPROPRIATION LANGUAGE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

For an additional amount for "Research and Development", $185,000,000; to remain available until September 30, 1980.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1979 SUPPLEMENTAL REQUIREMENT

OFFICE OF SPACE TRANSPORTATION SYSTEMS — SPACE SHUTTLE PROGRAM

PROGRAM STATUS:

Space Shuttle development is in a period of peak effort and well on the way toward the first orbital flight, planned for lite 1979. All major Shuttle system elements are proceeding in test and manufacture and all major ground test programs are now being conducted. The test elements for the Mated Vertical Ground Vibration Test (MVGVT) have been delivered to the Marshall Space Flight Center (MSFC) and testing is now in progress. This MVGVT program will verify the vibration characteristics during liftoff and at other times during the ascent profile. The tests will be completed in early 1979. The Main Propulsion Test (MPT) series was started in 1978 at the National Space Technology Laboratories (NSTL) and will continue through 1979 and part of 1980. This includes three main engines, mounted on an orbiter aft fuselage, and an External tan!:.

FY 1979 activities support preparations for the first orbital flight planned in late 1979. The Orbiter 102, which will be used for the orbital flight tests, is in final assembly and checkout at Palmdale, California. In early 1979, this orbiter will be delivered to KSC where it will begin preparations for launch. The orbiter structural test article was completed by Rockwell International and transferred to the Lockheed plant in Palmdale for structural testing, which started in 1978 and is scheduled for completion in mid-1979. Engine testing, temporarily suspended because of an engine failure in December 1378, which essentially destroyed an engine, was resumed on Januarv 29 after the modifications were completed. Prior to this incident, enqine testing was proceeding at a good pace, with over 5,000 seconds accumulated on one flight configured engine. The first set of flight engines will be acceptance tested at NSTL in Mississippi and, together with associated ground support equipment, will be delivered to KSC for installation on Orbiter 102 in 1979.

Fabrication of three external tank test articles has been completed, and are in use for structural, vibration, and main propulsion testing. The second and third solid rocket motor development firings were accomplished during 1978, and the fourth and final development firing plus three qualification firings are planned in 1979. Delivery of the external tank and the solid rocket motors to KSC for the first orbital flight is scheduled during the first half of 1979. In addition, some of the solid rocket booster components for the first orbital flight were delivered to KSC during 1978, while the remaining solid rocket booster components are scheduled for delivery in the first half of 1979.

Facilities installation and site activation is proceeding at both KSC and at the Dryden Flight Research Center (DFRC) in California to support STS-1. KSC facilities such as the Vehicle Assembly Building, Mobile Launch Platform, Orbiter Processing Facility, Launch Pad A, and the Rotating Service Structure with the Payload Changeout Room are all progressing satisfactorily. The computerized launch processing system (LPS) and the ground support equipment at KSC and DFRC are in the final stages of completion and software validation is underway. Flight equipment will be checked out and processed for STS-1 after it arrives at KSC for launch

In August 1978, a comprehensive program review was undertaken to assess the significance of technical problems encountered in several areas including the Space Shuttle main enqines, orbiter thermal protection subsystem production and installation, orbital maneuvering subsystem pod fabrication, solid rocket booster manufacture and test, external tank thermal protection application, and flight software development. The conclusion of the detailed review indicated that while substantial progress had been achieved, the overall program progress was slower than planned at the time the FY 1979 budget was prepared. The main engine development continued to be a primary technical concern. Importantly, the review also concluded that it is a technically sound engine and that a rapid accumulation of test seconds can be expected and indeed has been demonstrated. Approximately 35,000 seconds of test firings have been run, more than 10,000 of these at rated power levels. Based on the assessment of the engine status and the status of the other elements of the program, it was determined that it was reasonable to continue to plan to accomplish the first orbital test during 1979. Achievement of this target is dependent on successful completion of the key remaining ground tests and on encountering no major unforseen problems.

The program review also identified the need for additional FY 1379 funding of $185.0 million to provide timely support for urgent program requirements. This amount, which is requested as a Supplemental Appropriation, when added to the $1,443.3 million appropriated for FY 1979 for the Space Shuttle results in total FY 1979 budget authority of $1,628.3 million. These additional funding requirements are not due to any single element, but occur in a number of program areas. The additional funding is needed to solve technical problems; to provide for necessary changes in many elements of the program: and to meet the requirements of prime contractors and subcontractors for increased engineering and manufacturing effort to fabricate hardware and conduct test activities.

In summary, the progress at this critical phase of the development effort has been substantial, but has not sustained the pace necessary to accomplish the original FY 1979 budget plan thus making it necessary to adjust program schedules and request a supplemental appropriation. A summary of additional funding requirements by program element follows:

(Millions of Dollars)

Summary by Program Element	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
Orbiter	937.5	999.0	+61.5
Main Engine	194.7	242.7	+48.0
External Tank	80.5	107.6	+27.1
Solid Rocket Booster	63.5	100.2	+36.7
Launch and Landing	139.1	158.6	+19.5
Spares and Equipment	28.0	20.2	-7.8
TOTAL	1,443.3	1,628.3	+185.0

BASIS OF SUPPLEMENTAL FUND REQUIREMENT:

The requirement for the requested supplemental appropriation in FY 1979 is a result of development problems, program changes, and the need for more work than was previously planned, particularly in the fabrication and assembly of flight and test hardware and in systems qualification and certification. The impact of these difficulties has been hardware schedule delays, increased engineering and manufacturing requirements in prime and subcontractor efforts, and significant deferrals of work content into FY 1979. Fabrication activities on the second and subsequent orbiters have been proceeding on a constrained basis as funding is applied to keep development efforts on the new schedule directed towards the first orbital flight in late 1379. The additional funding requested in the Supplemental Appropriation will be applied to continue the development efforts on schedule and to restore the funding needed for follow-on orbiter fabrication activities.

RESEARCH AND DEVELOPMENT

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
	(Thousands of Dollars)		
Orbiter	937,500	999,000	61,500

STATUS:

During FY 1979, the emphasis will be on completion of manufacture and assembly of Orbiter 102, the testing required to certify Orbiter 102 for the first orbital flight test, and continuation of fabrication and assembly of the follow-on orbiters.

The structural test article (STA) which has a flight-type orbiter airframe, was transferred to the Lockheed test facility at Palmdale, California, early in 1978 and is currently undergoing static load testing. These tests are scheduled for completion in 1979, after which the STA will be converted to an orbital vehicle (099). Satisfactory completion of structural testing is required for flight loads certification of Orbiter 102.

The orbiter main propulsion test article along with three main engines and an external tank was installed in the test stand at NSTL and test firings started in 1978. Testing, to acquire aropulsion system performance data as well as acoustic data, will resume after main engine modifications are completed and will continue through 1979.

Orbiter 101 is currently being used in the full-scale ground vibration tests at MSFC. Results of these tests, will be correlated with data from quarter scale testing to verify the structural integrity of the shuttle system.

Approximately 600 hardware certification requirements are necessary for the first flight of Orbiter 102. All subsystems require certification including structural, thermal protection, main propulsion, reaction control, communications, guidance and navigation, orbital maneuvering, and environmental control. These certification tests are scheduled for completion late in FY 1979.

Preliminary orbital flight software is being used to conduct orbital flight verification tests. Initial checkout of the Palmdale and KSC test procedures, detailed evaluations of the flight control interaction with the dynamic model interfaces, and study of the remote manipulator system avionics

interactions will be performed at the Shuttle Avionics Integration Laboratory (SAIL). Facility acceptance tests of the SAIL at the Johnson Space Center (JSC) with the MSFC Mated Elements System will be completed in mid FY 1979. This will assure that these facilities are ready to start verification of the complete avionics system and its interfaces with the Shuttle vehicle. Acceptance test of the Flight Systems Laboratory (including the Avionics Development Laboratory, Flight Control Hydraulics Laboratory, crew station, and backup flight control system flight software verification facility) at Rockwell in Downey, California, will also be completed.

During FY 1979, mancfacture and assembly of Orbiter 102 will continue and delivery to KSC is scheduled for March 1979. Systems installation, final assembly, thermal protection system installation and final checkout are ali proceeding. Some effort, particularly the thermal protection system installation, will be completed after delivery to KSC.

After completion of the planned testing of the structural test article (STA), it will be returned to the Rockwell plant at Palmdale to begin conversion to an orbital configuration (Orbiter 099). During FY 1979, fabrication of subsystems for OV-099 will continue at the subcontractor level and fabrication of the crew module at the prime contractor will also be continued.

Fabrication and assembly of the major subsystems of Orbiter 103, which is scheduled for delivery earlv in FY 1983. has beaun at Rockwell International and at the major structural subcontractors. The crew module and the forward and aft-fuselage elements are in assembly at Rockwell, and the wings, the vertical stabilizer, and the mid-fuselage elements are in assembly at Rockwell's subcontractors. Fabrication of the thermal protection system tiles has also begun. Some long lead ordering of critical parts will also be accomplished for Orbiter 104 during FY 1979. Efforts have initiated during FY 1979 to identify and define a weight reduction program for implementation on Orbiters 099, 103, and 104. During FY 1979, NASA is negotiating a contract with the Canadians for remote manipulator flight systems, auxiliary equipment, ground handling and servicing support for the follow-on orbiters. Funds appropriated for FY 1979 to maintain the option for possible fabrication of a fifth orbiter will also be used to begin procurement of critical long lead items. NASA will only order items which are common to a four or five orbiter program and not specifically for a fifth orbiter.

BASIS OF SUPPLEMENTAL REQUEST:

The increase in funding requirements for FY 1979 is caused by a combination of mandatory design changes, technical problems in FY 1978 that caused work to be deferred into FY 1979 and the need for more work than was previously planned. Last year, the completion of manufacturing and

assembly of Orbiter 102 and delivery to KSC was scheduled for October 1978. During FY 1978, test results, engineering analysis, and systems evaluation identified the need for more technical changes than were previously anticipated. These changes included an increase in the helium purge system, addition of the backup flight control system, modification of the engine base heat shield and additional systems integration tasks. The need for more work than was planned occurred in a number of areas in FY 1978. The effort required by the prime contractor to manufacture the primary structures for Orbiter 102, install the subsystems, and assemble the vehicle was greater than previously estimated. A number of subcontractors also experienced technical problems and increased cost requirements in FY 1978. For example, an increase in the complexity of reusable surface insulation tiles was experienced as requirements were better defined; the production yield of acceptable tiles was lower than estimated; and a two month strike delayed deliveries. In addition, changes were required for the on-board computers; producability problems were experienced with the reaction control system and orbital maneuvering system; technical problems with the auxiliary power unit resulted in additional test and resolution effort: and the S-band radar system required more effort than was previously planned on the payload and network equipment as specifications changed and hardware requirements increased. These changes, technical problems and increases in required effort resulted in deferral of work into FY 1979 along with the need for increased funding. The current Orbiter 102 delivery is planned for March 1979 and subcontractor deliveries, systems installations, and final assembly are proceeding. The thermal protection system tile production and installation continues to be the most difficult problem ard this work will be completed at KSC in parallel with Orbiter checkout activity.

Increased requirements also occurred in areas other than the prime contractor's effort. Orbiter software problems and a large number of changes caused increased requirements in FY 1979. Cost increases also occurred on the extravehicular mobility units. A schedule stretchout of the main propulsion tests (MPT) due to main engine problems and implementation of a phased approach to the main propulsion certification requires additional funds in FY 1979. A schedule delay and the need for additional funds also occurred for the mated vertical-qround vibration tests (MVGVT) due to hardware delays and the identification of additional test requirements.

An orbiter weight savings program has been implemented in FY 1979 to identify and define areas where weight can be reduced for Orbiters 099, 103, and 104.

These increased requirements were partially offset by the deferral of manufacturing and assembly efforts for Orbiters 099, 103, and 104, consistent with the revised delivery schedule which delays the delivery of OV-099 seven months and OV-103 and OV-104 three months.

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
	(Thousands of Dollars)		
Main Engine	194,700	242,700	48,000

STATUS:

During FY 1978, problems developed during testing with a number of engine components, which caused the main engine project to fall behind in accumulated engine test time. Investigation of these problems has identified failure modes and causes, and modifications are being tested. As a result, engine testing was proceeding at a good pace until a recent (December 27, 1978) failure destroyed most of the integral parts of an engine (2001) undergoing acceptance testing. This caused a temporary suspension of the testing. The cause of the failure (in the main liquid oxygen valve) has been determined and modifications are now being made to all engines to correct this problem. The first engine with modified liquid oxygen valves was test fired on January 29 at Santa Susana and testing is now proceeding.

Engine testing is still a pacing item to perform STS-1 in 1979. However, progress on the main engine development since the summer of 1978 has been significant. A total of 6,600 seconds at the rated power level (RPL) of 100% was achieved in one month and over 5,000 seconds were recorded on one flight configured engine including six tests at RPL, each for the full mission duration of 520 seconds. A total of about 500 tests have been conducted accumulating almost 35,000 seconds of operation, with about 75 tests and 11,000 seconds at RPL. In addition to the two existing test stands at NSTL, an engine test stand has been activated at Santa Susana in California.

Testing will continue on flight configured engines during 1979, leading to the main engine flight certification for STS-1. Single engine testing will be intensive in order to prove the durability of each element of the system. Rigorous examination of each hardware component will be accomplished as a part of this thorough test activity. In FY 1979, the first set of three flight engines and one spare will be delivered to KSC. Fabrication of additional development engines for testing will continue in FY 1979.

FY 1979 funding also provides for continuation of long lead material and component procurements for these additional flight engines required for development backup and the operational orbiter fleet. Engine component procurements include hot gas manifold and preburner body forgings, turbopump castings, main combustion chamber parts and selected raw materials and plate stock for engine component fabrication. In addition, fabrication of liquid hydrogen and liquid oxygen high and low pressure turbopump components has been initiated and, assembly of the second set of flight engines will begin during FY 1979.

In addition to the manufacture and test work by Rocketdyne and the subcontractors, the main engine activities provide the necessary project support efforts. These efforts include the procurement of propellants for test firing the engine and its components, the maintenance of the engine systems hardware simulation laboratory, logistics support, and the evaluation of materials and processes.

BASIS OF SUPPLEMENTAL REQUEST:

In early FY 1979, NASA activated a third engine test stand at Santa Susana, which was previously unplanned, and began testing in order to enhance development progress by establishing an increased capability to conduct engine system testing. This additional capability is in response to the recommendations of the National Research Council's ad hoc committee for review of the Space Shuttle main engine development program (Covert Committee). Implementation of other recommendations by the Covert Committee which resulted in increased funding requirements for FY 1979 included the acceleration of follow-on engines to be available in the event additional test hardware is needed and the acquisition of additional critical parts. FY 1979 funding requirements also increased due to the deferral of work as a result of engine test problems in FY 1978, resolution of engine test problems, and increased engine manufacturing and assembly requirements, resulting from changes and redesigns made as a result of engine test solutions.

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
	(Thousands of Dollars)		
External Tank	80,500	107,600	27,100

STATUS:

Early in FY 1979, structural testing of the liquid hydrogen test tank was initiated at MSFC. This activity will be completed in 1979, along with the oxygen tank structural verification tests which began in FY 1978.

During the first quarter of FY 1979, the main propulsion test tank was upgraded at NSTL to a full flight configuration. A complete test tank is also being used in the full scale ground vibration tests, together with the Orbiter "Enterprise" and solid rocket boosters. This testing is planned for completion in early 1979.

Four flight tanks are currently in various stages of assembly and checkout at the Michoud Assembly Facility (MAF) in Louisiana. Improvements in some manufacturing techniques were required, particularly with regard to the application of thermal protection materials. Some fabrication delays were encountered, and delivery of the first flight tank to KSC is now expected in the first half of 1979 to support tne planned STS-1 launch. Fabrication of the final two DDT&E flight external tanks will be initiated during FY 1979, and the second flight tank is expected to be delivered to KSC the end of the fiscal year.

BASIS OF SUPPLEMENTAL REQUEST:

Technical design changes, were largely responsible for the increase in FY 1979 funding requirements. Revised aerodynamic loads and a change in the predicted ascent aerothermal environments resulted in a redesign of the external propulsion lines and cable tray and a large increase in the amount of thermal protection coverage required. Increased requirements also resulted from the deferral of manufacture and assembly effort into FY 1979 as a result of these design changes and the need for more work than was previously planned. Additional maintenance and test support due to the stretchout of the main propulsion, ground vibration, and structural test programs, and additional support at Michoud Assembly Facility as a result of the change requirements and fabrication delays also resulted in additional funding requirements.

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
	(Thousands of Dollars)		
Solid Rocket Booster	63,500	100,200	36,700

STATUS:

The third solid rocket development motor (DM-3) firing occurred in October 1978 and the fourth (DM-4) and final firing is scheduled for February 1979. Both of these firings were delayed to incorporate the new inhibitor design. The manufacture of three qualification motors has been initiated and testing will follow the completion of the development motor test program with the three qualification motor firinqs scheduled prior to the STS-1 launch.

The SRB structural test program was initiated at MSFC and testing will continue in FY 1979. The SRB hardware required for the mated ground vibration test was delivered to MSFC in 1978 and testing is currently in progress.

The manufacture of flight motors for the first test fliqht (STS-1) has begun and delivery of the flight set of two SRM's to KSC will be completed by mid-1979. The manufacture of flight motors for the follow-on orbital flight tests will continue through FY 1979.

Verification testing will continue in FY 1979 on the SRB subsystems including the thrust vector control and booster separation motor subsystems. In addition, the booster assembly contractor will complete activation of the Refurbishment Subassembly Facility at KSC leading to the assembly and checkout of the SRB for the first orbital flight.

BASIS OF SUPPLEMENTAL REQUEST:

Increased requirements in FY 1979 occurred in most of the subsystem areas within the SRB. In the structures area a number of changes occurred including modification to the aft skirt skin forming tools and changes to the heat shield attachments. Cost increases were also caused by welding and assembly problems of the forward and aft skirts. Redesign changes to components being procured by the booster assembly contractor and the deferral of ground support equipment from FY 1978 resulted in the need for additional funding. In addition, checkout software support to the Launch Processing System at KSC in the Refurbishment Subassembly Facility was greater than previously planned.

Other subsystems such as integrated electronics, thrust vector control and the recovery system ail experienced changes due to test results and engineering updates. The prime contractor for the solid rocket motor experienced increased cost requirements. The development motor firinqs caused component redesign, inhibitor modifications, and tooling redesigns resulting in cost increases. Also the labor requirements for processing the development and early flight rocket motors were greater than previously estimated.

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Additional Funding Requested
	(Thousands of Dollars)		
Launch and Landing	139,100	158,600	19,500

STATUS:

Approximately 1,430 design models of ground support equipment (GSE) for station sets have been

defined, including some 80 provided by the vehicle development contractors and 620 provided by separate KSC GSE procurements. All of the GSE is on contract. About 55% of the development contractor GSE and 90% of the KSC GSE have been received. A major portion of the effort remaining in FY 1979 involves receiving the remaining GSE, installing and checking it out, and activating the resulting station sets.

All hardware and system software for the central data subsystem have been accepted. All major launch processing system operating software releases have been made to support the ground checkout software programs required for launch operations.

During 1979, the final phase of construction of facilities required for the first orbital flight will be completed. The launch processing system will be ready for mating with ground support equipment. All station sets in the first flow processing line will be activated and will complete operational readiness checkout before the first set of flight hardware reaches each respective station. Launch operations procedures will be prepared and verified for this same readiness schedule. Orbiter 102, the first flight sets of main engines and solid rocket boosters, and the first flight ET will be delivered to KSC starting in early 1979.

The development contractors' support activities and manpower buildup at KSC will continue and reach a peak prior to the STS-1 launch. The development contractors constitute the bulk of the launch team and are also the operators of the launch processing station sets, launch support equipment, and the GSE. Processing of the vehicle for the first orbital flight will commence early in 1979. Flight elements will be assembled, checked out, serviced and launched for the first manned orbital flight. In addition, launch processing of some elements of the follow-on orbital flight tests will be in progress during 1979.

The development contractors' onsite launch support efforts at KSC have been initiated with Rockwell International (including both orbiter and main engine contractors), Martin Marietta, United Space Boosters, Inc., and Thiokol. These contractors are preparing specifications, procedures and test documentation for vehicle assembly, test, servicing, checkout and launch.

BASIS OF SUPPLEMENTAL REQUEST:

The increase in the FY 1979 funding estimate is due to the deferral of effort from FY 1978 and increased requirements in FY 1979. Due to the delay in shipment of the first flight elements to KSC, efforts such as ground support equipment (GSE) procurement, installation and checkout; propellant purchases; and launch processing system equipment buys were deferred into FY 1979. In addition, more ground support equipment spares were required, and the effort required to activate the various station sets, such as the orbiter processing facility, hypergolic system maintenance facility, and SRB disassembly area, were greater than previously planned.

	Basis for FY 1979 Authorization and Appropriation	Current Estimate	Change in Funding Requested
	(Thousands of Dollars)		
Spares and Equipment	28,000	20,200	-7,800

STATUS:

Shuttle spares and equipment include orbiter flight and ground support equipment spares, main engine spares, KSC launch site ground support equipment spares, crew equipment, and solid rocket booster and external tank rate tooling required to increase the rate of production during the operational years. In FY 1979, the crew equipment being procured is primarily additional extra-vehicular mobility units and portable oxygen systems required by the astronaut crew for the early operational period. External tank tooling for assembly, thermal protection installation, welding, and handling will be procured in FY 1979 to increase the production rate capability of External Tanks. Solid Rocket Booster tooling in FY 1979 includes additional nozzle, propellant loading and case preparation tooling and associated handling equipment.

BASIS OF SUPPLEMENTAL REQUEST:

Consistent with the schedule adjustment of the first orbital flight and the associated delay of nine months in the initial operating capability, crew equipment and orbiter flight spares have been replanned with requirements rephased into FY 1980.

Program and Financing (in thousands of dollars)

Research and Development

Identification Code: 80-0108-4-1-999	Budget Plan (amounts for research and development actions programmed)			Costs and Obligations		
	1979	1979	1979	1979	1979	1979
Program by activities:	Presently available	Revised estimate	Proposed supplemental	Presently available		
Direct program:						
1. Space transportation systems:						
(a) Space shuttle...	1,443,300	1,628,300	185,000	1,408,700	1,593,700	185,000
(b) Space flight operations	309,700	309,700	---	306,900	306,900	---
(c) Expendable launch vehicle development and support...	42,600	42,600	---	95,400	95,400	---
2. Scientific investigations in space:						
(a) Physics and astronomy	300,400	300,400	---	285,700	285,700	---
(b) Planetary exploration	182,400	182,400	---	182,000	182,000	---
(c) Life sciences	40,100	40,100	---	38,100	38,100	---
3. Space and terrestrial applications:						
(a) Space applications	286,200	286,200	---	284,900	284,900	---
(b) Technology utilization	9,100	9,100	---	10,100	10,100	---
4. Space research and technology	107,300	107,300	---	109,400	109,400	---
5. Aeronautical research and technolog	264,100	264,100	---	244,000	244,000	---
6. Energy technology	5,000	5,000	---	5,700	5,700	---
7. Supporting activity:						
(a) Tracking and data acquisition..	302,000	302,000	---	301,100	301,100	---
Total direct program	3,292,200	3,477,200	185,006	3,272,000	3,457,000	185,000

Program and Financing (in thousands of dollars)

Research and Development

Identification Code: 80-0108-4-1-999	Budget Plan (amounts for research and development actions programmed)			Costs and Obligations		
	1979 Presently available	1979 Revised estimate	1979 Proposed supplemental	1979 Presently available	1979 Revised estimate	1979 Proposed supplemental
Reimbursable program:						
1. Space transportation systems:						
(a) Space shuttle....	34,594	34,594	---	29,860	29,860	---
(b) Space flight operations	63,574	63,574	---	61,710	61,710	---
2. Scientific investigations in space:						
(a) Physics and astronomy	600	600	---	3,440	3,440	---
(c) Life sciences	419	419	---	470	470	---
3. Space and terrestrial applications:						
(a) Space applications	220,973	220,973	---	217,890	217,890	---
(b) Technology utilization	7,293	7,293	---	8,020	8,020	---
4. Space research and technology	---	---	---	1,170	1,170	---
5. Aeronautical research and technology	16,692	16,692	---	18,240	18,240	---
6. Energy technology	158,400	158,400	---	161,830	161,830	---
7. Supporting activity:						
(a) Tracking and data acquisition	3,655	3,655	---	3,570	3,570	---
Total, reimbursable program	506,200	506,200	---	506,200	506,200	---
Total program costs, funded	3,798,400	3,983,400	185,000	3,778,200	3,963,200	185,000
Change in selected resources (undelivered orders and stores)	---	---	---	377,548	377,548	---
10.00 Total	3,798,400	3,983,400	185,000	4,155,748	4,340,748	185,000

Program and Financing (in thousands of dollars)

Research and Development

Identification Code: 80-0108-4-1-999	Budget Plan (amounts for research and development actions programmed)			Costs and Obligations		
	1979	1979	1979	1979	1979	1979
Financing:	Presently available	Revised estimate	Proposed supplemental	Presently available	Revised estimate	Proposed supplemental
Offsetting collections from:						
11.00 Federal funds	-313,184	-313,184	---	-313,184	-313,184	---
14.00 Non-Federal sources	-193,016	-193,016	---	-193,016	-193,016	---
Budget Authority:						
21.40 Unobligated balance available, start of year:						
For completion of prior year budget plans:						
Direct	---	---	---	-240,403	-240,403	---
Reimbursable	---	---	---	-116,945	-116,945	---
40.00 Budget authority (appropriation)	3,292,200	3,477,200	185,000	3,292,200	3,477,200	185,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Program and Financing (in thousands of dollars)

A-11-39B

Research and Development

Identification Code: 80-0108-4-1-999	Budget Plan (amounts for research and development actions programmed)			Costs and Obligations		
	1979	1979	1979	1979	1979	1979
	Presently available	Revised estimate	Proposed supplemental	Presently available	Revised estimate	Proposed supplemental
Relation of obligations to outlays:						
71.00 Obligations incurred, net				3,649,548	3,834,548	185,000
72.40 Obligated balance, start of year				515,865	515,865	---
74.40 Obligated balance, end of year				-1,016,913	-1,038,713	-21,800
90.00 Outlays				3,148,500	3,311,700	163,200

Note: Reconciliation of budget plan to obligations:	1979 estimate		
	Presently available	Revised estimate	Proposed supplemental
Total budget plan	3,798,400	3,983,400	185,000
Add obligations of prior year budget plans	357,348	357,348	---
Total obligations	4,155,748	4,340,748	185,000

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NATIONAL AERONAUTICS AND SPACE **ADMINISTRATION**
RESEARCH **AND DEVELOPMENT**

OBJECT CLASSIFICATION (in thousands of dollars)

A-11-34

Identification code 80-0108-4-1-999	1979 Present Available	1979 Revised Estimate	1979 Proposed Supplemental
Direct obligations:			
~~11.1 Permanent positions~~			
~~11.3 Positions other than permanent~~			
~~11.5 Other personnel compensation~~			
~~11.8 Special personal services payments~~			
~~Total personnel compensation~~			
Personnel benefits:			
~~12.1 Civilian~~			
~~13.0 Benefits for former personnel~~			
~~21.0 Travel and transportation of persons~~			
22.0 Transportation of things	8,950	9,510	560
23.1 Standard level user charges	141	141	---
23.2 Communications, utilities and other rent	44,480	46,880	2,400
24.0 Printing and reproduction	2,900	3,090	190
25.0 Other services	3,246,590	3,416,970	170,380
26.0 Supplies and materials	143,250	150,650	7,400
31.0 Equipment	81,940	86,010	4,070
32.0 Lands and structures	1,550	1,550	---
~~33.0 Investments and loans~~			
41.0 Grants, subsidies, and contributions	2,802	2,802	---
~~42.0 Insurance claims and indemnities~~			
~~43.0 Interest and dividends~~			
~~44.0 Refunds~~			
99.0 Total direct obligations	3,532,603	3,717,603	185,000

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND DEVELOPMENT

A-11-34

Identification code 80-0108-4-1-999	'979	'979	1979
Reimbursable obligations:	Presently Available	Revised Estimate	Proposed Supplemental
~~11.1 Permanent positions~~			
~~11.3 Positions other than permanent~~			
~~11.5 Other personnel compensation~~			
~~11.8 Special personal services payments~~			
~~Total personnel compensation~~			
Personnel benefits:			
~~12.1 Civilian~~			
~~13.0 Benefits for former personnel~~			
~~21.0 Travel and transportation of persons~~			
22.0 Transportation of things	820	820	---
~~23.1 Standard level user charges~~			
23.2 Communications, utilities and other rent	2,030	2,030	---
24.0 Printing and reproduction	170	170	---
25.0 Other services	595,745	595,745	---
26.0 Supplies and materials	10,165	10,165	---
31.0 Equipment	12,175	12,175	---
32.0 Lands and structures	2,040	2,040	---
~~33.0 Investments and loans~~			
~~41.0 Grants, subsidies, and contributions~~			
~~42.0 Insurance claims and indemnities~~			
~~43.0 Interest and dividends~~			
~~44.0 Refunds~~			
Total reimbursable obligations	623,145	623,145	---
99.0 **Total obligations**	4,155,748	4,340,748	185,000

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