NASA

National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR **1978**

Volume II

Construction of Facilities

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

This appropriation provides for contractual services for the design, major rehabilitation, and modification of facilities; the construction of new facilities; minor construction; the purchase of related equipment and advance design related to facilities planned for future authorization.

The funds requested for 1978 provide for the continuation of prior years' endeavors in meeting the facilities requirements for the space shuttle program; construction and modification of large aeronautical research and development facilities; and construction, rehabilitation, and modification of other facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; and facility planning and design activities.

The projects and amounts reflected in the budget estimate are time sensitive in order to meet the specific milestones established for the first horizontal and manned orbital flights. In addition to space shuttle facilities projects, the estimates include funds for facility modifications to provide for processing space shuttle and spacelab payloads.

The program for FY 1978 also includes the second increment of funding for two large aeronautical facilities, the construction of a National Transonic Facility at the Langley Research Center and modification of the 40- by 80-Foot Subsonic Wind Tunnel at the Ames Research Center. Requirements for these and other aeronautical research and technology facilities are outlined in detail in the enclosed justifications.

Other projects included in the FY 1978 program are in support of scientific investigations in space, space applications, space research and technology, and supporting activities.

The Rehabilitation and Modification of Facilities program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities, and to ensure continued safe, economical and efficient use of the NASA physical plant. The Minor Construction program provides the means to accomplish smaller facility projects which for the most part are to accommodate technical requirements stemming from research, development, test and similar activities.

Funds requested for Facility Planning and Design cover advance planning and design requirements for potential future projects, master planning, facilities studies, and engineering reports and studies.

The request for FY 1978 is $161,800,000, an increase of $43,710,000 over the amount appropriated for FY 1977. Outlays are estimated to be $132,500,000 in FY 1978, an increase of $7,400,000 over the estimate for FY 1977.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION LANGUAGE

Construction of Facilities

For construction, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and for facility planning and design not otherwise provided, for the National Aeronautics and Space Administration, and for the acquisition or condemnation of real property, as authorized by law, [$118,090,000] *$161,800,000*, to remain available for obligation until September 30, [1979] *1980*: *Provided*, That, notwithstanding the limitation on the availability of funds appropriated under this head by this appropriation act, when any activity has been initiated by the incurrence of obligations therefor, the amount available for such activity shall remain available until expended, except that this provision shall not apply to the amounts appropriated pursuant to the authorization for rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and facility planning and design. (*42 U.S.C. 2451, et. seq.; Department of Housing and Urban Development—Independent Agencies Appropriation Act, 1977; additional authorizing legislation to be proposed.*)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Construction of Facilities

Program and Financing (in thousands of dollars)

Identification Code: 80-0107-0-1-999	Budget Plan (amounts for construction of facilities actions programed)				Costs and Obligations			
	1976 actual	TQ actual	1977 estimate	1978 estimate	1976 actual	TQ actual	1977 estimate	1978 estimate
Program by activities:								
Direct program:								
1. Space flight	47,220		30,695	65,740	65,273	12,444	56,100	52,500
2. Scientific investigations in space			8,120	6,410	9,783	1,800	5,800	6,900
3. Space applications				3,100	−21		100	1,400
4. Space research and technology			890		257	56	400	400
5. Aeronautical research and technology	4,635		34,990	38,400	8,413	1,148	26,900	32,000
7. Supporting activities	30,275	10,750	43,645	48,150	35,442	9,862	37,500	49,500
Total direct program costs, funded	82,130	10,750	118,090	161,800	119,147	25,310	126,800	142,700
Reimbursable program:								
7. Supporting activities (reimbursable program costs)	3,000				2,918	282	200	
Total program costs, funded	85,130	10,750	118,090	161,800	122,065	25,592	127,000	142,700
Change in selected resources (undelivered orders)					−24,753	−4,072	18,600	18,700
10.00 Total	85,130	10,750	118,090	161,800	97,312	21,520	145,600	161,400
Financing:								
11.00 Offsetting collections from: Federal funds	−3,000				−3,000			
21.00 Unobligated balance available, start of period: For completion of prior period budget plans:								
Direct					−116,430	−104,493	−93,386	−65,990
Reimbursable					−400	−155	−114	
24.00 Unobligated balance available, end of period: For completion of prior period budget plans:								
Direct					104,493	93,386	65,990	66,390
Reimbursable					155	114		
25.00 Unobligated balance lapsing						378		
40.00 **Budget authority (appropriation)**	82,130	10,750	118,090	161,800	82,130	10,750	118,090	161,800
Relation of obligations to outlays:								
71.00 Obligations incurred, net					94,312	21,520	145,600	161,400
72.00 Obligated balance, start of period					108,608	82,003	77,738	98,238
74.00 Obligated balance, end of period					−82,003	−77,738	−98,238	−127,138
90.00 Outlays					120,917	25,785	125,100	132,500

Note.—Reconciliation of budget plan to obligations:	1976 act.	TQ act.	1977 est.	1978 est.
Total budget plan	85,130	10,750	118,090	161,800
Deduct portion of budget plan to be obligated in subsequent periods	56,759	9,317	28,590	40,400
Add obligations of prior period budget plans	68,941	20,087	56,100	40,000
Total obligations	97,312	21,520	145,600	161,400

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY OF THE BUDGET PLAN BY LOCATION

Location	FY 1976	Transition Quarter	FY 1977	FY 1978
		(In Dollars)		
Ames Research Center	2,695,000	---	4,490,000	---
Hugh L. Dryden Flight Research Center	---	---	750,000	420,000
Goddard Space Flight Center	---	---	---	3,100,000
Jet Propulsion Laboratory	---	---	---	2,830,000
Lyndon B. Johnson Space Center	---	---	2,200,000	2,540,000
John F. Kennedy Space Center	---	---	2,805,000	2,130,000
Langley Research Center	1,940,000	---	6,185,000	1,770,000
Lewis Research Center	---	---	2,170,000	860,000
National Space Technology Laboratories	---	---	---	620,000
Large Aeronautical Facilities	---	---	31,000,000	37,000,000
Various Locations	---	---	---	1,750,000
Space Shuttle Facilities	47,220,000	---	30,695,000	65,740,000
Space Shuttle Payload Facilities	---	---	4,340,000	6,410,000
Rehabilitation and Modification	16,000,000	7,000,000	17,875,000	18,900,000
Minor Construction	5,000,000	1,250,000	2,925,000	5,950,000
Facility Planning and Design	9,275,000	2,500,000	12,655,000	11,780,000
Total Plan	82,130,000	10,750,000	118,090,000	161,800,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

	FY 1976	Transition Quarter	FY 1977	FY 1978
		(In Dollars)		
SUMMARY OF THE BUDGET PLAN BY COGNIZANT OFFICE				
Office of Space Flight	47,220,000	---	34,625,000	72,150,000
Office of Space Science	---	---	2,970,000	---
Office of Applications	---	---	---	3,100,000
Office of Aeronautics and Space Technology	4,635,000	---	36,850,000	37,980,000
Office of Tracking and Data Acquisition	---	---	750,000	1,750,000
Office of Center Operations	---	---	9,440,000	10,190,000
NASA Comptroller	30,275,000	10,750,000	33,455,000	36,630,000
Total Plan	82,130,000	10,750,000	118,090,000	161,800,000

SUMMARY OF THE BUDGET PLAN BY SUBFUNCTION

Code No.	Title				
253	Space Flight	47,220,000	---	30,695,000	65,740,000
254	Space Science, Applications and Technology	---	---	8,800,000	9,510,000
255	Supporting Space Activities	30,275,000	10,750,000	43,645,000	48,150,000
(250)	Subtotal, General Science, Space and Technology	77,495,000	10,750,000	83,140,000	123,400,000
405	Air Transportation	4,635,000	---	34,950,000	38,400,000
	Total	82,130,000	10,750,000	118,090,000	161,800,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

BUDGET PLAN BY LOCATION AND PROJECT

Cognizant Office	Subfunction Code	Installation and Project	FY 1976	Transition Quarter	FY 1977	FY 1978	Page No.
			(In Thousands of Dollars)				
		Ames Research Center	2,695	---	4,490	---	
AST	254	Modification for high enthalpy entry facility.....	---	---	1,220	---	
AST	405	Modification of flight simulator for advanced aircraft.....	---	---	1,730	---	
Cntr Ops	255	Construction of supply support facility.....	---	---	1,540	---	
AST	405	Modification of 11 by 11-foot transonic wind tunnel.....	2,695	---	---	---	
		Hugh L. Dryden Flight Research Center	---	---	750	420	
Cntr Ops	405	Construction of central hydraulic system.....	---	---	---	420	CF 1-1
TDA	255	Construction of addition to flight control facility.....	---	---	750	---	
		Goddard Space Flight Center	---	---	---	3,100	
OA	254	Construction of additional technical processing facilities.....	---	---	---	3,100	CF 2-1
		Jet Propulsion Laboratory	---	---	---	2,830	
Cntr Ops	255	Modifications to various buildings for seismic protection.....	---	---	---	2,830	CF 3-1

Cognizant Office	Subfunction Code	Installation and Project	FY 1976	Transition Quarter	FY 1977	FY 1978	Page No.
			(In Thousands of Dollars)				
		Lyndon B. Johnson Space Center	---	---	2,200	2,540	
Cntr Ops	255	Modification of chillers in central heating and cooling plant.....	---	---	---	2,540	CF 4-1
SS	254	Construction of addition to lunar sample curatorial facility.....	---	---	2,200	---	
		John F. Kennedy Space Center	---	---	2,805	2,130	
Cntr Ops	255	Modifications for utility control system.....	---	---	2,445	2,130	CF 5-1
SF	254	Construction of airlock to spin test facility.....	---	---	360	---	
		Langley Research Center	1,940	---	6,185	1,770	
Cntr Ops	255	Rehabilitation of main heating plant.....	---	---	---	790	CF 6-1
AST	405	Rehabilitation of unitary plan wind tunnel.....	---	---	---	980	CF 6-6
AST	405	Construction of addition for aeroelastic model laboratory.....	---	---	730	---	
Cntr Ops	255	Construction of data reduction center annex.....	---	---	2,970	---	
Cntr Ops	255	Construction of refuse-fired steam generating facility.....	---	---	2,485	---	
AST	405	Addition for composite model and metal finishing shops.....	1,940	---	---	---	
		Lewis Research Center	---	---	2,170	860	
Cntr Ops	255	Modification of central chilled water system.....	---	---	---	860	CF 7-1
AST	254	Modification of refrigeration system, electric propulsion laboratory.....	---	---	680	---	
AST	405	Rehabilitation of combustion air drying system, engine research building.....	---	---	1,490	---	

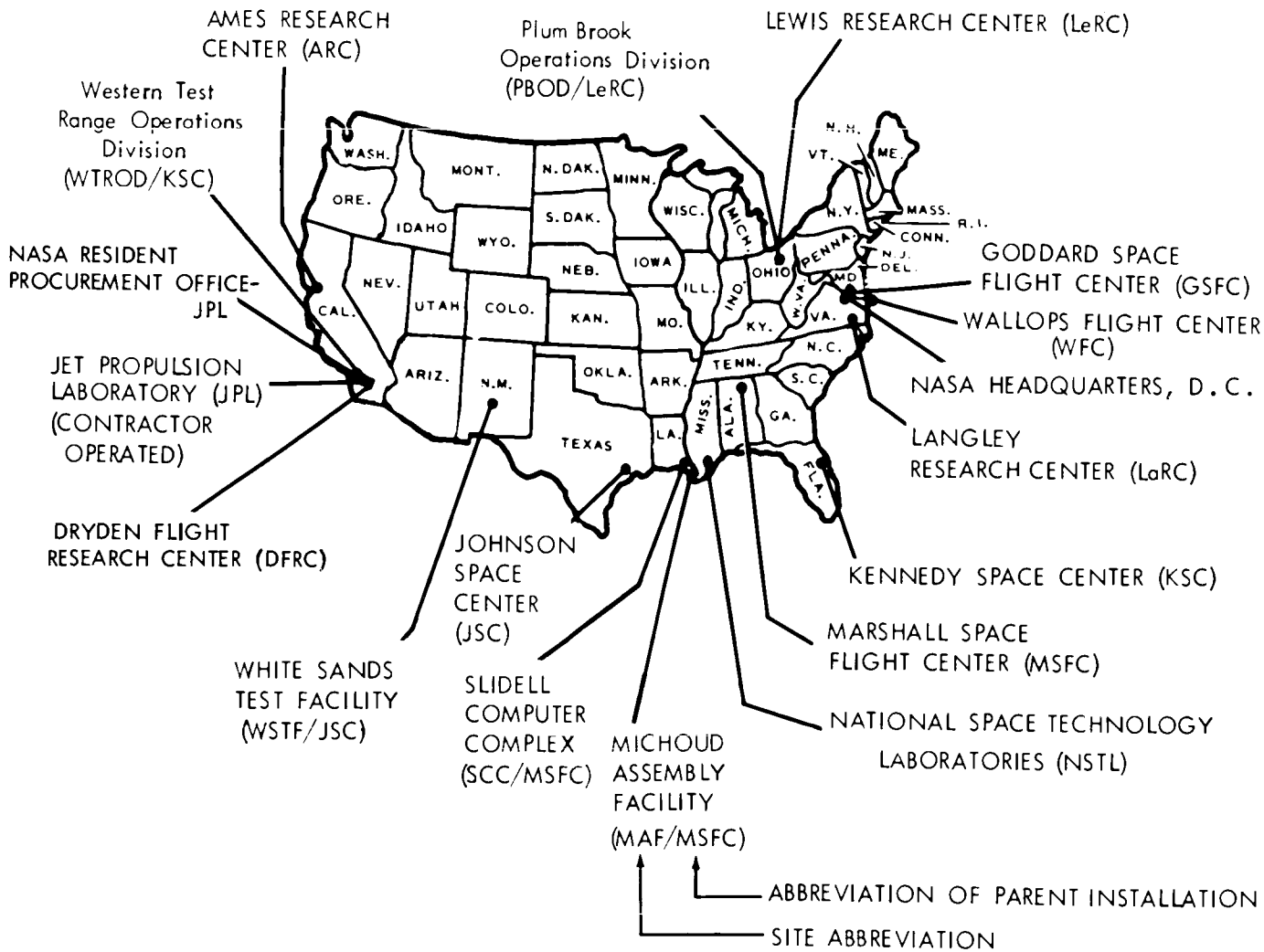
Cognizant Office	Subfunction Code	Installation and Project	FY 1976	Transition Quarter	FY 1977	FY 1978	Page No.
			(In Thousands of Dollars)				
		National Space Technology Laboratories	---	---	---	620	
Cntr Ops	255	Modifications for utility control system.....	---	---	---	620	CF 8-1
		Large Aeronautical Facilities as Follows:	---	---	31,000	37,000	
AST	405	Construction of national transonic facility (LaRC).....	---	---	25,000	23,500	CF 9-3
AST	405	Modification of 40- by 80-foot subsonic wind tunnel (ARC).....	---	---	6,000	13,500	CF 9-17
		Various Locations	---	---	---	1,750	
TDA	255	Rehabilitation and modification of 64-meter antenna components.....	---	---	---	1,750	CF 10-1
		Space Shuttle Facilities at Various Locations as Follows:	47,220	---	30,695	65,740	
SF	253	Modifications to launch complex 39 (KSC).....	13,110	---	12,855	40,700	CF 11-4
SF	253	Modifications for solid rocket booster processing facilities (KSC).....	5,240	---	8,700	1,730	CF 11-15
SF	253	Rehabilitation of barge channels (KSC).....	---	---	---	2,090	CF 11-21
SF	253	Modifications for crew training facilities (JSC).....	830	---	---	860	CF 11-26
SF	253	Modification of manufacturing and final assembly facilities for external tanks, (MAF).....	---	---	1,930	18,610	CF 11-33
SF	253	Rehabilitation and modification of shuttle facilities, at various locations.....	---	---	1,760	1,750	CF 11-43

Cognizant Office	Subfunction Code	Installation and Project	FY 1976	Transition Quarter	FY 1977	FY 1978	Page No.
			(In thousands of Dollars)				
SF	253	Construction of orbiter processing facility (KSC).....	8,160	---	3,750	---	
SF	253	Construction of shuttle/carrier aircraft mating facilities (FRC, Palmdale, Calif., and KSC).....	3,890	---	1,700	---	
SF	253	Modifications for hypergolic checkout and refurbishment facilities (KSC).....	6,940	---	---	---	
SF	253	Modifications for launch equipment test facilities (KSC).....	1,960	---	---	---	
SF	253	Construction of orbiter approach and landing test facilities (FRC, Calif. and Palmdale, Calif.).....	1,680	---	---	---	
SF	253	Modification of the vibration and acoustic test facility (JSC).....	2,410	---	---	---	
SF	253	Modifications for solid rocket booster component manufacturing and assembly facilities (location to be designated).....	3,000	---	---	---	
		Space Shuttle Payload Facilities at Various Locations as Follows:	---	---	4,340	6,410	
SF	254	Modifications and addition for shuttle payload vertical processing (KSC).....	---	---	---	6,410	CF 12-1
SF	254	Modifications to operations and checkout building for spacelab (KSC).....	---	---	3,570	---	
SS	254	Modifications and addition for shuttle payload development (GSFC).....	---	---	770	---	
COMPT	255	Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of $500,000 Per Project.....	16,000	7,000	17,875	18,900	CF 13-1

Cognizant Office	Subfunction Code	Installation and Project	FY 1976	Transition Quarter	FY 1977	FY 1978	Page No.
			(In Thousands of Dollars)				
COMPT	255	Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations, Not in Excess of $250,000 Per Project	5,000	1,250	2,925*	5,950	CF 14-1
COMPT	255	Facility Planning and Design	9,275	2,500	12,655	11,780	CF 15-1
		TOTAL PLAN	82,130	10,750	118,090	161,800	

* In FY 1977 the Minor Construction Program totaled $5,125,000. Within the amount authorized by PL 94-307 and subsequently permitted by Appropriation Conference Report No. 94-1362, dated July 22, 1976, $2,200,000 of the $5,125,000 was redirected to the Lunar Sample Curatorial Facility at the Johnson Space Center. Priority minor construction work resulting from this redirection has been incorporated in the FY 1978 request.

LOCATION OF NASA MAJOR AND COMPONENT INSTALLATIONS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

REPORT OF CAPITAL TYPE PROPERTY
BY REPORTING INSTALLATION
AS OF SEPTEMBER 30, 1979
(Dollars in Thousands)

Reporting Installation	Real Property: Land	Buildings	Other Structures and Facilities	Leasehold Improvements	Total	Plant Equipment	Fixed Assets in Progress	Grand Total
Ames Research Center	2,425	197,345	7,282	---	209,058	115,308	12,826	337,192
ARC - Moffett Field, CA	2,425	198,848	7,282	---	209,058	111,827	12,826	333,711
Various Locations (a)	--	---	---	---	---	3,481	---	3,481
Flight Research Center	---	10,401	3,286	---	13,687	61,437	2,543	77,667
FRC - Edwards AFB, CA	---	10,401	3,286	---	13,687	57,827	2,543	74,057
Various Locations (a)	---	---	---	---	---	3,610	---	3,610
Goddard Space Flight Center	1,661	47,198	58,904	372	157,835	484,554	15,865	658,266
GSFC - Greenbelt, MD	1,308	80,786	16,161	41	98,336	203,267	10,879	312,482
Tracking Stations (Networks)	353	16,321	42,700	41	59,465	261,150	4,986	325,601
Various Locations (a)	---	1	45	---	46	20,137	---	20,183
Jet Propulsion Laboratory	1,067	79,370	66,846	530	147,813	217,765	21,069	386,647
JPL - Pasadena, CA	1,067	67,797	8,174	385	77,423	127,704	21,069	226,196
Deep Space Network	---	11,573	58,672	145	70,390	90,061	---	160,451
Langley Research Center	162	132,810	155,451	---	288,423	145,903	57,914	492,240
LaRC - Hampton, VA	156	117,406	155,375	---	272,937	131,321	57,914	462,172
Various Locations (a)	6	15,404	76	---	15,486	14,582	---	30,068
Lewis Research Center	3,662	213,168	74,983	139	291,952	118,544	6,420	416,916
LeRC - Cleveland, OH	316	128,451	56,135	139	185,041	89,035	6,420	280,496
Plum Brook Operations Division								
PBOD - Sandusky, OH	3,346	84,717	18,848	---	106,911	13,097	---	120,008
Various Locations (a)	---	---	---	---	---	16,412	---	16,412
Johnson Space Center	9,047	191,551	58,986	116	259,700	409,576	35,733	705,009
JSC - Houston, TX	5,477	156,797	33,667	63	196,004	330,488	17,047	543,539
White Sands Test Facility								
WSTF-Las Cruces, NM	---	8,773	20,289	---	29,062	---	---	29,062
Various Locations (a)	3,570	25,981	5,030	53	34,634	79,088	18,686	132,408
Kennedy Space Center	71,345	297,983	334,938	---	704,266	773,035	60,057	1,537,358
KSC - Cape Canaveral, FL	71,345	297,983	334,938	---	704,266	767,122	59,709	1,531,097
Western Test Range Operations Div.								
WTROD - Lompoc, CA	---	---	---	---	---	5,039	348	5,387
Various Locations (a)	---	---	---	---	---	874	---	874
Marshall Space Flight Center	7,587	198,136	111,500	---	317,223	427,131	15,430	759,784
MSFC - Huntsville, AL	---	120,132	56,660	---	176,792	273,147	15,081	465,020
Michoud Assembly Facility								
MAF - New Orleans, LA	7,522	66,102	27,513	---	101,137	31,579	---	132,716
Slidell Computer Complex								
SCC - Slidell, LA	65	4,612	973	---	5,650	19,204	---	24,854
Various Locations (a)	---	7,290	26,354	---	33,644	103,201	349	137,194
National Space Technology Laboratories	18,074	64,865	187,283	---	270,222	47,304	---	317,526
NSTL - Bay St. Louis, MS	18,074	64,865	187,283	---	270,222	47,304	---	317,526
Wallops Flight Center	1,277	23,577	51,073	---	75,927	55,915	3,598	135,440
WFC - Wallops Island, VA	1,277	23,577	51,073	---	75,927	54,409	3,598	133,934
Various Locations (a)	---	---	---	---	---	1,506	---	1,506
NASA Headquarters	---	---	---	---	---	11,592	---	11,592
Washington, DC	---	---	---	---	---	3,732	---	3,732
Various Locations (a)	---	---	---	---	---	7,860	---	7,860
TOTAL	119,810	1,307,817	1,110,534	957	2,538,118	2,888,084	231,422	5,657,624

(a) Includes Capital Type Property in possession of Contractors at Various Locations.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

HUGH L. DRYDEN FLIGHT RESEARCH CENTER

	Amount	Page No.
Office of Center Operations:		
Construction of central hydraulic system.....	420,000	CF 1-1

HUGH L. DRYDEN FLIGHT RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF CENTRAL HYDRAULIC SYSTEM

LOCATION PLAN

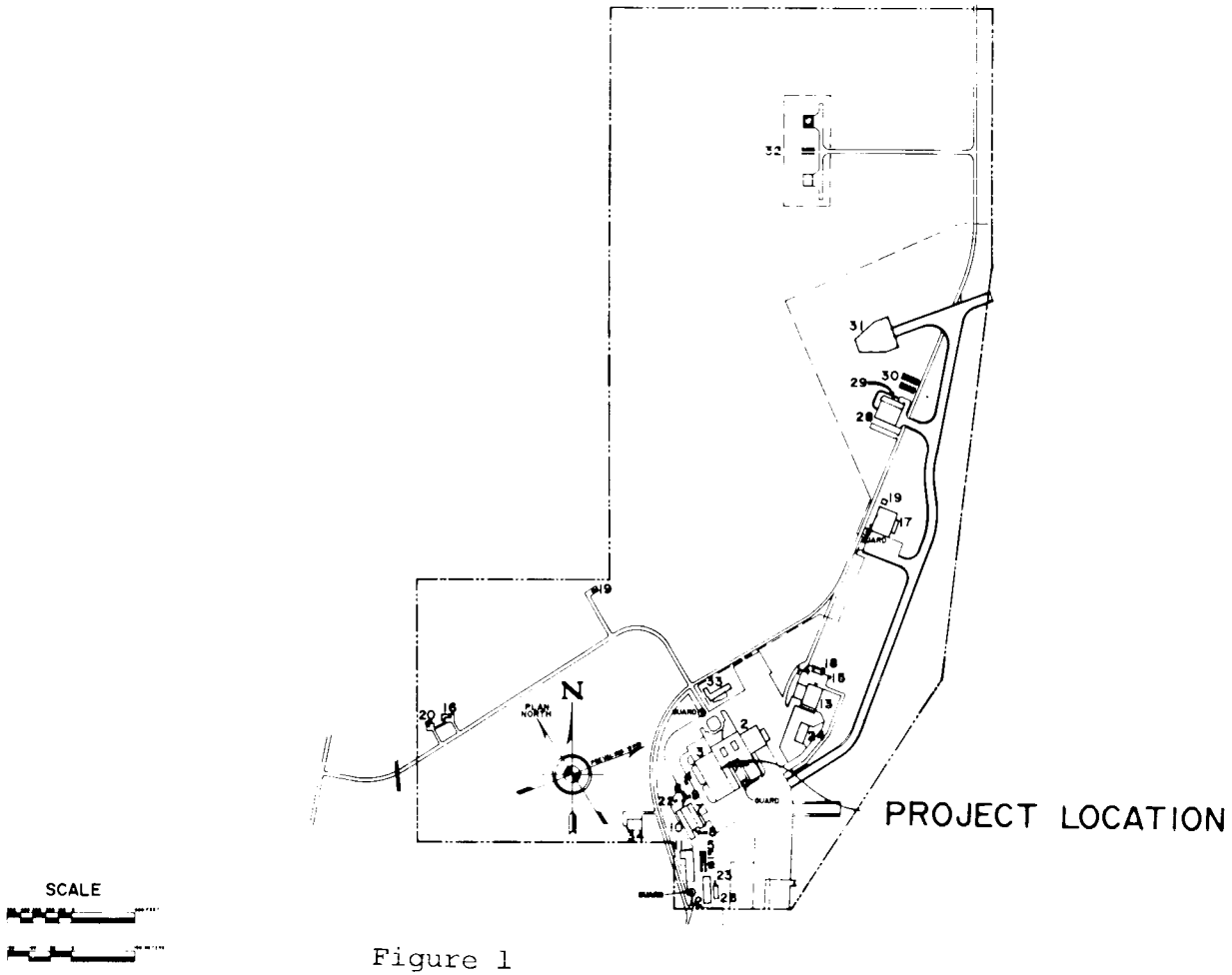


Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Construction of Central Hydraulic System
INSTALLATION:	Hugh L. Dryden Flight Research Center
FY 1978 CoF ESTIMATE:	$420,000

LOCATION OF PROJECT: Edwards, Kern County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	22,800	---	22,800
Other affiliated funding	---	---	---
Total	22,800	---	22,800

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide for the construction and installation of a central hydraulic system for the main aircraft hangar, Building 4802, at the Dryden Flight Research Center (DFRC) for use during ground testing and maintenance of research and support aircraft at the Center. The project location is shown in Figure 1. The proposed system will replace the aging portable hydraulic units now being used. The portable units have limited capacity and are becoming subject to increasing risks while in use. The new central system will have increased capability and will eliminate noise and other hazards associated with the use of portable units. It will also provide increased reliability and flexibility, and will require minimum maintenance.

PROJECT JUSTIFICATION:

The NASA Dryden Flight Research Center presently operates about sixteen aircraft in conducting its flight research activities. This group of aircraft includes high speed aircraft such as the YF-12, F-15, F-104, also conventional and jet powered aircraft. In the future, it is anticipated that newer high performance and other research aircraft will be assigned to DFRC (e.g. F-16, F-17, X-24C, etc.).

Almost all of the aircraft now at DFRC have one or more independent hydraulic systems that are used to provide power for landing gear, flaps, dual flight control systems, speed brakes, and/or wing sweep. As newer and more advanced aircraft are developed, the reliance on and requirements of the aircraft hydraulic systems will increase. For example, while both the F-8 and the F-111 have 3000 psi systems, the F-8 requires hydraulic fluid flow rates of 10-12 gallons per minute (GPM) and the F-111, a later aircraft, requires hydraulic fluid flow rates of 30-40 GPM. It is expected that newer high performance aircraft may require even higher pressures and flow rates for their flight control systems.

To properly maintain and prepare these "hydraulically operated" aircraft for flight requires a source of hydraulic power on the ground to activate these aircraft systems so that the necessary checks, calibrations, adjustments and, if needed, trouble-shooting can be accomplished. Some of these operations involve hydraulic power for all systems to be applied eight hours a day for several days before the aircraft can be released for test or other flight.

At the present time, this ground hydraulic power is being provided by 14 heavy and portable hydraulic test units. However, the portable units are rapidly becoming inadequate to meet the present requirements, without consideration for future needs. Of the fourteen portable units now in use, seven were manufactured in 1955, four in 1957, and three in 1960. Because of the age of these units, replacement parts are no longer in stock and it has become necessary within the last year to "cannibalize" three other units to keep the remaining units in operation. The decreasing reliability and increasing maintenance requirements of these portable units are of major concern. They are also extremely noisy, expecially when operated inside a hangar. The noise, which exceeds the acceptable 85db level, is such that it interferes with normal speech communications in the hangar. To reduce the noise level, some of the continuous duty units have been enclosed in air conditioned "sheds" which occupy limited hangar floor space. In addition, only four of these portable units are now capable of exceeding a flow rate of 16 GPM and these four are limited to a maximum rate of 30 GPM, which is insufficient to satisfy the demand of the F-15 and the F-111. Six of the present portable units have maximum outputs of only 10 GPM.

To continue to provide the necessary ground hydraulic power support for the current and future flight activities at DFRC, the portable hydraulic test units must be replaced and the total system capability upgraded to meet present as well as anticipated demands of the newer research aircraft. To accomplish this in

the most effective manner, NASA has determined that the installation of a central hydraulic system for the main aircraft hangar, Building 4802, will provide the best answer. The central system will have advantages not readily available with replacement of the portable units now being used.

Aircraft currently hangared in Building 4802 include five F-104's (with two 3000 psi-20 GPM systems each), one F-111 (with two 3000 psi 30-40 GPM systems), one T-37 (with one 1500 psi-10 GPM system), and one T-38 (with two 3000 psi-10 GPM systems). In the near future a Jet Star and two F-15's (with three 3000 psi-36 GPM systems) will also be hangared there, as will any new acquisitions such as the F-16 or F-17. Installation of a central hydraulic system for Building 4802 for these research and support aircraft will eliminate the need for single or dual portable hydraulic units. Some of these units would have to be designed especially for a particular aircraft and would require electrical power that exceeds the present capacity of the wiring in the hangar. In addition, the central system will provide a relatively "noise-free" working environment in the hangar. It will not require additional hangar floor space, nor will it generate heat in the hangar area. It will provide sufficient outlets in the hangar with the proper pressures and flow rates for present aircraft and still allow for long-term growth and flexibility potential at minimum cost. Such a system will permit the operation of only the pumps needed to satisfy the demand, regardless of the number of aircraft systems being used. In addition, it will require a minimum of maintenance while providing a high degree of reliability.

PROJECT DESCRIPTION:

The centralized hydraulic system will consist of four modular pump units, a 600 gallon (2.3 kiloliters) hydraulic fluid central reservoir, a hydraulic fluid distribution piping system, nine single-control consoles and two dual-control consoles located in the main aircraft hangar, Building 4802. An electrical logic circut to automatically control the pump units will also be provided. The pump units and reservoir will be housed in a soundproof enclosure 20 x 60 feet (6.1 x 18.3 meter) that will be constructed adjacent to Substation No. 1 between Buildings 4801 and 4802. This new enclosure will be designed to control the noise in the surrounding area. The hydraulic fluid distribution piping system will be routed in a concrete trench from the enclosure to the south wall of Building 4800 and then to Building 4802. The proposed hydraulic plan layout is shown in Figures 2 and 3.

The centralized hydraulic system will have the capacity and capability of supplying hydraulic fluid from a central reservoir at a maximum flow rate of 200 GPM at 3000 psi to the main hangar through distribution lines running from the reservoir to the single and dual control consoles. The aircraft's hydraulic system will be connected to the control console with a high pressure hydraulic hose. The system will be designed to provide for future growth and have flexibility of adding additional pump units and/or extending the distribution system at some later time.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				157,500
Soundproof enclosure	SF	1,200	41.67	50,000
Concrete slab and trench	LS	---	---	6,700
Hydraulic piping	LS	---	---	77,000
Electrical	LS	---	---	23,800
Equipment				262,500
Hydraulic pump units	EA	4	35,500	142,000
Hydraulic reservoir	LS	---	---	16,100
Cooling tower	EA	1	14,200	14,200
Single-control consoles	EA	9	7,000	63,000
Dual-control consoles	EA	2	13,600	27,200
Fallout Shelter (not feasible)	---	---	---	---
Total				420,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Hydraulic Plan Layout
Figure 3 - Central Hydraulic System Schematic

OTHER EQUIPMENT SUMMARY:

There are no additional known collateral or noncollateral equipment requirements to make this system operational.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no foreseen future funding requirements necessary to complete this work in Hangar Building 4802. However, this system may later be expanded in Hangar Building 4801 as the remaining portable hydraulic units used become inoperable.

HUGH L. DRYDEN FLIGHT RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF CENTRAL HYDRAULIC SYSTEM

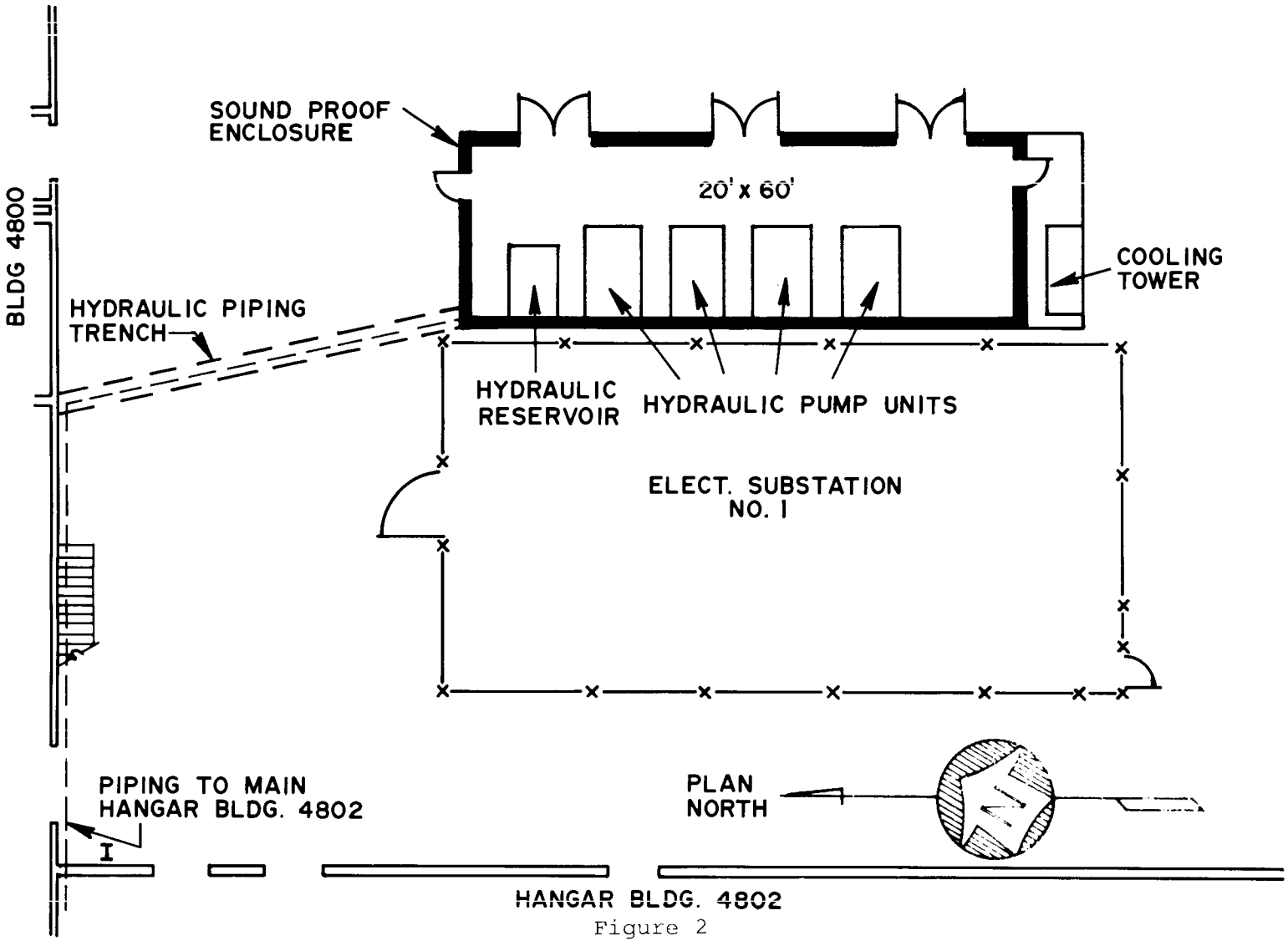


Figure 2

HUGH L. DRYDEN FLIGHT RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF CENTRAL HYDRAULIC SYSTEM

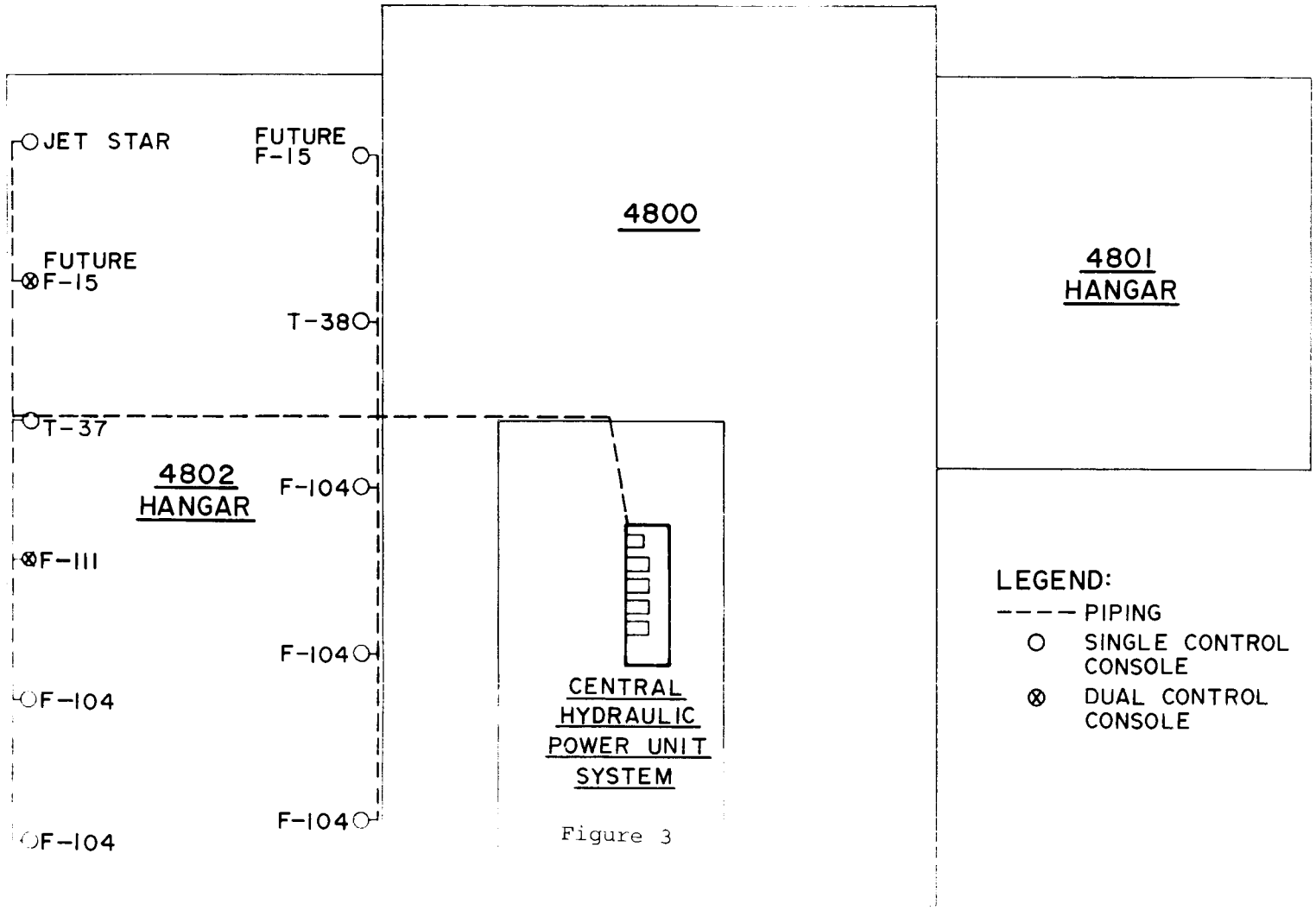


Figure 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

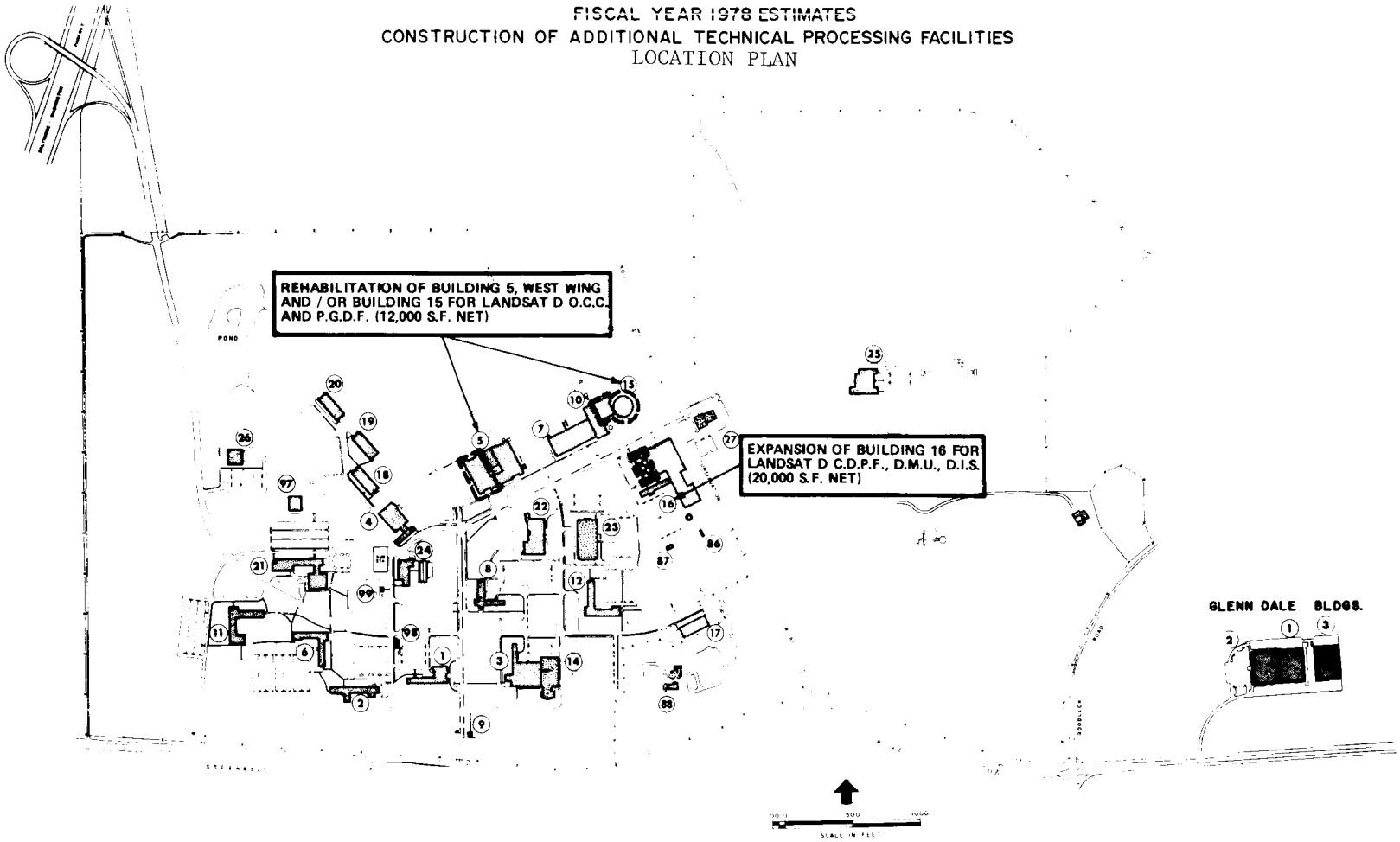
FISCAL YEAR 1978 ESTIMATES

SUMMARY

GODDARD SPACE FLIGHT CENTER

	Amount	Page No.
Office of Applications:		
Construction of additional technical processing facilities.....	3,100,000	CF 2-1

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1978 ESTIMATES
CONSTRUCTION OF ADDITIONAL TECHNICAL PROCESSING FACILITIES
LOCATION PLAN



GODDARD SPACE FLIGHT CENTER
MAIN SITE

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Construction of Additional Technical Processing Facilities
INSTALLATION:	Goddard Space Flight Center
FY 1978 CoF ESTIMATE:	$3,100,000

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Applications

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	210,000	---	210,000
Other affiliated funding	---	10,766,900	10,766,900
Total	210,000	10,766,900	10,976,900

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of an addition to the Development Operations Building, Building 16, and the modification of existing facilities at the Goddard Space Flight Center (GSFC) to satisfy the operations control and data processing requirements for the Landsat-D program.

The objective of the Landsat-D program is to continue the exploration of advanced research and development techniques for satellite-based earth resources remote sensing systems with the experimental thematic mapper (TM). The following functions require that additional space be made available to accommodate the

increased requirements: an Operations Control Center of approximately 6,000 net sq. ft. (558 sq. m) to house the satellite command, control, and equipment operating in conjunction with the existing mission operating computing facility; a Data Management Unit of approximately 5,000 net sq. ft. (460 sq. m) and a Data Input Subsystem of approximately 5,000 net sq. ft. (460 sq. m), both systems will isolate the TM data and send it to the Central Data Processing Facility of approximately 10,000 net sq. ft. (920 sq. m) where it will be processed; the Product Generation and Distribution Facility of approximately 6,000 net sq. ft. (558 sq. m) where the high density tapes, computer compatible tape and latent film will be generated and produced. The development of the TM film masters will take place in multipurpose photographic laboratories which already exist.

The necessary facilities for the Landsat-D Operations Control Center and the Product Generation and Distribution Facility will be obtained by the modification of suitable areas in the Instrument Construction and Installation Laboratory, Building 5 and/or the Launch Phase Simulator, Building 15. The Data Management Unit, Data Input Subsystem, and Central Data Processing Facility will be housed in a 30,000 gross sq. ft. (2,788 sq. m) addition to the Development Operations Building, Building 16. The equipment in these facilities will edit, preprocess, and produce data products which will be distributed to the users by the Earth Resources Operational System (EROS) Data Center/Department of Interior (DOI). The Landsat-D program will provide the opportunity for the user community to test, under realistic conditions, a total information system by bringing the satellite sensed earth resources data to the users in a timely fashion. This project is the minimum level of effort necessary to provide the user community with a total information system for the processing and program operating requirements of the Landsat-D program.

PROJECT JUSTIFICATION:

The Landsat-D program will provide advanced research and development of the use of remotely-sensed data in applications relating to the management of the earth's resources. The major objective of the Landsat-D program is to continue the exploration of advanced research and development techniques for satellite-based earth resources remote sensing systems with the experimental TM.

The Landsat-D program will focus on the test of the TM instrument's capabilities and an improved ground data handling system. The TM offers higher resolving power and additional spectral coverage and promises to open up a significant number of uses as well as to enhance many current uses for Landsat data. The improvements in data quality will enhance the utility of remotely sensed satellite data for mineral and petroleum exploration, expand the application of crop inventory techniques to world-wide small field agriculture areas, and significantly increase the number and precision of land inventory applications in the United States.

The Landsat-D program will also provide the opportunity for the user community (other Government agencies, industry, and the scientific community) to experiment with the TM data and to test, under realistic conditions,

a total information system (spacecraft, ground processing and data analysis), by bringing the satellite sensed earth resources data to the users in a timely fashion (five to seven days).

GSFC's operations control and data processing responsibilities for Landsat-D include mission command and control, operational support computing, pre-data processing, instrument performance evaluation, product generation and distribution, mission utilization, and direct readout.

The planned Landsat-D launch is scheduled in the first quarter of calendar year 1981. This project must be completed by July 1980 to meet this planned launch date in order to provide for operational readiness and checkout of the various Landsat-D systems.

PROJECT DESCRIPTION:

This project proposes the construction of a 30,000 gross sq. ft. (2,788 sq. m) structural steel and industrial siding addition to the Development Operations Building, Building 16. Raised flooring and utilities will be provided for computers necessary to accommodate the processing of the incoming data for the Data Management Unit, Data Input Subsystem, and a Control Data Processing Facility. The modifications in Buildings 5 and/or 15 include the associated moves necessary to provide for the increased space requirements. Modifications to these buildings will require approximately 6,000 net sq. ft. (558 sq. m) of space to satisfy a requirement for an Operations Control Center. These modifications include the necessary raised flooring and utilities to support computer operations. Lastly, approximately 6,000 net sq. ft. (558 sq. m) of space will be modified in these buildings to allow for a Product Generation and Distribution Facility. This work includes the necessary modifications to handle the processing of the high density tape, computer compatible tape and latent film.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	3,100,000
Site work and utilities	---	---	---	250,000
Building 16	LS	---	---	(155,000)
Duct bank	LF	900	105.55	(95,000)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Building 16 Addition	---	---	---	2,160,000
Architectural/structural	SF	30,000	32.00	(960,000)
Mechanical	SF	30,000	21.30	(639,000)
Electrical	SF	30,000	18.70	(561,000)
Building 5/15 (Modification)	---	---	---	690,000
Architectural/structural	SF	12,000	15.00	(180,000)
Mechanical	SF	12,000	11.40	(137,000)
Electrical	SF	12,000	8.25	(99,000)
Relocation modifications	LS	---	---	(274,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,100,000

LIST OF RELATED GRAPHICS:

Location Plan

OTHER EQUIPMENT SUMMARY:

The cost of additional noncollateral equipment required to complete this project is approximately $27,000,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

For presently planned usage, there are no currently foreseen future funding requirements necessary to complete this project. This project, however, is the minimum effort necessary to sustain a program of this size and character. Therefore, if future expansion and increased capability is necessary, increased funding will be required.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

JET PROPULSION LABORATORY

	Amount	Page No.
Office of Center Operations:		
Modifications to various buildings for seismic protection.....	2,830,000	CF 3-1

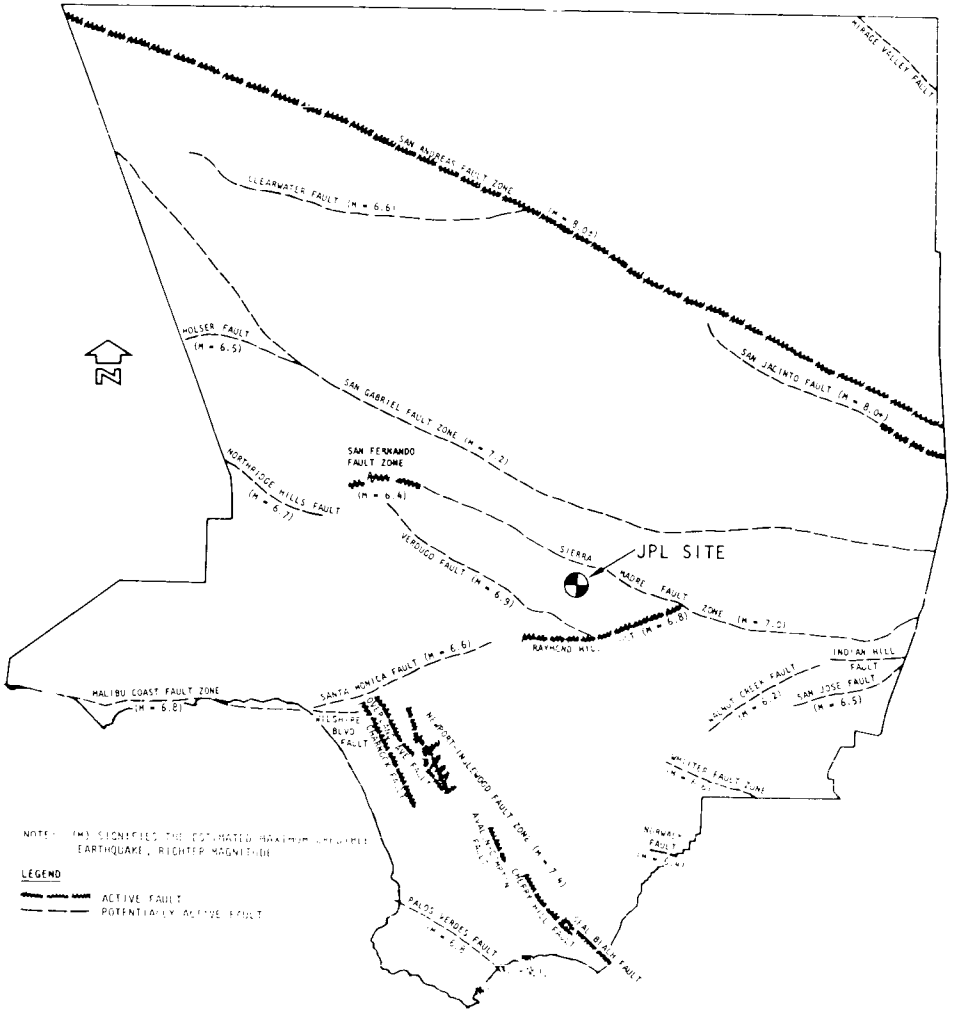
JET PROPULSION LABORATORY

FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION

GEOLOGICAL FAULT MAP OF LOS ANGELES COUNTY

SITE PLAN A



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications to Various Buildings for Seismic Protection
INSTALLATION:	Jet Propulsion Laboratory
FY 1978 ESTIMATE:	$2,830,000

LOCATION OF PROJECT: Pasadena, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	265,000	126,000	391,000
Other affiliated funding	---	250,000	250,000
Total	265,000	376,000	641,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide structural strengthening of those facilities at the Pasadena site which are most susceptible to collapse and potential loss of life in the event of a major earthquake. The seismic hazard at the JPL site is greater than the average hazard for the Los Angeles basin. This is due to the fact that the site is on the active fault system of the San Gabriel Fault zone, and that the site lies within 25 miles of the San Andreas Fault. A JPL Seismic Safety Plan has been developed on the basis of a ten percent probability in 50 years for an earthquake occurring in the San Gabriel Fault zone which would produce a ground shaking that corresponds to a 40 percent of gravity ground acceleration

for 10 to 15 seconds duration, and a 50 percent probablity in 50 years of a major earthquake occurring at the San Andreas Fault, with a 20 percent of gravity ground acceleration for an extended period of time at the site. The evaluation of the investigation conducted in the development of the Seismic Safety Plan has shown conclusively that the earthquake resistance of some JPL facilities should be upgraded. The modification of the eleven buildings included in this project are considered critical because of their more serious structural deficiencies and their use by a large number of occupants which relates to a probable loss of life if the facilities were subjected to earthquakes defined above. This initial phase of the effort is limited to that work which can be accomplished during fiscal year 1978. Additional studies will be made during this year to determine what modifications will be required in the remaining facilities. The modification effort will include reinforcement by adding new shear walls, "guniting" existing walls for greater stiffness, improving bolted connections and the addition of masonry anchors to "tie" roofs and floors to the masonry walls. Other devices will be utilized to better "tie" the buildings together to prevent collapse during intense shaking and provision of automatic shut-offs for utility lines. The modifications envisioned by this project are intended to minimize loss of life due to a major earthquake but not necessarily to insure the survival of any individual buildings involved. The facilities to be modified by this project are therefore major buildings, with a cumulative replacement cost of approximately $48.0 million, for which there is planned utilization throughout the 1980's.

PROJECT JUSTIFICATION:

The JPL site is located in rugged topography at the base of the San Gabriel Mountains. The entire northern portion of the site is steep and mountainous. The lower portion of the site is an alluvial fan, composed mainly of decomposed granite, with slopes of 14 percent. After the 1971 San Fernando Earthquake, geologic investigations located a thrust-type fault running east and west across the northern end of the Laboratory. This fault, identified as the JPL Bridge Fault, has been related to the general fault zone that produced the San Fernando Earthquake and is considered to be potentially active.

Site Plan A shows a geological fault map of the Los Angeles Basin and the location of JPL relative to the San Gabriel Fault zone. Site Plan B shows the "Bridge Fault" trace through the laboratory.

The site is so situated that it is likely that an earthquake generating very strong ground shaking will be experienced at JPL. The protection of human life is of prime importance. Consequently, this project proposes to upgrade the facilities most likely to experience collapse during a major earthquake, but only to the extent deemed essential to protect life. JPL buildings have been designed over the past 35 years to building code requirements in effect at the time of construction and are now found to be inadequate for the earthquake risk at JPL. The codes that were used for design were those generally adopted by cities or counties, and design procedures were based on accepted practice. Codes did not, however, provide an upper

bound criterion for design; they were considered a minimum requirement. In ensuing years, experience has indicated that what has been thought to be a "safe" design is now questionable. This is due mainly to the process of "learning" from earthquakes as they occur. A significant experience milestone was the San Fernando Earthquake of 1971. In the past five years, observations analyses, experiments, and extensive investigations have provided new insight into earthquake resistant design. It is imperative that all the important structures at JPL be strengthened, as required, to ensure that they will not collapse and safe exit from all areas is insured, in the event of ground shaking approximately twice as intense as was experienced at JPL during the San Fernando earthquake (40 percent-g peak ground acceleration). The probability of an earthquake of this magnitude has been estimated at approximately ten percent in 50 years. Another source of seismic hazard at JPL is the San Andreas Fault. Studies show that there is a rather high probability for the occurrence of a large earthquake on the San Andreas Fault to the northeast of JPL, estimated at 50 percent probability during the next 50 years. The taller buildings at JPL would then experience vibrations almost as strong as from a close earthquake.

JPL had initiated studies, soon after the 1971 San Fernando earthquake, based on immediate priorities. As a result, they have investigated over the past several years seismic hazard and the earthquake-resistant characteristics of a significant number of structures. In summary, these investigations consisted of (1) local and regional geology and seismicity, (2) foundation materials, (3) earthquake probabilities and the nature of resulting ground shaking, (4) determination of seismic design criteria, (5) design check of several buildings under the provisions of new codes, (6) dynamic analyses of several buildings, (7) identification of unsafe structures or structural elements, (8) estimated cost of upgrading structures, and (9) estimated cost of replacement of structures. These investigations have been used to develop the JPL Seismic Safety Plan.

PROJECT DESCRIPTION:

This is the first phase to modify the most critical facilities necessary to protect human life. In order to accomplish this, consideration must be given to both nonstructural and structural components. Nonstructural systems or components normally relate to architectural, electrical and mechanical designs. Failure of nonstructural elements can affect life safety in two ways: (1) failure of their connections or anchorage to the main structure or (2) failure of their structural support, allowing components to fall. The modifications necessary to prevent these failures are strengthening of elevator systems by providing hoistway bracing, addition of battery fire alarm and light systems in the event electrical power is terminated, strengthening of stairways to allow for vacating buildings, the tie down of the heating, ventilating and air conditioning equipment to withstand ground shaking, automatic shut-off valves on the water and natural gas line in the event of failure or collapse.

The proposed structural modifications will prevent the collapse of walls and floors. These include adding reinforced concrete shear walls, guniting and reinforcing existing walls for greater stiffness, bracing of ceilings and partitions, adding stiffness to building columns, and the addition of masonry anchors to tie roofs and floors to masonry walls. A typical example of the type of work to be done may be conveyed by a brief review of the specifics with respect to the Engineering and Mechanics Building, Building 157. Seismic investigations reveal that the lateral resistance of this building is inadequate. If a major earthquake were to occur, the walls could possibly fail with the eventual collapse of the floors and roof. In order to remedy this, additional walls designed to withstand the heavier lateral load will be constructed. This five floor building is constructed in such a way that the second floor and all upper floors through the top floor overhang the first floor, thus creating the possibility of overturning during a major earthquake. Column supports, as well as pile footings and caps will be added to alleviate this hazard. In addition, all mechanical and electrical equipment will be tied down as well as the utility lines made flexible so as to better withstand the vibration. Lastly, the elevator system will be strengthened to prevent bending of the guide rails and collapse of the counterweight.

The following facilities will be modified:

Building No.	Building Title	Average Number of Occupants
144	Environmental Laboratory	40
157	The Engineering and Mechanics Building	120
158	Material Research Process Laboratory	85
167	Cafeteria	600
168	Space Sciences Instrument System Laboratory	145
169	Surveyor Project Office	150
183	Physical Science Laboratory	330
198	Guidance Laboratory	240
200	Plant Engineering Services	155
230	Space Flight Operations Facility	260
238	Telecommunications Laboratory	365
	Total	2,490

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,830,000
Modifications to Building 144	LS	---	---	100,000
Modifications to Building 157	LS	---	---	260,000
Modifications to Building 158	LS	---	---	65,000
Modifications to Building 167	LS	---	---	85,000
Modifications to Building 168	LS	---	---	440,000
Modifications to Building 169	LS	---	---	505,000
Modifications to Building 183	LS	---	---	720,000
Modifications to Building 198	LS	---	---	125,000
Modifications to Building 200	LS	---	---	65,000
Modifications to Building 230	LS	---	---	145,000
Modifications to Building 238	LS	---	---	320,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,830,000

LIST OF RELATED GRAPHICS:

Geological Fault Map of Los Angeles County (Site Plan A)
JPL Site Plan showing "Bridge Fault" Trace (Site Plan B)
Second Floor Plan of Building 157
Example of Location of a Shear Wall in Building 157

OTHER EQUIPMENT SUMMARY:

There is no known additional collateral equipment required to be used with this facility.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

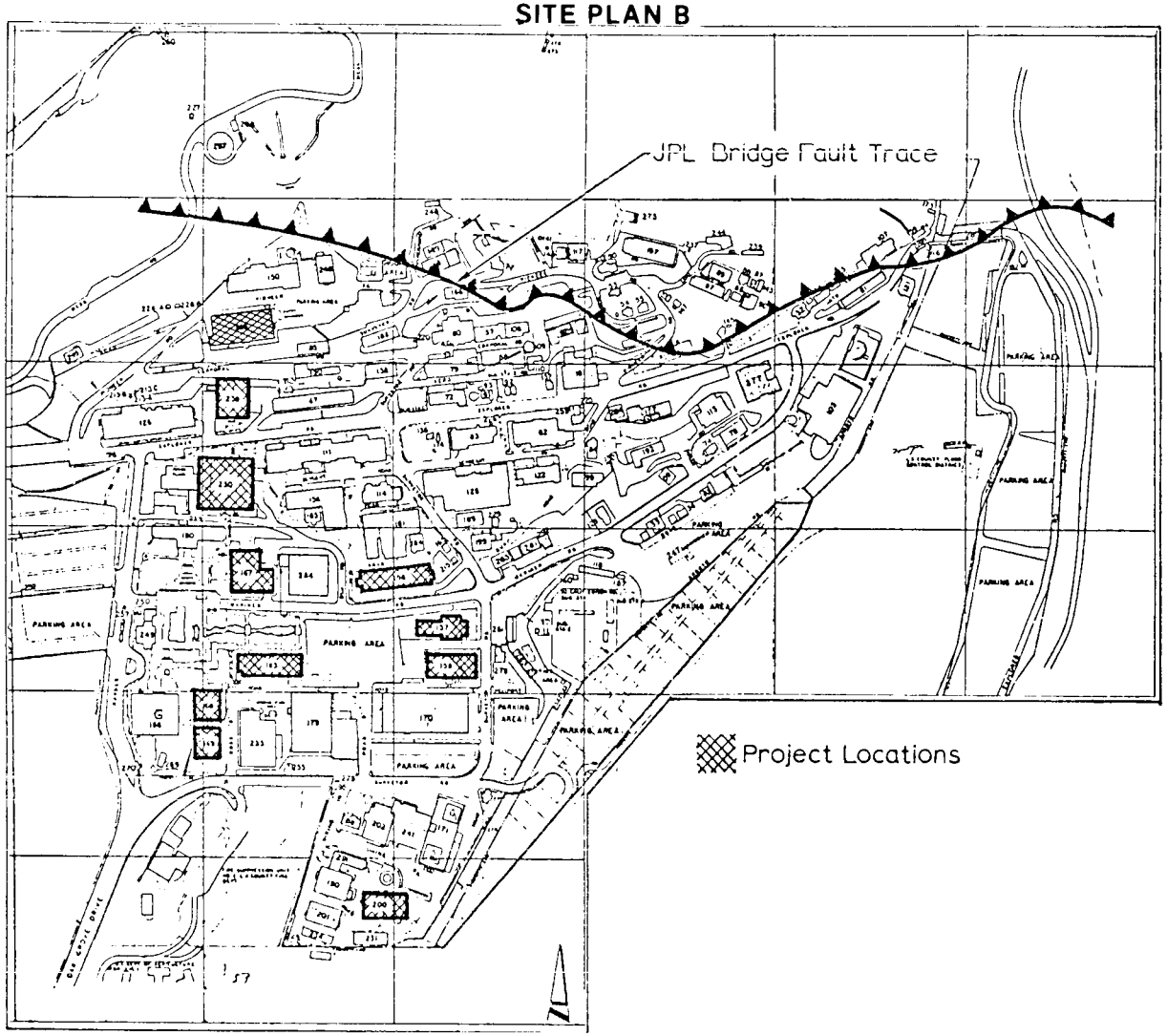
It is anticipated that additional buildings may well have to be modified in order to prevent loss of life. This is being further studied, however, the upper limit of this future estimated cost is now felt to be approximately $1,500,000.

JET PROPULSION LABORATORY

FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION

SITE PLAN B



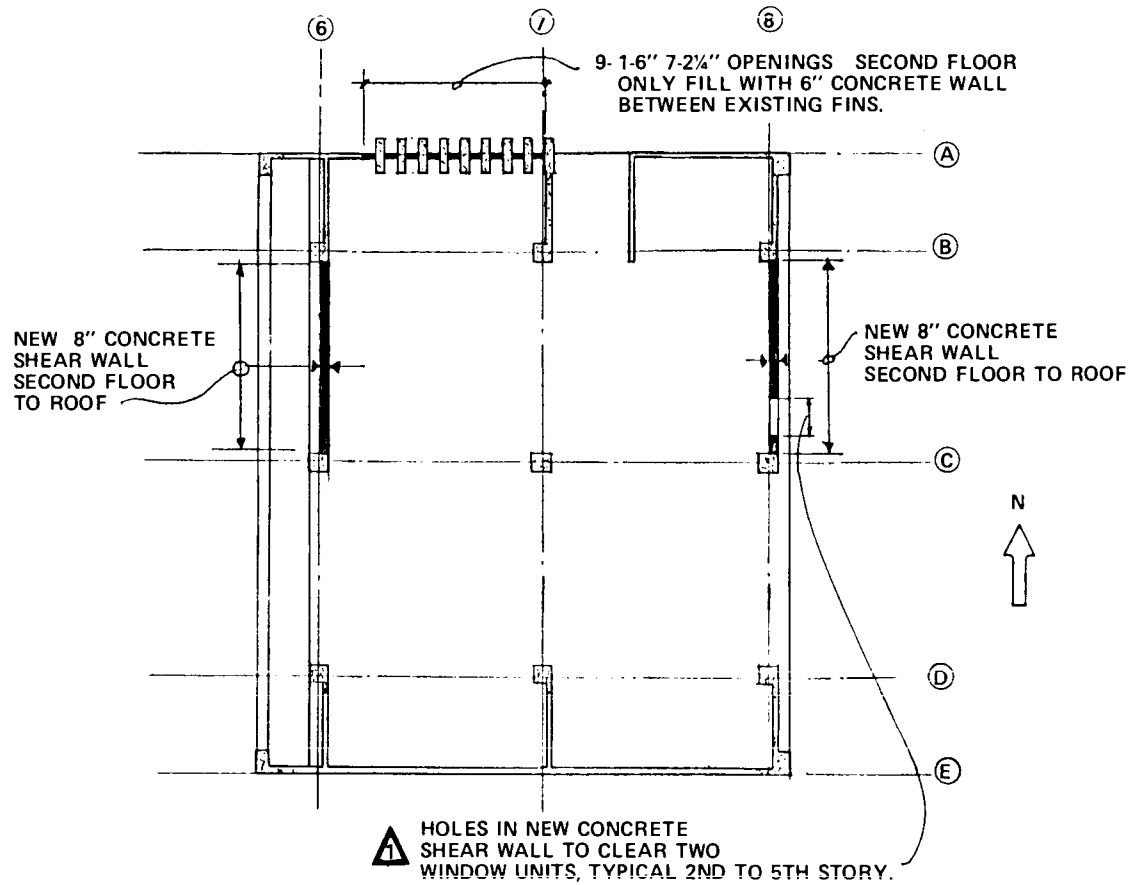
JET PROPULSION LABORATORY

FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION

SECOND FLOOR PLAN

(UPPER FLOORS SIMILAR)

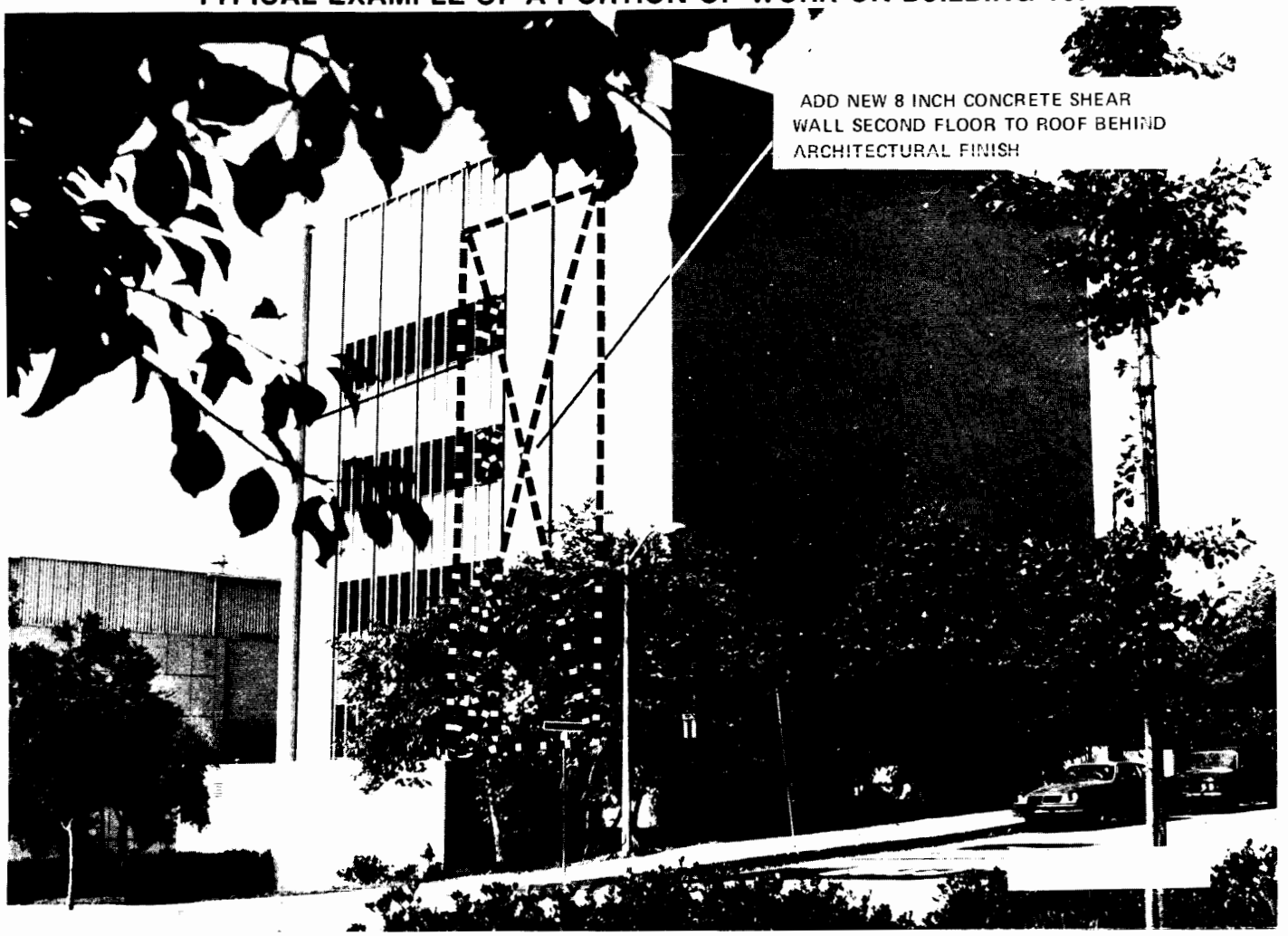


JET PROPULSION LABORATORY

FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION

TYPICAL EXAMPLE OF A PORTION OF WORK ON BUILDING 157



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

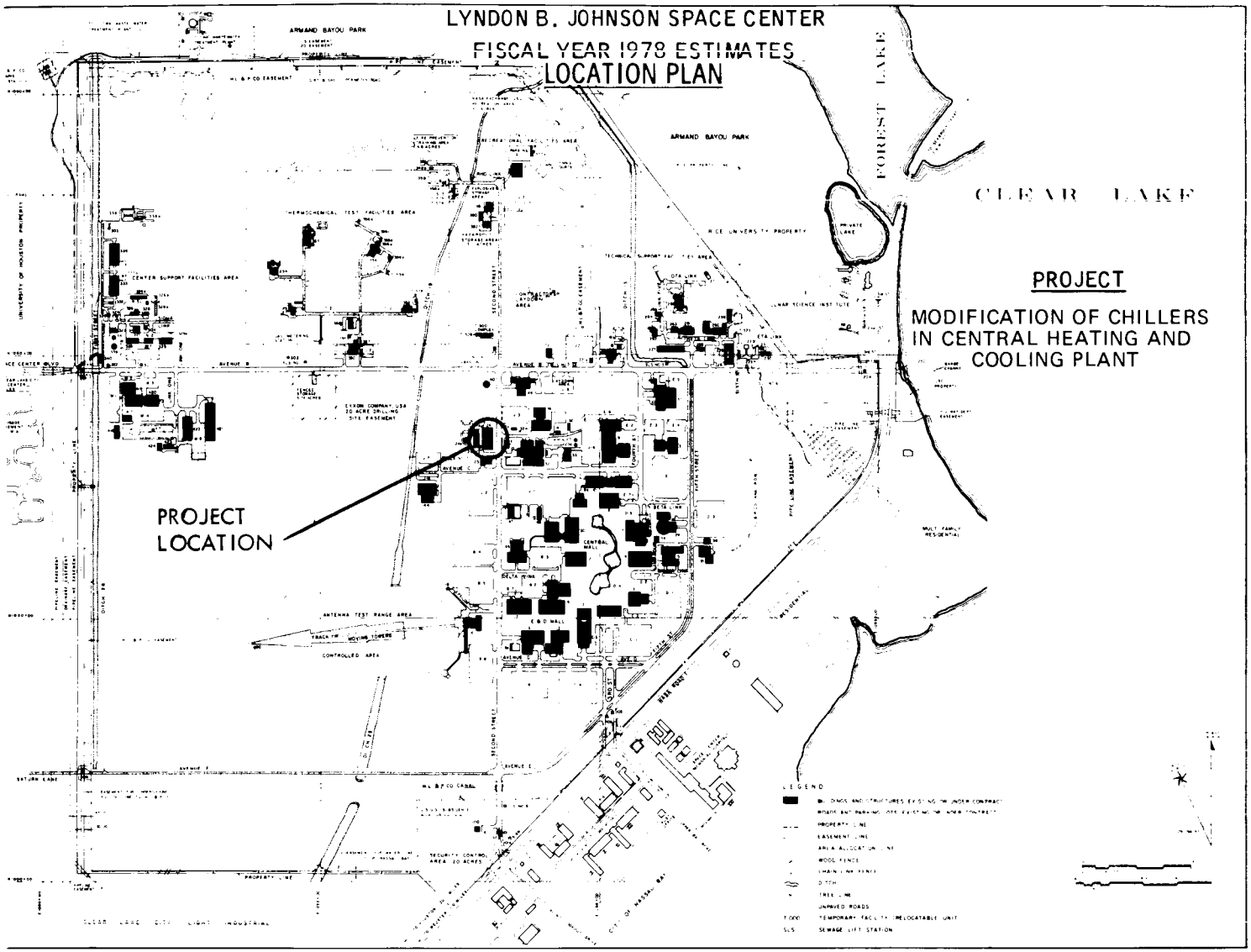
CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

LYNDON B. JOHNSON SPACE CENTER

	Amount	Page No.
Office of Center Operations:		
Modification of chillers in central heating and cooling plant.....	2,540,000	CF 4-1


LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
LOCATION PLAN
ARMAND BAYOU PARK
FOREST LAKE
CLEAR LAKE
PROJECT
MODIFICATION OF CHILLERS IN CENTRAL HEATING AND COOLING PLANT
PROJECT LOCATION
THERMOCHEMICAL TEST FACILITIES AREA
CENTER SUPPORT FACILITIES AREA
RICE UNIVERSITY PROPERTY
ANTENNA TEST RANGE AREA
CONTROLLED AREA
SECURITY CONTROL AREA 20 ACRES
MULTI-FAMILY RESIDENTIAL
LEGEND
PROPERTY LINE
EASEMENT LINE
AREA ALLOCATION LINE
WOOD FENCE
CHAIN LINK FENCE
DITCH
TREE LINE
UNPAVED ROADS
TEMPORARY FACILITY (RELOCATABLE UNIT)
SLS SEWAGE LIFT STATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Modification of Chillers in Central Heating and Cooling Plant

INSTALLATION: Lyndon B. Johnson Space Center

FY 1978 CoF ESTIMATE: $2,540,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	179,000	---	179,000
Other affiliated funding	---	7,172,000	7,172,000
Total	179,000	7,172,000	7,351,000

SUMMARY PURPOSE AND SCOPE:

This project provides for major modifications to the chilled water generation system in the Central Heating and Cooling Plant, Building 24, to convert the steam turbine-driven systems of four chiller units to electric motor-driven systems. The modifications proposed by this project will modify the existing system to: (1) reduce operating costs by converting to a less costly method of driving the chiller compressors, (2) increase chiller operational loading capability, and (3) reduce the "well head" natural gas consumption by approximately 35%.

These chiller compressors are presently driven by steam turbines fed from gas-fired boilers in the central plant. The compressors on four of the seven chiller units will be converted from steam turbine drive to electric motor drive. This conversion will result in a net utility cost saving (since the cost of electrical power needed to drive the units is considerably less than the cost of the natural gas needed to produce the required amount of turbine steam), and will also significantly reduce overall energy consumption.

PROJECT JUSTIFICATION:

This project is necessary as a long-term improvement to reduce the consumption of energy at Johnson Space Center (JSC) and to reduce the cost of operating the JSC Central Heating and Cooling Plant. The project provides for an optimum conversion of the power source for cooling the major portion of the Center from natural gas to electricity. This conversion results in significantly reducing the net cost of operating the cooling system because of the rapidly rising costs of the intrastate natural gas used. Since 1972, the cost of natural gas at JSC has increased eightfold while the cost of electricity has increased twofold. In addition, shortages of natural gas are predicted for the future. It has become essential, therefore, to convert the system so that it depends less on the more costly, probably less available, energy source of natural gas; and to modify it so it will use less energy of all kinds.

At the time the chillers were originally installed (1963), the relative costs of natural gas and electricity were such that using natural gas-fired steam turbines for cooling was economical. This situation is no longer true because of the more rapid relative cost rise for natural gas. Electricity is now less expensive than natural gas for driving the chiller compressors. Even though the electricity is produced at a commercial generating plant which uses natural gas, the commercial generating plant is more efficient in its use of natural gas. The commercial plant requires 11.4 standard cubic feet (SCF) (0.32 cu.m.) of natural gas to produce enough electricity to provide 1 ton of refrigeration, but the chiller compressors at JSC require 17.7 SCF (0.50 cu.m.) of natural gas to produce enough steam to provide 1 ton of refrigeration.

Four of the seven chillers will be converted to electricity, leaving three powered by gas-fired steam. Four units will satisfy the needs of the Center during most periods, and the dual capability will provide operational flexibility for meeting any circumstances when the availability of electricity may be reduced. The chillers are presently operating below their refrigeration capacity. Converting the chillers from 3-pass to 2-pass configuration, and installing higher capacity distribution pumps will lower the design temperature differential across the chillers, thereby requiring less energy. Temperature differentials of 5°F to 12°F (2.8°C to 6.6°C) are sufficient to provide the Center with cooling for personnel comfort and computer operation while maintaining optimum loading capacity.

It is therefore desirable to accomplish this project from both an energy conservation and an operational cost standpoint. The proposed modification will result in an estimated saving of 35% in net gas well head energy consumed in providing refrigeration from the central plant. Based on the estimated savings associated with this project, the capital investment would be returned within 2-3 years.

PROJECT DESCRIPTION:

This project provides for converting four of the seven 2,000-ton chiller units in the Central Heating and Cooling Plant, Building 24 at JSC, from a steam turbine-driven system to an electric motor-driven system. The project also provides for related modifications to the electrical feeder system and associated switchgear to furnish the additional electrical power required for the new electric-drive motors. The work includes removing the steam system and turbine drive from the chillers, the turbine control panel and associated controls piping, surface condensers and steam ejectors. It also includes modifying the cooling tower piping to conform to the reduced heat rejection requirements. The project provides for installing electric-drive motors on four chillers, switchgear for the electric-drive motor system, and appropriate electrical motor system controls. In addition, the project provides for reconfiguring the chilled water distribution flow to increase the system efficiency. The reconfiguration includes repiping the heads of all seven chiller units to convert them from a 3-pass to a 2-pass configuration, and replacing the distribution pumps to provide greater volume.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				2,540,000
Demolition and equipment removal	Units	4	3,000	12,000
Conversion of chillers to electric drive	EA	4	290,000	1,160,000
Modifications to electric feeder system				605,000
1,200-A circuit breaker	EA	2	85,000	(170,000)
3-phase, 15-kV, 600-A cable	LF	6,800	64.00	(435,000)
Modifications to cooling tower pumps and fan motor	EA	7	14,000	98,000
Repiping of chiller heads	EA	7	95,000	665,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				2,540,000

LIST OF RELATED GRAPHICS:

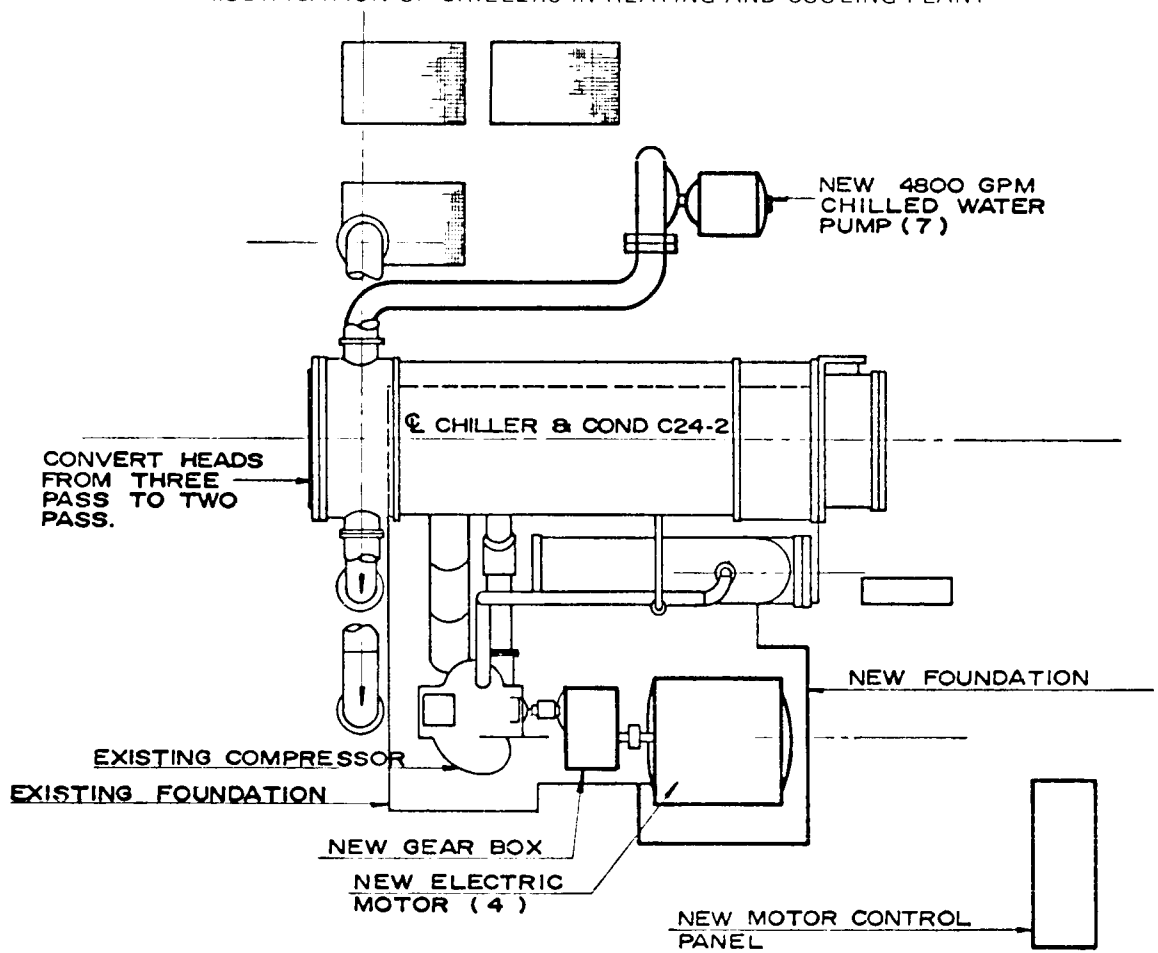
Location Plan
Schematic of Chiller Conversion
Schematic of Chiller Head Repiping

OTHER EQUIPMENT SUMMARY: None

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is presently estimated that no future CoF funding will be required to complete this project.

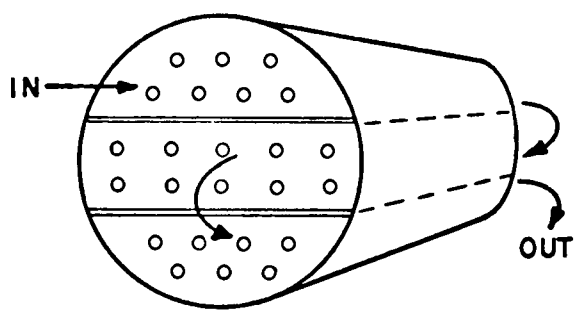
LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATION OF CHILLERS IN HEATING AND COOLING PLANT



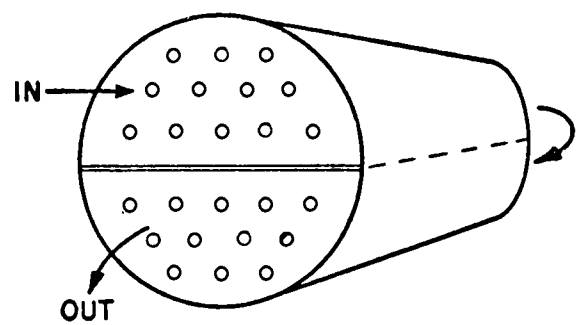
NOT TO SCALE

CHILLER PLAN

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATION OF CHILLERS IN HEATING AND COOLING PLANT



THREE PASS
CONFIGURATION



TWO PASS
CONFIGURATION

SCHEMATIC
NOT TO SCALE

MODIFICATION OF CHILLER HEADS
FROM 3-PASS TO 2-PASS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

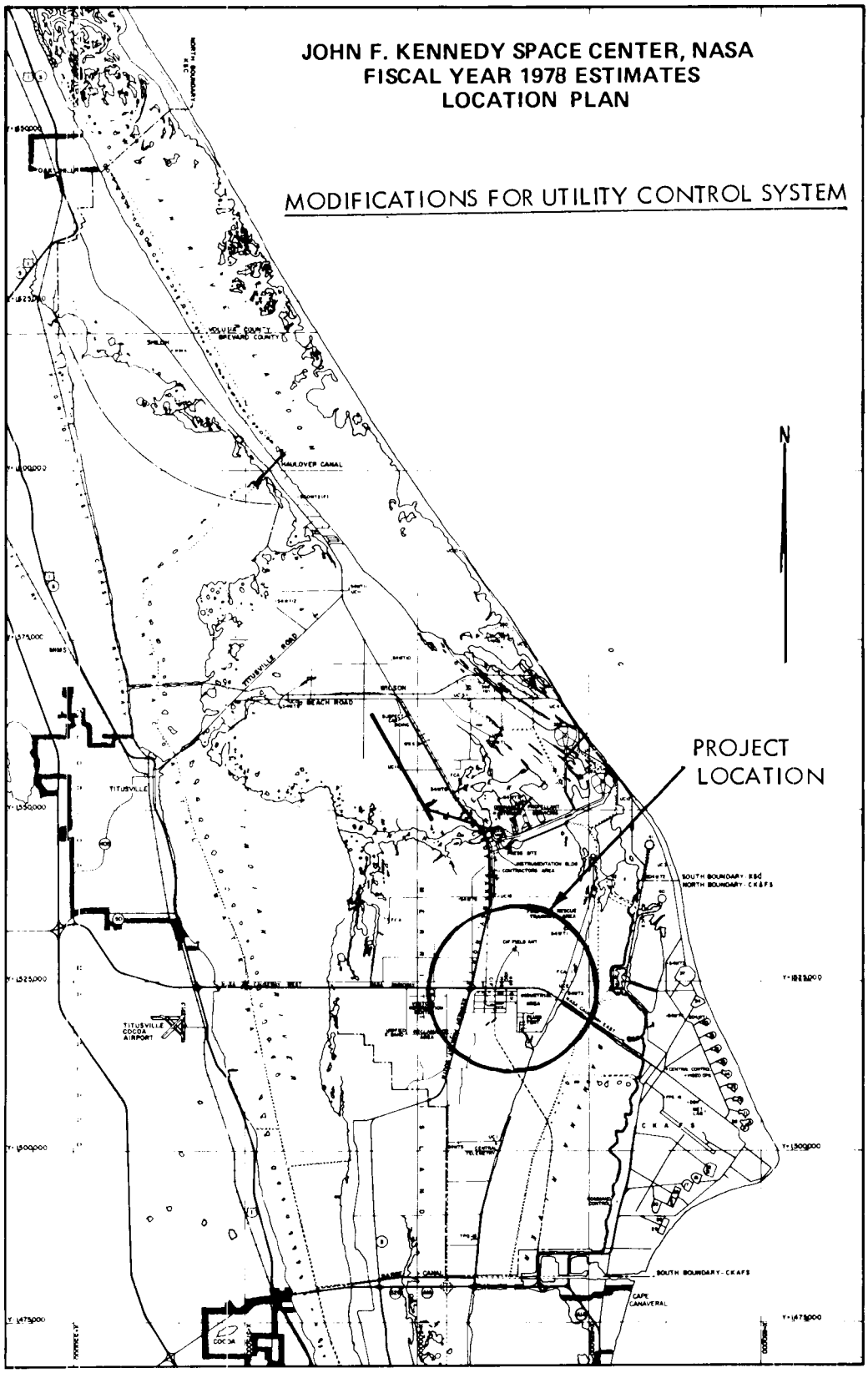
CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

JOHN F. KENNEDY SPACE CENTER

	Amount	Page No.
Office of Center Operations:		
Modifications for utility control system.....	2,130,000	CF 5-1


JOHN F. KENNEDY SPACE CENTER, NASA
FISCAL YEAR 1978 ESTIMATES
LOCATION PLAN
MODIFICATIONS FOR UTILITY CONTROL SYSTEM
N
PROJECT LOCATION
HAULOVER CANAL
TITUSVILLE ROAD
BEACH ROAD
TITUSVILLE
TITUSVILLE COCOA AIRPORT
SOUTH BOUNDARY - CKAFS
NORTH BOUNDARY - CKAFS
SOUTH BOUNDARY - CKAFS
CAPE CANAVERAL
COCOA

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications for Utility Control System
INSTALLATION:	John F. Kennedy Space Center
	FY 1978 CoF ESTIMATE: $2,130,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	416,000	2,755,000	3,171,000
Other affiliated funding.....	90,000	1,315,000	1,405,000
Total.....	506,000	4,070,000	4,576,000

SUMMARY PURPOSE AND SCOPE:

This project continues and extends the modifications for the Utility Control System (UCS) being installed in the Kennedy Space Center (KSC) Industrial Area. Prior year programs provided instrumentation systems for remote monitoring and control of the heating, ventilating and air conditioning (HVAC), potable water and sewage treatment systems in the main Industrial Area; and for these same systems as well as the 60-Hertz electrical power and fire alarm systems in Launch Complex 39. The purpose of this year's increment is to expand the UCS to include HVAC, potable water and sewage treatment systems in the outlying facilities of the Industrial Area; and the 60-Hertz electrical power and fire alarm systems in the Industrial Area itself. The centralized monitoring and control of various systems that the UCS provides will enhance safety, conserve energy, and improve

reliability and efficiency of utilities operation and maintenance, thus contributing to better management of resources and savings of personnel.

PROJECT JUSTIFICATION:

This is the fourth increment of a project initiated in CY 1974 to retain and improve the support capabilities inherent in existing facilities necessary for KSC's long-range launch mission role through the shuttle program. The monitoring and control of utility HVAC, fire alarm, and 60-Hertz electrical power by automation will achieve a significant reduction in manpower for operations now performed manually in a large number of facilities required to support KSC launch activities. Savings in the utility conservation program will also be achieved; the mission of support operations and task performance of maintenance and operations personnel will be enhanced; and greater responsiveness to potential problems through early warnings of out-of-limit system conditions will be possible as a result of remote monitoring and control.

The UCS will monitor and control, through automation, systems that provide basic services -- HVAC for personnel and equipment, potable water, fire detection and protection, sewage treatment, and electrical power for machinery and equipment in systems which indirectly support the processing and launch of shuttle payloads and vehicles.

Automation will allow testing of utility systems on an end-to-end basis with significantly fewer personnel than previously achieved by manual means. This will permit faster identification of system defects than that now obtained by periodic preventive maintenance performed by roving field personnel. Immediate shutdown or corrective action can thus be taken before major damage occurs. It will also provide operational flexibility because of the capability to change system configurations by preplanned software program inputs.

The implementation of this project is expected to result in identifiable manpower, energy and transportation savings. The potential manpower cost savings associated with this project, scheduled to begin in mid-CY 1979, are as follows:

Approximately 25 electrical, 6 mechanical and 10 fire protection personnel will be eliminated, equating to a "savings" of about $1,120,000 the first year. Electrical energy consumption savings of approximately one million KWH also equates to a possible savings of approximately $25,000 to $30,000 the first year.

Based upon the total cost of $2,130,000 and the identified potential cost savings of about $1,150,000 the first year, the resultant "simple payback" period is about 2 years for this project. This is then a "good investment".

PROJECT DESCRIPTION:

This project provides sensors and controls in various utility systems connected to central computing equipment via the communications cable system. The fire alarm system has requirements for 350 signals in 65 facilities, including fire and smoke detectors and sprinkler flow indicators. The 60-Hertz electrical power system has requirements for about 1,260 signals from some 55 facilities, including current and voltage of transformers in substations, status of circuit breakers and remote control of automatic transfer switches. The HVAC system has requirements for 135 signals in the Spacecraft Assembly and Encapsulation Facilities, including air handler status, compressor motor currents, chiller and pump status, and water temperatures. The sewage treatment and potable water systems will require approximately 10 signals.

Fourteen existing remote units will be modified and three new remote units will be installed to collect signals from a given area and transmit them to the centrally located computer equipment. The data processing equipment supporting the monitoring and control functions, such as telemetry equipment, appropriate mass storage devices, centrally located computer equipment with operator consoles, and cathode ray tube displays, were funded with prior year resources. Peripheral equipment such as the front-end processor which collects and processes signals from remote terminal units and feeds them to a computer will be provided by this project.

The UCS will also monitor and control sensors and controls in facilities constructed and modified under the space shuttle program, such as the hypergolic facilities.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				1,400,000
HVAC subsystem	LS	---	---	282,000
Potable water subsystem	LS	---	---	2,000
Sewage treatment subsystem	LS	---	---	3,000
Fire alarm subsystem	LS	---	---	256,000
60-Hertz power subsystem	LS	---	---	857,000
Equipment				730,000
Remote units	LS	---	---	430,000
Peripheral equipment	LS	---	---	98,000
UCS system installation and checkout	LS	---	---	202,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				2,130,000

LIST OF RELATED GRAPHICS:

Location Plan
KSC Industrial Area - Site Plan

OTHER EQUIPMENT SUMMARY:

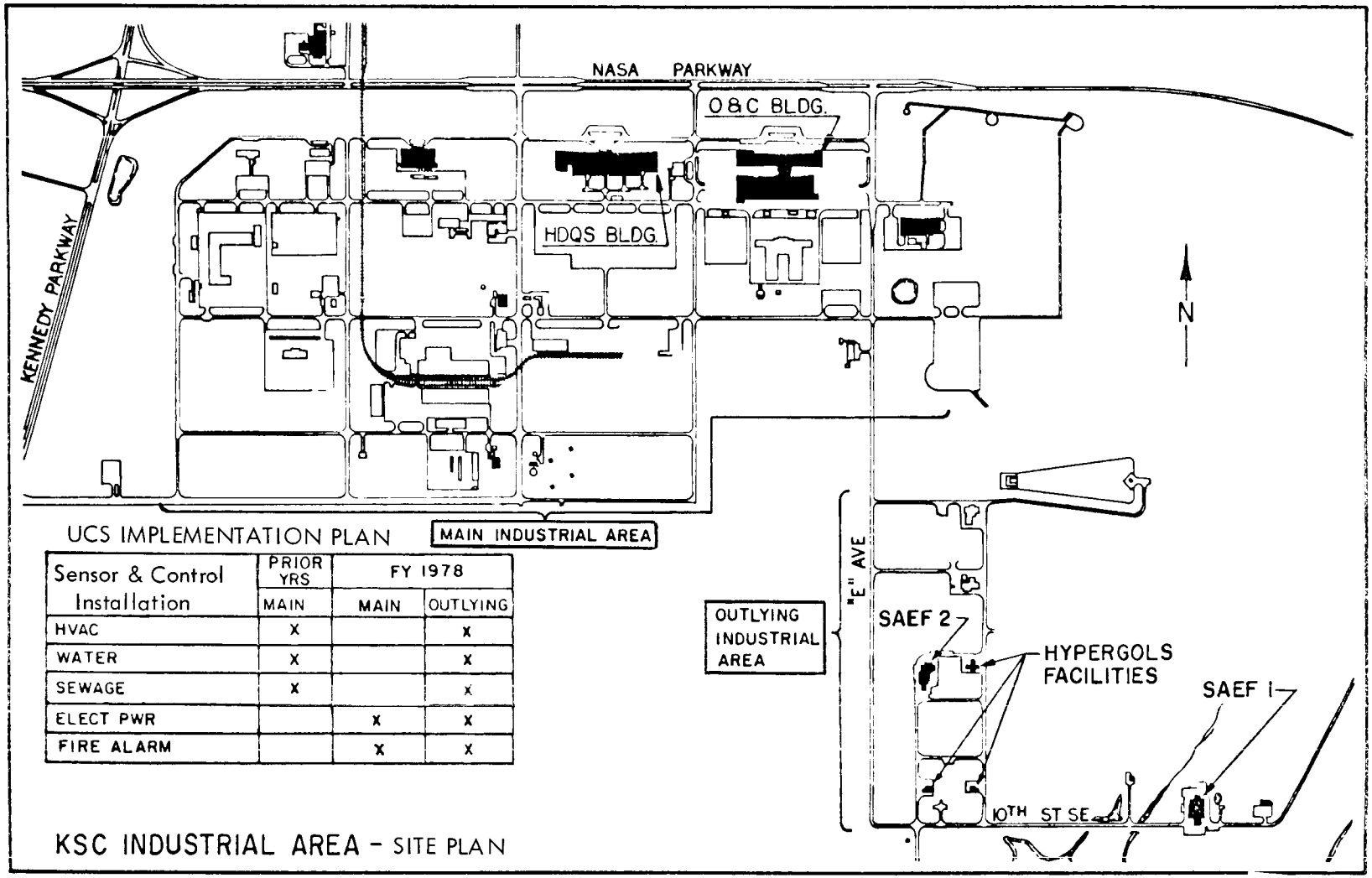
Sensors, controls and some remote units will be installed in the HVAC systems, and in the hypergolic facilities being modified and funded under the space shuttle unique CoF program. These are required for the initial operations of these space shuttle facilities and are in addition to this project. The total estimated cost of this "shuttle unique" equipment is approximately $200,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that about $500,000 to $1,000,000 will be required in future CoF programs to complete this project and provide monitoring and control of the "second shuttle flow" facilities, such as at Launch Pad "B". However, this FY 1978 fourth increment is fully operable and usable by itself and the resultant estimated "savings" are not dependent on any such future funding.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS FOR UTILITY CONTROL SYSTEM



UCS IMPLEMENTATION PLAN

Sensor & Control Installation	PRIOR YRS	FY 1978	
	MAIN	MAIN	OUTLYING
HVAC	X		X
WATER	X		X
SEWAGE	X		X
ELECT PWR		X	X
FIRE ALARM		X	X

KSC INDUSTRIAL AREA - SITE PLAN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

LANGLEY RESEARCH CENTER

	Amount	Page No.
Office of Center Operations:		
Rehabilitation of main heating plant	790,000	CF 6-1
Office of Aeronautics and Space Technology:		
Rehabilitation of unitary plan wind tunnel	980,000	CF 6-6
Total	1,770,000	

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF MAIN HEATING PLANT
LOCATION PLAN

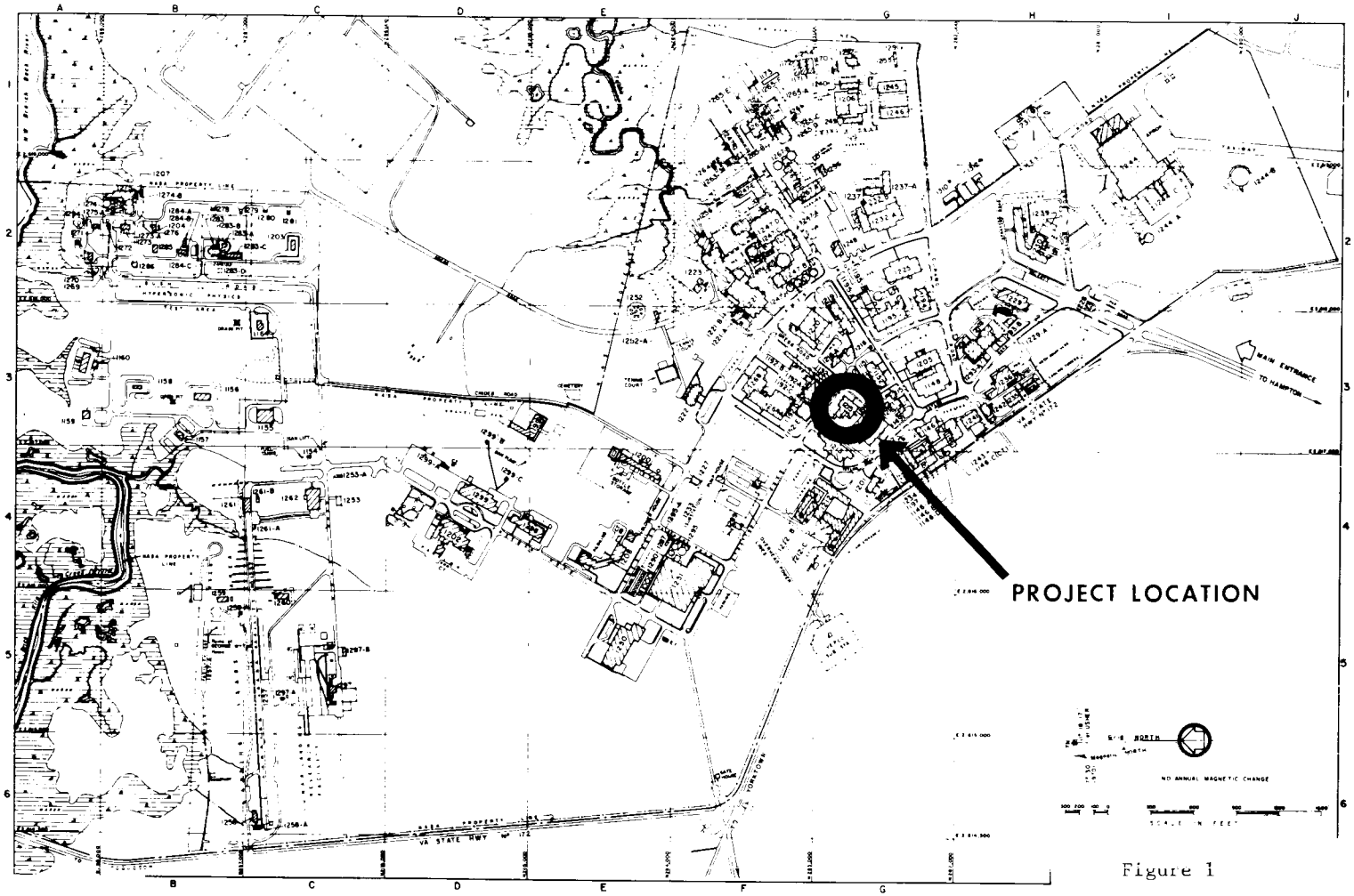


Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Rehabilitation of Main Heating Plant
INSTALLATION:	Langley Research Center
FY 1978 ESTIMATE:	$790,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	48,000	---	48,000
Other affiliated funding.....	---	2,800,000	2,800,000
Total.....	48,000	2,800,000	2,848,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to upgrade the reliability, effectiveness and efficiency of the main heating plant by rehabilitating the building and replacing the worn and outmoded equipment. The main heating plant provides steam for building heating and air conditioning and is the primary source of process steam at research facilities employing steam ejectors. The building is nearly 30 years old and requires general rehabilitation to correct normal deterioration. The existing air compressor service systems are 20 years old, and not only are worn out but are obsolete. The present vertical boiler feedwater pumps must be replaced by more reliable and more effective horizontal pumps. The deactivated,

24-year old boiler #4 will be removed, creating space for relocating boiler feedwater chemical treatment equipment. New boiler feedwater pumps will be installed in the space previously occupied by the chemical treatment equipment, eliminating the need for additional building space. The location of the main heating plant is shown in Figure 1.

PROJECT JUSTIFICATION:

As a key facility at Langley, the main heating plant must be maintained in a state of high reliability and readiness. The facility does and will continue to play a vital role. In late 1979, the Refuse-Fired Steam Generating Facility (RSGF), which was authorized for FY 1977, is scheduled to become operational. The steam capacity of the RSGF will not be enough to meet the total Center demand at all times. During the summer, the main heating plant will be required to carry the full steam demand during annual maintenance shutdown of the RSGF, and must be capable of coming "on line" to fill research demands that cannot be met by the RSGF. During the winter, the plant must supply the balance of the peak demand load that the RSGF cannot supply, plus research load demands. In addition, the main heating plant houses compressor systems which provide the primary source of service air for 75 facilities. The service air is used to drive various pneumatically operated valves and for the operation of the boilers.

To provide the needed reliability and readiness, the worn and outmoded equipment must be replaced. Spare parts are difficult to procure, since design obsolescence precludes obtaining them from general stock. Special fabrication is costly and delivery time lengthy. The frequent breakdown of the obsolete boiler feedwater pumps is a major problem and has limited the capability of the plant to supply peak steam demands. These pumps have been in service for approximately 10 years and have deteriorated to the point where small turbine driven pumps have been installed to insure plant operation. This project has been deferred for the past several years because of higher priority projects. Further deferral will result only in continued high maintenance costs and could seriously affect the operation of many of the major research facilities at the Langley Research Center.

PROJECT DESCIPTION:

This project will entail general rehabilitation of the building to correct normal deterioration and improve the work environment. New acoustical ceilings, wall surfaces and flooring will be installed in the foyer and two offices. The ceiling and walls of the shop will be painted. New lighting, air conditioning and windows will be installed in both areas. In the boiler room area, exterior walls will be repaired, interior surfaces painted, and, where required, new lighting fixtures and improved ventilation will be installed. The deactivated, 24-year old low-pressure #4 boiler will be removed and disposed of. As mentioned earlier, the chemical treatment for the boiler feedwater will be moved from its present location to the vicinity of the boiler that was removed, permitting installation of the new boiler feedwater pumps in the space formerly occupied by the treatment equipment (Figure 2).

The two 350 psi (24.1×10^5 newton/meter^2) air compressors will be replaced by an improved air compressor system complete with intercoolers, air dryers, and controls. The 100 psi (6.9×10^5 newton/meter^2) central air system will be improved by installing dual air filters which will permit simultaneous operation of two compressors in this system.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	185,000
Building rehabilitation	LS	---	---	145,000
Boiler #4 demolition	LS	---	---	40,000
Equipment	---	---	---	605,000
Boiler feedwater pumps	EA	2	127,500	255,000
Air compressor systems	LS	---	---	350,000
Fallout Shelter (not feasible)	---	---	---	---
Total				790,000

LIST OF GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Plan View

OTHER EQUIPMENT SUMMARY:

No other collateral or noncollateral equipment is necessary.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

At the present time, there are no foreseen requirements which would require future CoF funding for this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF MAIN HEATING PLANT

PLAN VIEW

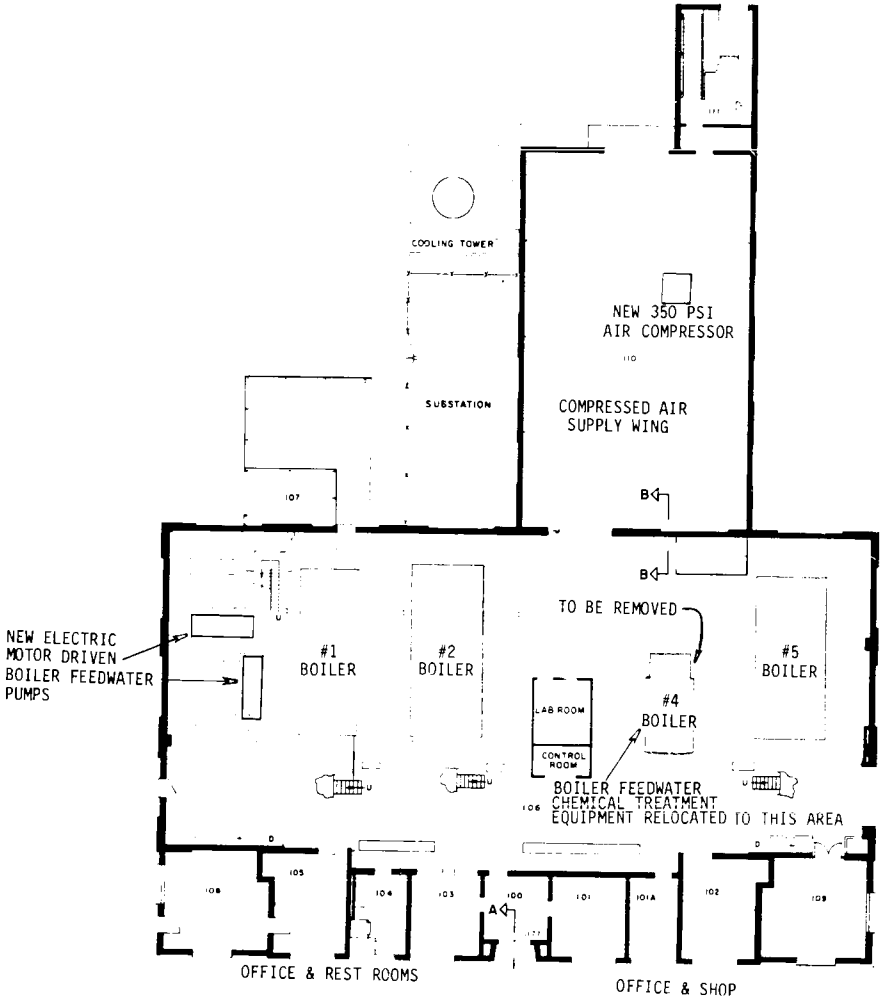


Figure 2

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF UNITARY PLAN WIND TUNNEL

LOCATION PLAN

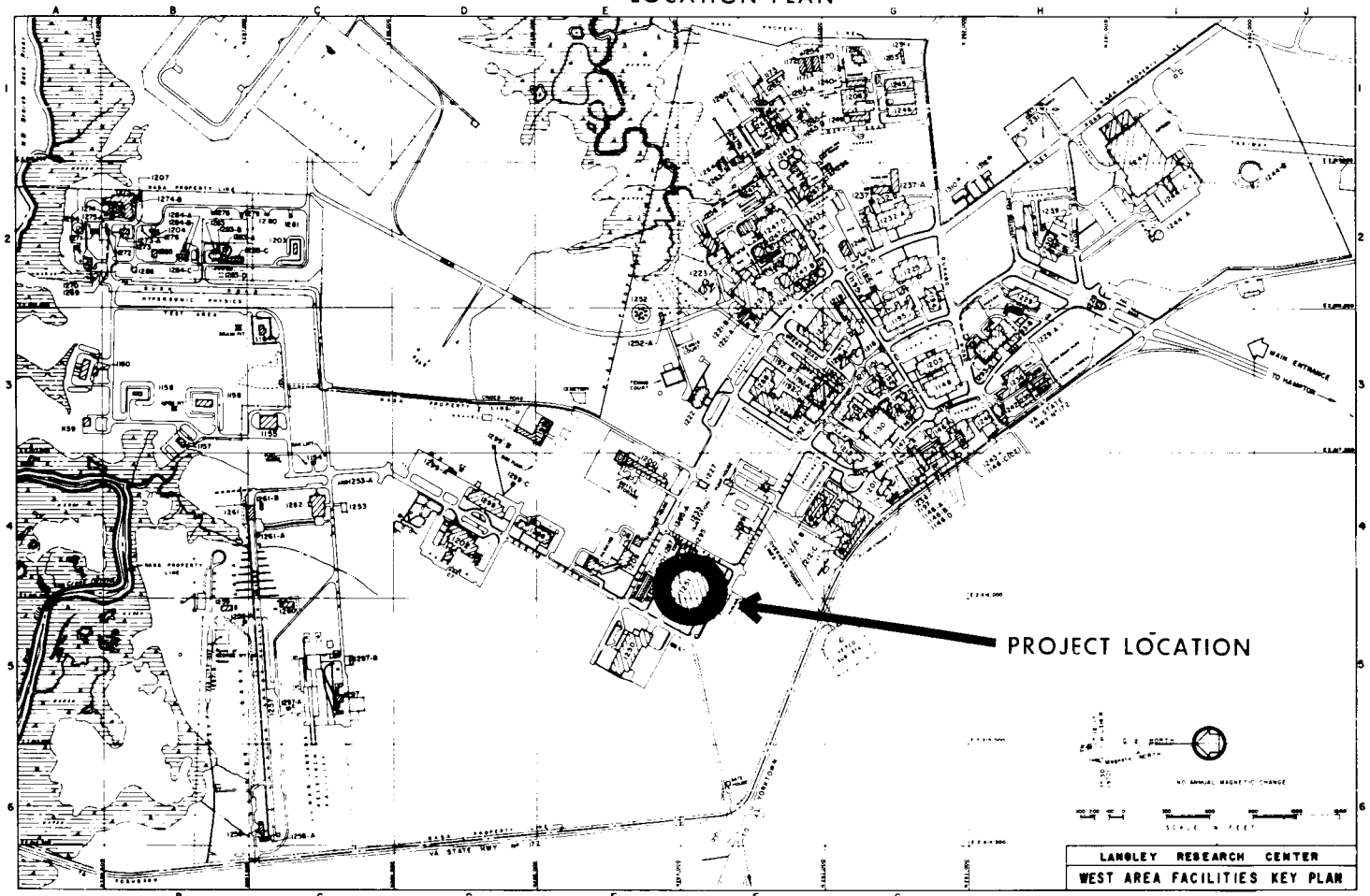


Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Rehabilitation of Unitary Plan Wind Tunnel
INSTALLATION:	Langley Research Center
	FY 1978 CoF ESTIMATE: $980,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	185,000	490,000	675,000
Other affiliated funding.....	---	19,500,000	19,500,000
Total.....	185,000	19,990,000	20,175,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to rehabilitate several critical elements of the Unitary Plan Wind Tunnel (UPWT). It is part of an overall program objective to repair and replace aging equipment that requires increasingly frequent maintenance and emergency repair. Rehabilitation of the 21-year old UPWT commenced with an FY 1976 rehabilitation and modification project. The FY 1978 project will provide for rehabilitation of the most critical items of the main drive system, rehabilitation of the tunnel support roller nests and slides, alignment of the main drive system and compressors, and rehabilitation of the cooling tower. Timely rehabilitation of this wind tunnel, which is a critical aerodynamic test facility used to support national

programs pertaining to supersonic flight, stability and control, and fluid dynamics is essential to avoid catastrophic failure, reduce unscheduled downtime for emergency repairs, and lower the overall operating and maintenance costs.

PROJECT JUSTIFICATION:

The Unitary Plan Wind Tunnel Act of 1949 provided for the construction of this unique facility to meet the critical needs of NASA, Industry, Military, and other Government agencies in the development of high speed aircraft and missiles. In recent years it has played a major role in space systems development in the critical boost and reentry phases, and is a primary facility in space shuttle development. In military support, essentially all supersonic configurations have been tested in this facility. Examples include development programs on the F-14, F-15, and F-16 aircraft. The Unitary Plan Wind Tunnel Act also makes provision for industry proprietary tests on a cost reimbursable basis. The research capability of this facility is essential to current and projected aerodynamic and missile research programs. Its annual occupancy rate of 1,500-2,000 hours (for each of the two test sections) attests to its importance as an aerodynamic development tool for the entire aerospace community.

The research capability of this facility is essential to current and projected research programs in the areas of missile research, military aircraft research, and long haul aircraft research. The UPWT is the only supersonic wind tunnel capable of stability, control, and performance testing required to support Langley's roles and missions. In addition to these major roles, the facility will continue to support the Space Shuttle Program, direct DoD requests, and industry testing (including joint and cost reimbursable programs). The UPWT is a major element of the current and future LaRC research effort and provides significant support to other Government agencies and industry. Any reduction of operating capability would not be in the best national interest.

The requirements for this facility are so vital that it has remained in constant use since initial start-up and maintains a backlog of 20 to 30 planned R&D activities which is approximately six months operation. Assuming that the project is approved for FY 1978, the facility will have logged approximately 40,000 hours at the time of renovation without a major overhaul. The probability of serious failures is obviously increasing with additional operating time. Also underscoring the importance of this project are procurement lead times of six to 18 months for many critical components. The alternative to this project is continued operation of a large facility at a high maintenance cost and the increasing risk of a serious equipment failure and prolonged downtime.

Rehabilitation of this facility is necessitated by the unreliable condition of certain crucial mechanical elements, such as the main drive system and the cooling tower. Typical problems with the main drive system

include shaft misalignment and abnormal vibration. The drive system has the capability of developing 100,000 horsepower and is coupled to six large compressors. It has been operating for 21 years at an average of 1,800 hours per year without a complete detailed inspection. Recent inspections of the cooling tower have revealed accelerated deterioration of that structure. The cooling tower support structure is cracked and rotten (Figure 4) and the wood baffles have deteriorated to such an extent that they are falling into the basin. This causes clogging of screens and filters and seriously reduces cooling tower efficiency, thereby limiting tunnel test capabilities on hot summer days.

PROJECT DESCRIPTION:

This project provides for the rehabilitation of the 8-cell cooling tower (Figure 4), alignment of the main drive system and compressors (Figure 5), rehabilitation of the tunnel support roller nests and slides, and rehabilitation of critical elements of the main drive system and compressors. An inspection of the compressors is currently planned as normal maintenance. If the inspection reveals that required repairs to any of the compressors are more extensive than presently envisioned, then the rehabilitation work will be programmed in some future year.

The continuing deteriorating condition of the 8-cell cooling tower is becoming a serious problem with respect to the uninterrupted operation of the UPWT. Because of the advanced state of deterioration and risk of serious failure, emergency repairs to one cell have already been made. This project will provide for the rehabilitation of the remaining 7 cells, replacement of the 14-inch (0.36 meter) hot water risers, and provide a fiberglass treatment for the exterior of the cooling tower.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				980,000
Rehabilitation of the cooling tower cells.....	EA	7	60,000.00	420,000
Replacement of 14-inch hot water risers.....	FT	200	75.00	15,000
Exterior fiberglass treatment.....	SF	15,300	6.86	105,000
Alignment of main drive motors and compressors.	LS	---	---	68,000
Tunnel support roller nests and slides rehabilitation.....	LS	---	---	32,000
Main drive system and compressor rehabilitation	LS	---	---	340,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				980,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Location
Figure 3 - Plan View
Figure 4 - Cooling Tower
Figure 5 - Main Drive
Figure 6 - Typical View of Tunnel and Support Equipment

OTHER EQUIPMENT SUMMARY:

No other collateral or noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Construction of Facilities funding required to complete the rehabilitation of this facility is estimated at approximately $4 million. However, results of the compressor inspections will be required to confirm the ultimate cost of all required rehabilitation.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF UNITARY PLAN WIND TUNNEL

SITE LOCATION

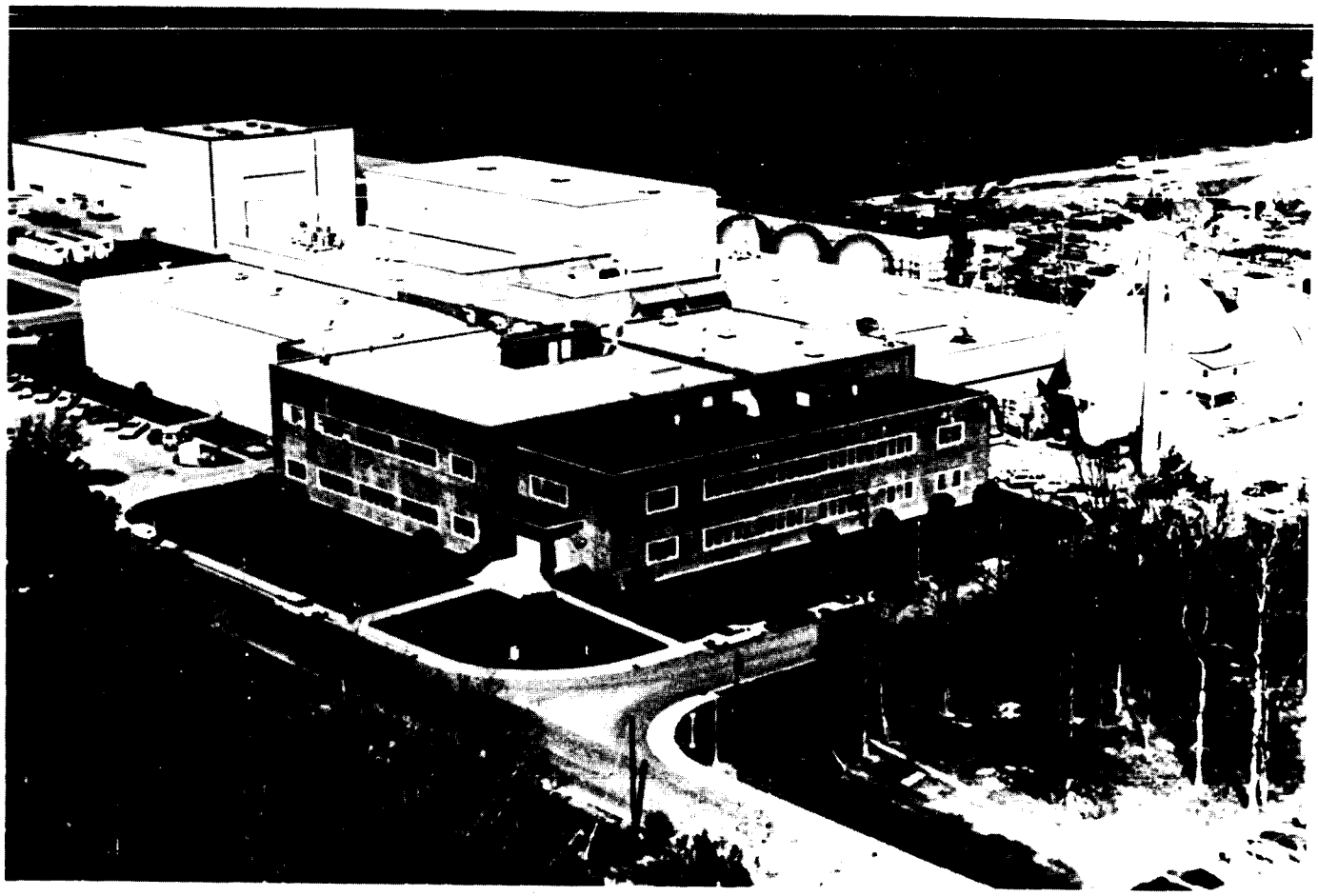


Figure 2

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF UNITARY PLAN WIND TUNNEL

PLAN VIEW

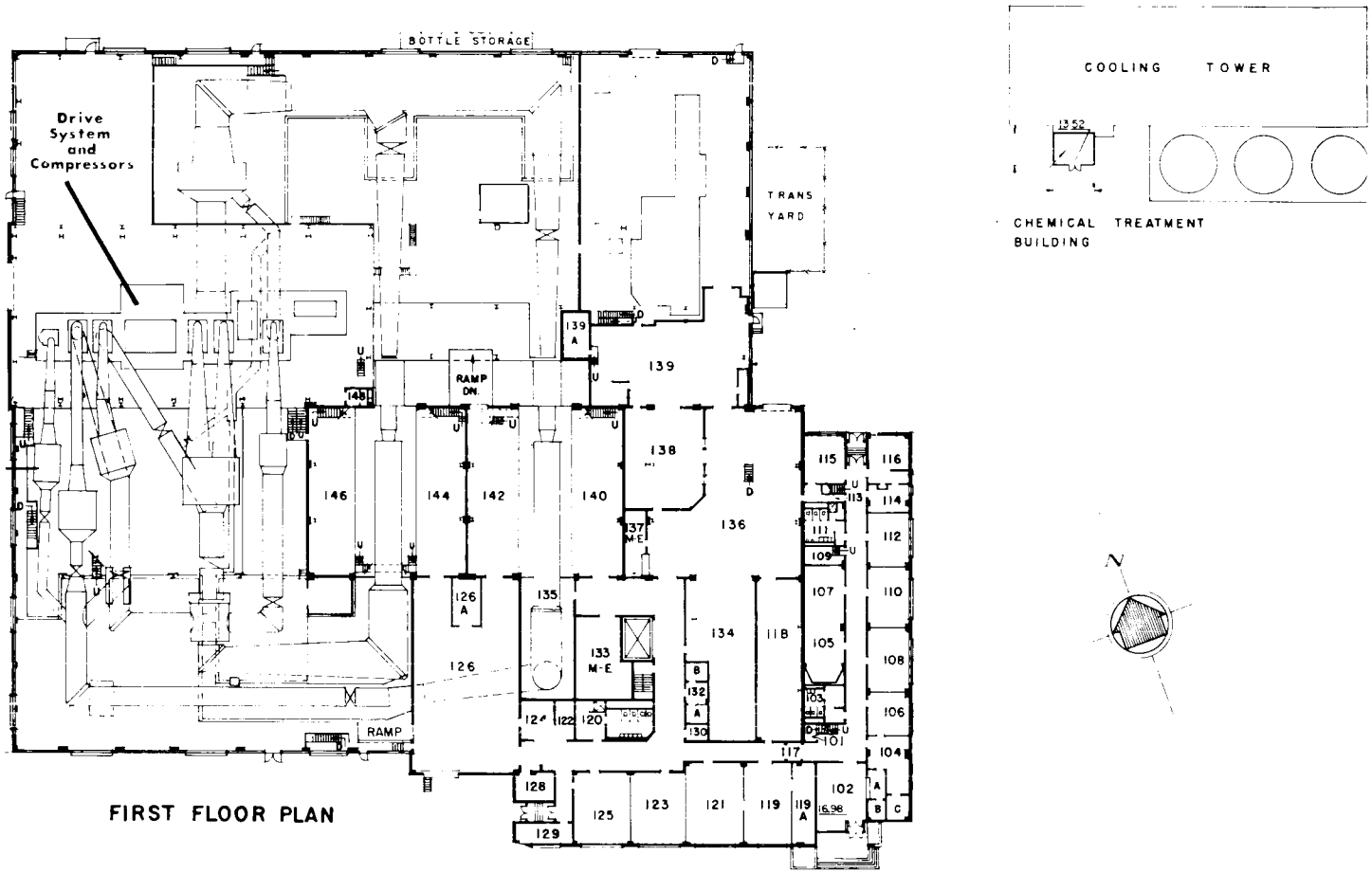


Figure 3

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF UNITARY PLAN WIND TUNNEL

COOLING TOWER

Figure 4

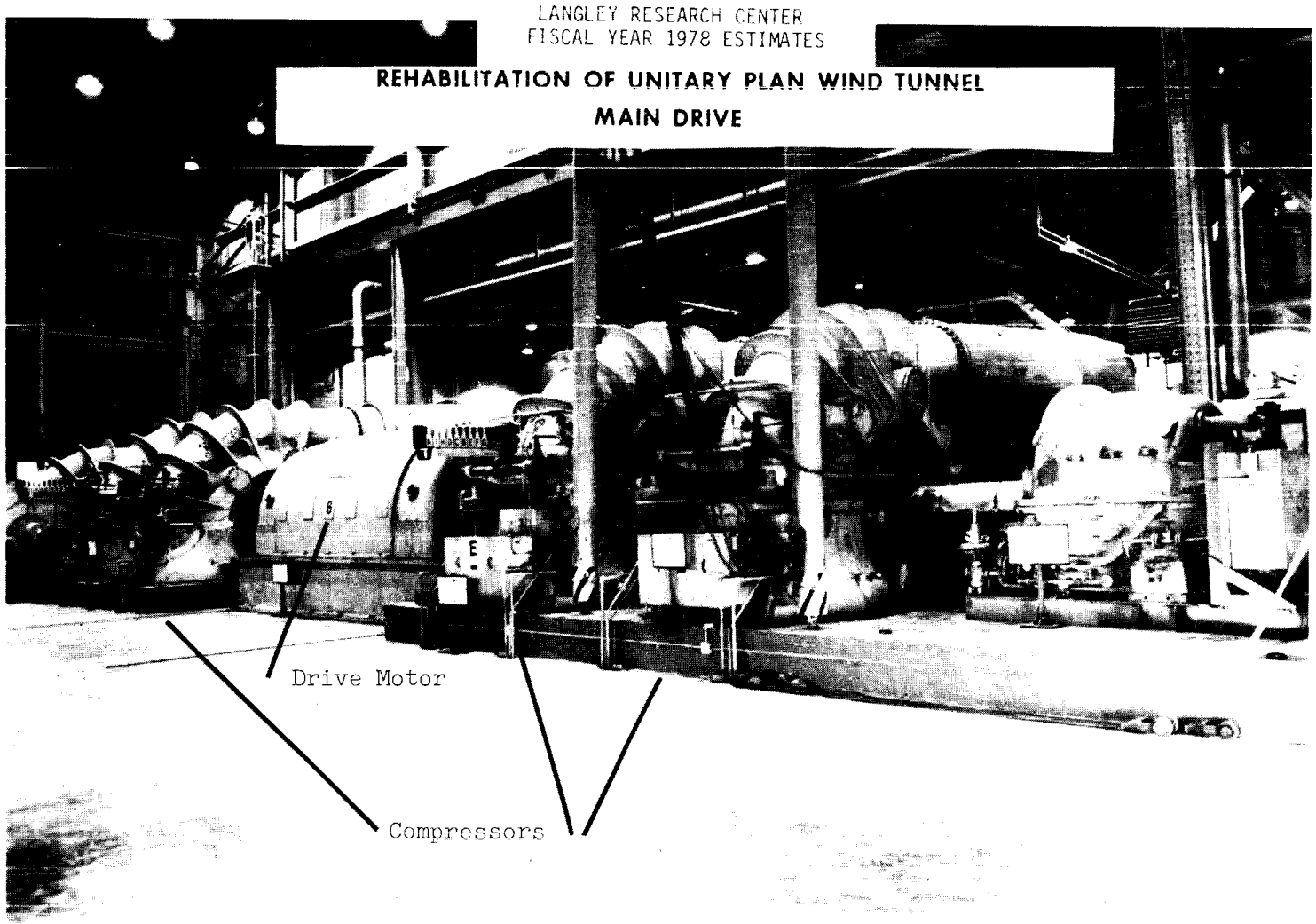

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES
REHABILITATION OF UNITARY PLAN WIND TUNNEL
MAIN DRIVE
Drive Motor
Compressors

Figure 5

LANGLEY RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF UNITARY PLAN WIND TUNNEL

TYPICAL VIEW OF TUNNEL AND SUPPORT EQUIPMENT

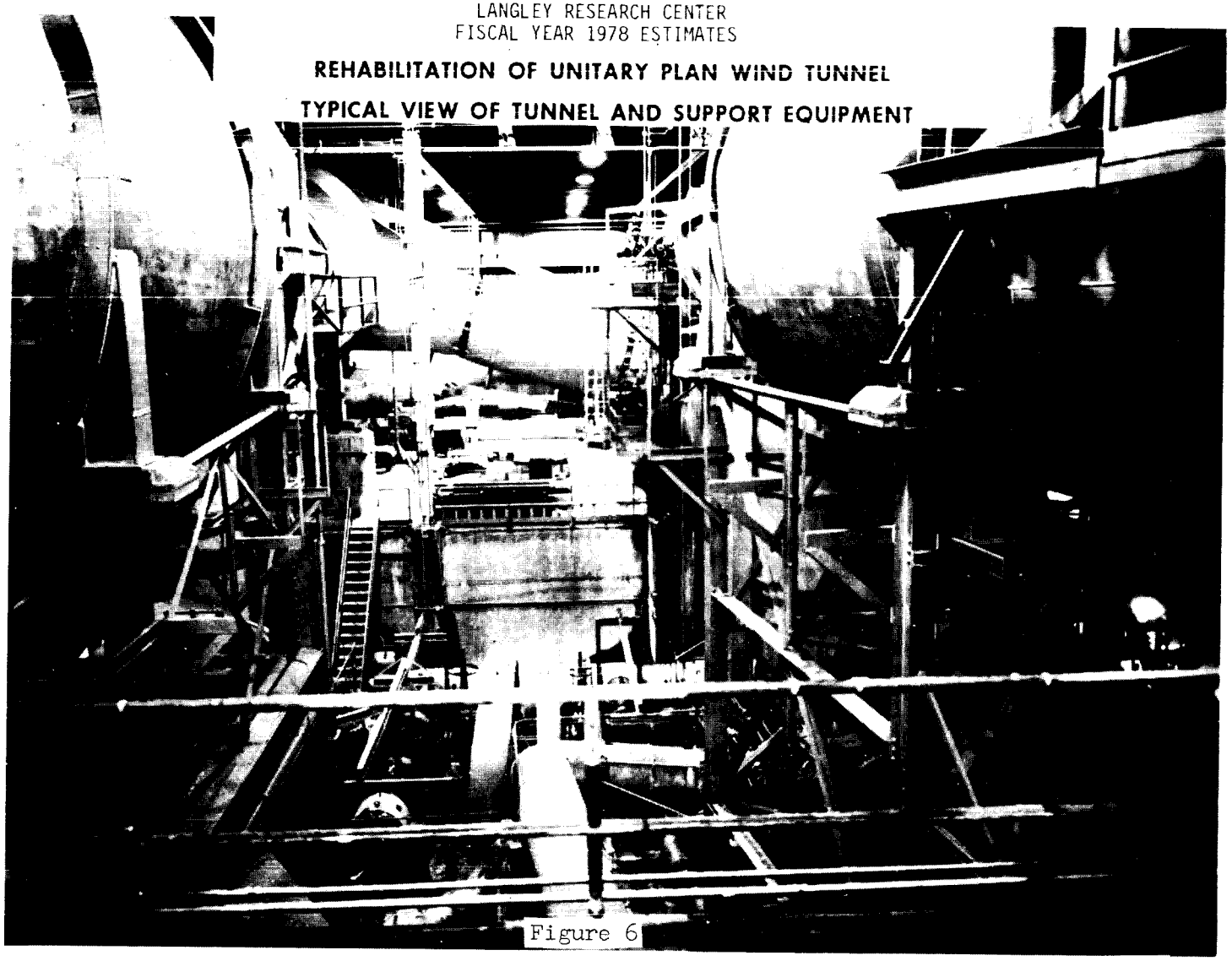


Figure 6

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

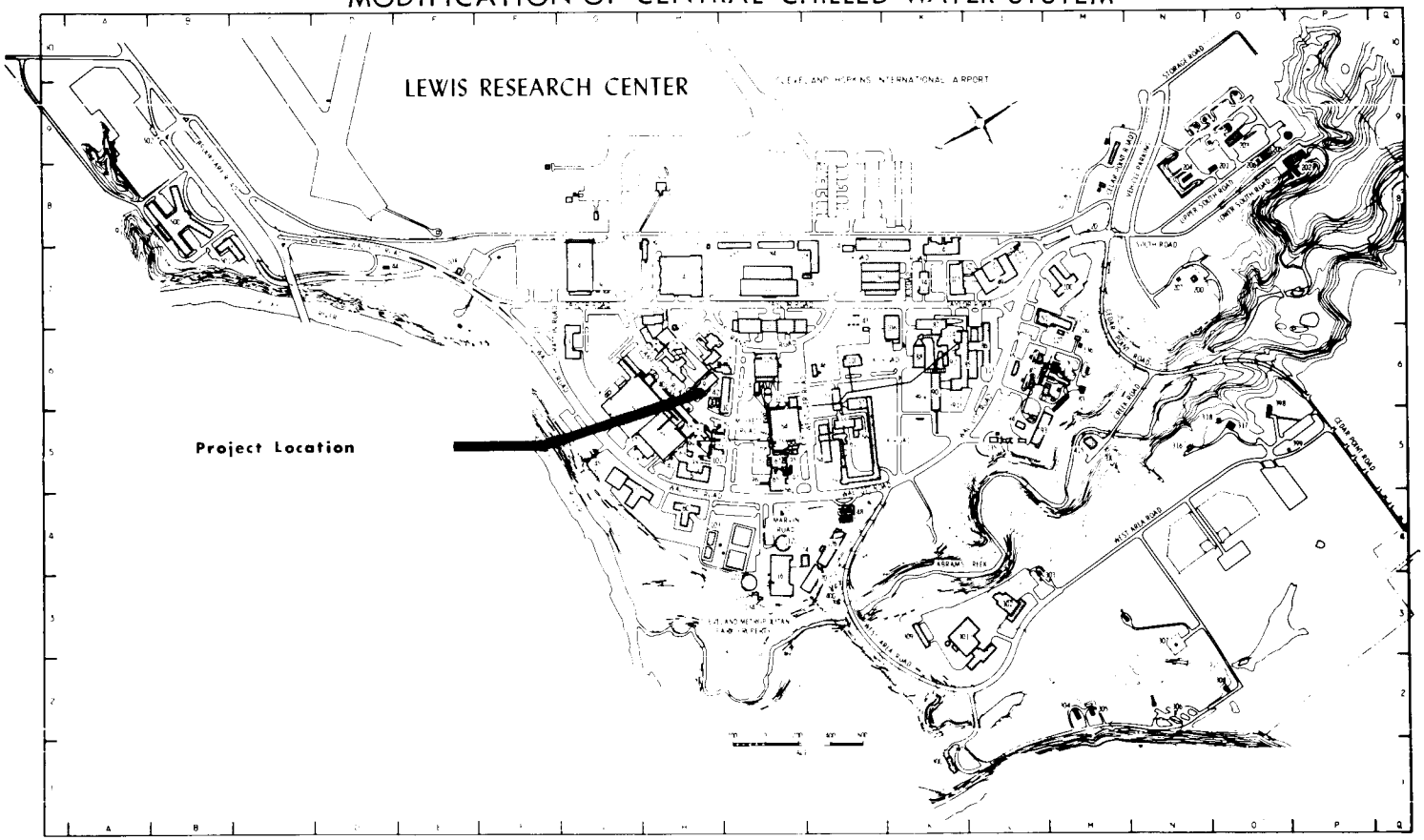
SUMMARY

LEWIS RESEARCH CENTER

	Amount	Page No.
Office of Center Operations:		
Modification of central chilled water system.....	860,000	CF 7-1

LEWIS RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF CENTRAL CHILLED WATER SYSTEM



LOCATION PLAN

Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modification of Central Chilled Water System
INSTALLATION:	Lewis Research Center
	FY 1978 CoF ESTIMATE: $860,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	60,000	---	60,000
Other affiliated funding	---	2,149,000	2,149,000
Total	60,000	2,149,000	2,209,000

SUMMARY PURPOSE AND SCOPE:

This project consists of modifications to the central chilled water supply system in Refrigeration Building No. 9 at Lewis Research Center (Figure 1). The system presently supplies chilled water for air conditioning and process equipment to nine buildings that accommodate research and supporting facilities involved in advanced aeronautical propulsion technology. This modification will replace old, unreliable piston type compressors with the new centrifugal type, and provide all necessary connections, controls, and related installation items. Besides upgrading the 35-year old system, modification will increase the systems capacity, enabling it to serve five other buildings in addition to the nine it currently serves.

PROJECT JUSTIFICATION:

The chilled water supply system in Refrigeration Building No. 9 (Figure 2) is the central source of chilled water for air conditioning and process equipment in the nine buildings that accommodate research and supporting facilities involved in advance aeronautical propulsion technology. These nine buildings are the Refrigeration Building (control room), Icing Research Tunnel (offices and shops), Chemistry Laboratory, Engine Research Building (ERB) (offices, photographic laboratory, small cafeteria, some control rooms and some test cells), ERB-Southwest Wing Extension (control room), ERB-West Wing (offices), Space Power Chambers (offices), Visitors Information Center and the Administration Building. Some of the projects depending on the system for test cell and control room cooling include Helicopter Transmission Test, traction drive systems, dynamics of multi-mass flexible rotors, Alternate Aircraft Fuels, and Advanced Fan and Compressor Technology.

The original system (Figure 3), which provided 1,320 tons (16.7×10^9 joules/hr) of heat removal capacity, is obsolete. Over the years, research requirements have changed, the equipment has failed, parts have been "cannibalized" from defunct equipment to maintain operational equipment, and the systems capacity gradually has been reduced to its present 500-ton (6.33×10^9 joules/hr) capacity. Removal of the existing obsolete equipment and installation of new water chillers with 1,650-ton (20.9×10^9 joules/hr) capacity will provide expanded service within the nine buildings and will extend service to five additional buildings. The additional buildings are the Library Services Building, Instrument Research Laboratory, Utilities Building (main cafeteria, post exchange store, telephone room and classrooms), Engineering Services Building and the ERB-Northwest Wing (control room).

Existing equipment has a total load of 688 tons (8.7×10^9 joules/hr), which will increase to 1,217 tons (15.4×10^9 joules/hr) with the addition of the five buildings and to 1,647 tons (20.9×10^9 joules/hr) with additional loads in presently served buildings. The existing 500-ton (6.33×10^9 joules/hr) system has accommodated the 688 ton (8.7×10^9 joules/hr) load with only a few days of total capacity shortage. The shortage, however, is evidenced by an increase in chilled water supply temperature, causing temperature and humidity levels to rise in control rooms. This has resulted in test cell equipment and instrument calibration point drift, which seriously affect data quality. The shortage also affects the main photographic laboratory, where changes in room temperature and humidity alter film developing time, and film processors are affected because the chilled water is used to control processing water temperature.

If chilled water is not supplied from a central source, a number of smaller equipment systems operating at lower efficiency and requiring increased energy usage, are required. The central system, on the other hand, will eliminate 25 individual systems of various types of equipment, thereby lowering maintenance costs and reducing energy consumption. The direct energy reduction is due to removing about 126 kW of electric load. An indirect saving of about 63,000,000 gallons (239,000 kl) of city water annually now used to cool some of the 25 systems being replaced will also be realized. The use of central chilled water also will reduce space requirements for mechanical equipment within each building.

PROJECT DESCRIPTION:

This project includes removal of the obsolete 500-ton (6.33×10^9 joules/hr) chilled water supply system and the installation of three new centrifugal water chillers with a total capacity of 1,650 tons (20.9×10^9 joules/hr) and three new pumps. Also included are modifications to floor slabs to accommodate the new chillers, and hook up of the new equipment to existing chilled water distribution piping and cooling tower water system. The existing cooling tower and water system supplying Refrigeration Building No. 9 are adequate to meet the increased requirements of the new chillers.

The following electrical work and equipment shall be included in this project. Existing 30-year-old, 2,400-volt, and 208-volt oil switch gear and power and control wiring associated with existing compressors and pumps is inadequate for the new requirements. New 2,400-volt switchgear and 480 volt transformer and motor control will be installed. Included will be controls to integrate the operation of equipment under variable loads.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				34,500
Demolition and removal	LS	---	---	34,500
Equipment	---	---	---	825,500
Water chiller (350-ton)	EA	1	82,000	82,000
Water chiller (650-ton)	EA	2	152,000	304,000
Pumps	EA	3	13,500	40,500
Valves, piping and installation	LS	---	---	174,000
Electrical power and installation	LS	---	---	225,000
Fallout Shelter (not feasible)	---	---	---	---
Total				860,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Plot Plan
Figure 3 - Overall System View

OTHER EQUIPMENT SUMMARY:

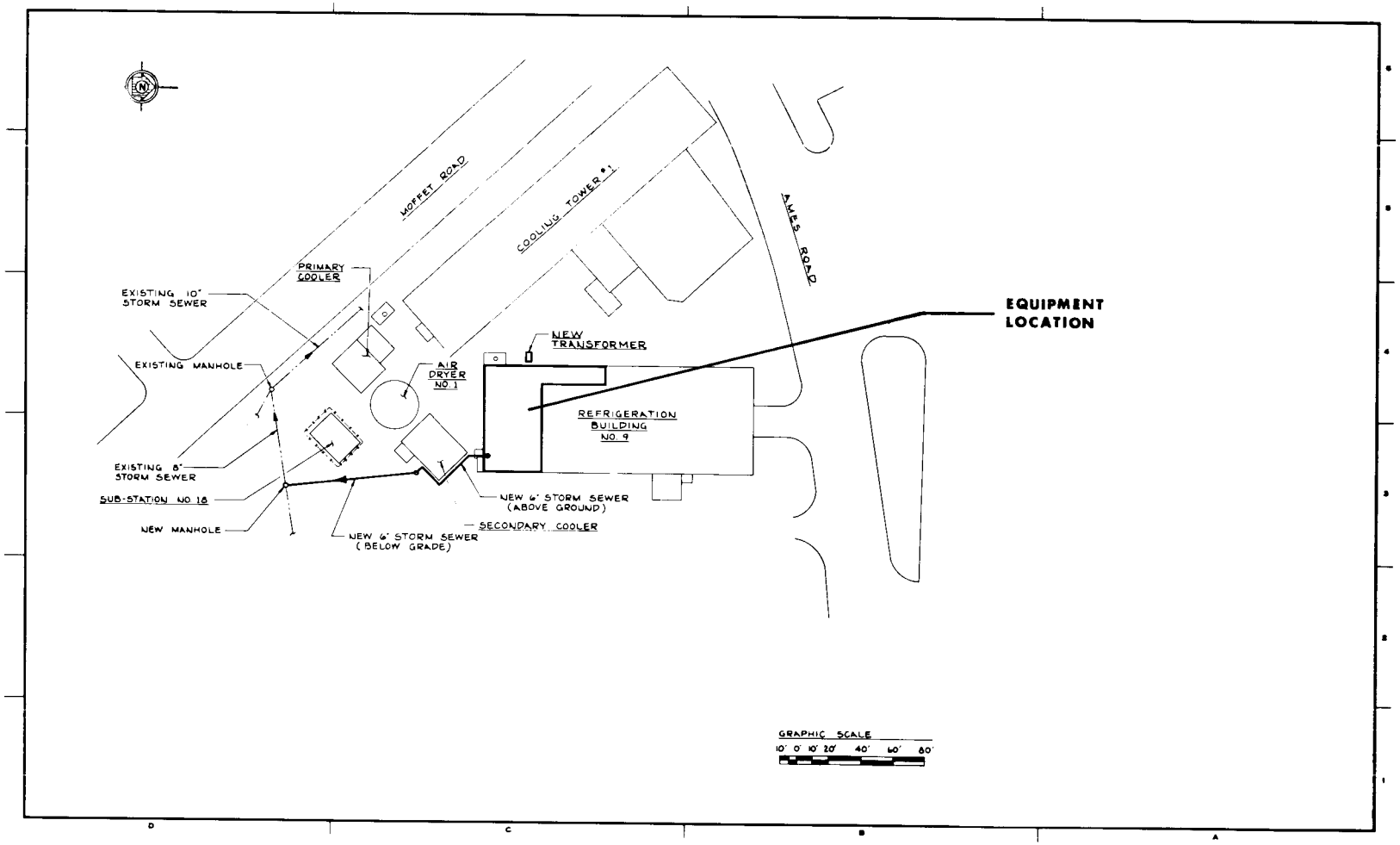
No other collaterial or noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no currently foreseen future funding requirements to complete this project.

LEWIS RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF CENTRAL CHILLED WATER SYSTEM



PLOT PLAN

Figure 2

LEWIS RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF CENTRAL CHILLED WATER SYSTEM

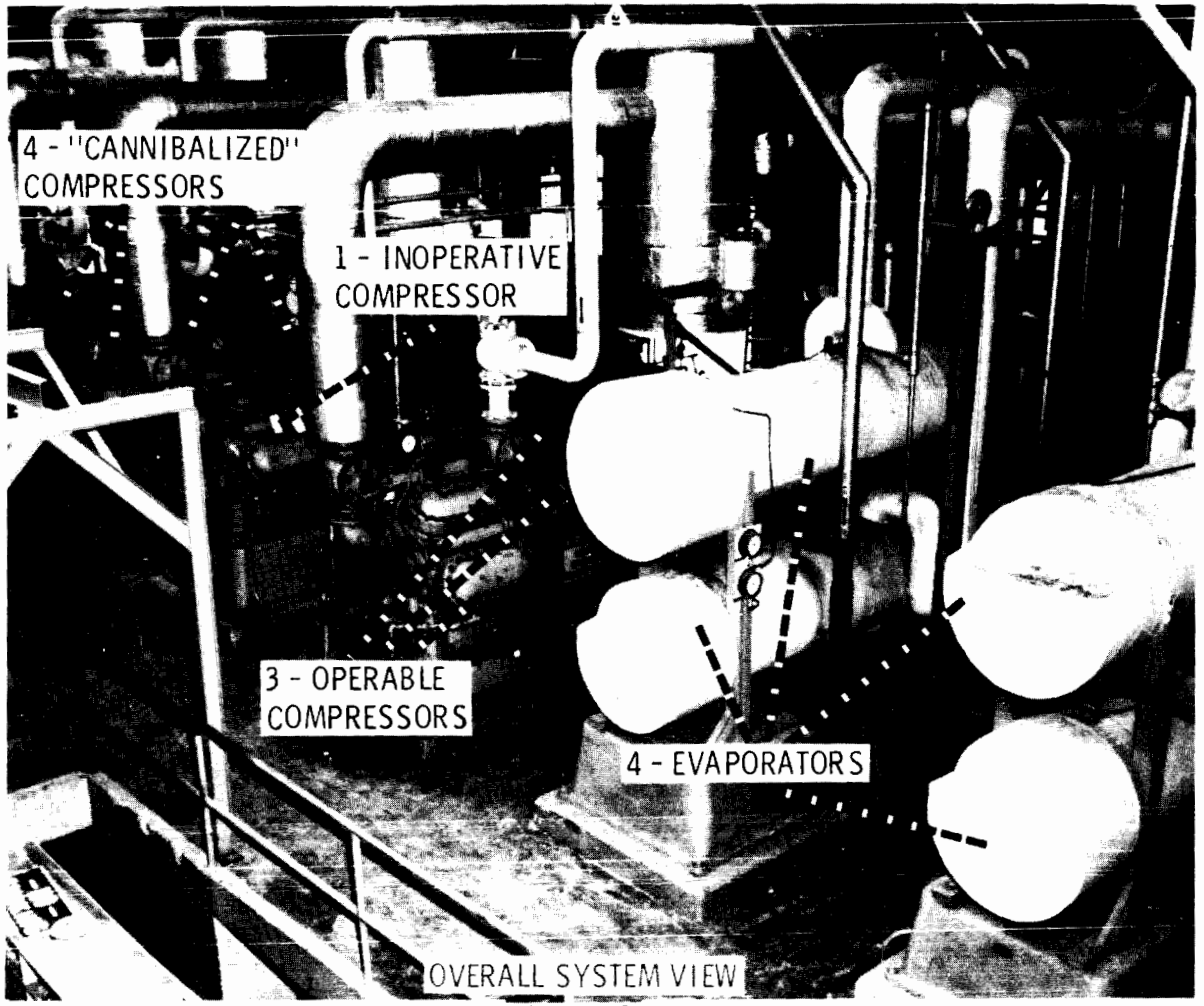


Figure 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

NATIONAL SPACE TECHNOLOGY LABORATORIES

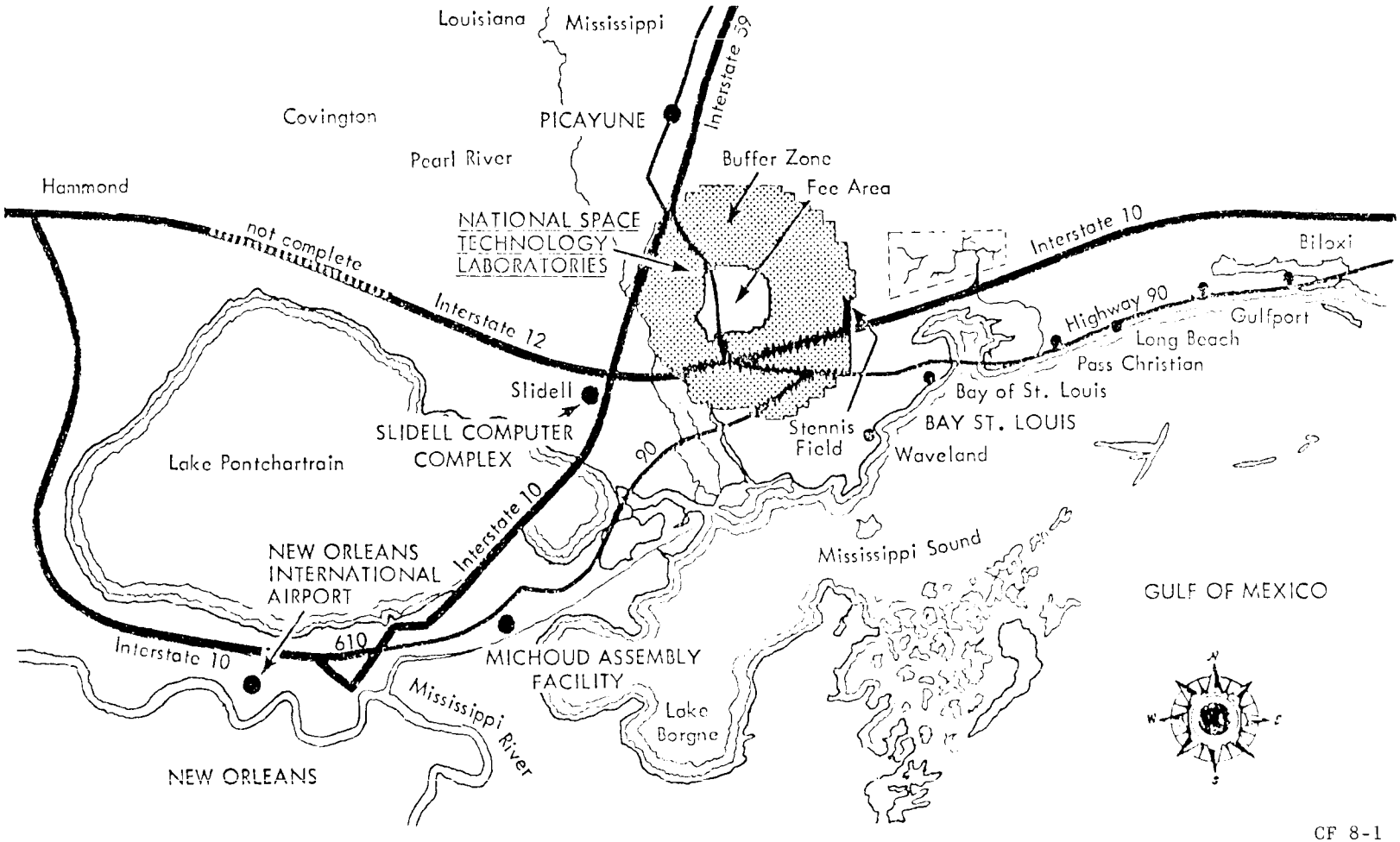
	Amount	Page No.
Office of Center Operations:		
Modifications for utility control system.....	620,000	CF 8-1

NATIONAL SPACE TECHNOLOGY LABORATORIES

FISCAL YEAR 1978 ESTIMATES

VICINITY MAP

MODIFICATIONS FOR UTILITY CONTROL SYSTEM



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications for Utility Control System
INSTALLATION:	National Space Technology Laboratories
FY 1978 CoF ESTIMATE:	$620,000

LOCATION OF PROJECT: Bay St. Louis, Hancock County, Mississippi

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	44,000	---	44,000
Other affiliated funding	---	---	---
Total	44,000	---	44,000

SUMMARY PURPOSE AND SCOPE:

This project will provide for the modification of 17 buildings at the National Space Technology Laboratories (NSTL) to provide a Utility Control System (UCS). The UCS will include remote sensors at approximately 400 locations within the buildings to monitor the heating, ventilating and air conditioning (HVAC); high temperature hot water; sewage treatment; and 60-Hertz electrical power systems. Sensors will be connected by a communications network to a central monitoring station in the Central Heating Plant, Building 3204. Remote monitoring and control of the utilities will make it possible to reduce both energy and manpower costs to the extent that the investment cost in this UCS will be realized in about three years.

PROJECT JUSTIFICATION:

The mission of NSTL is to support space shuttle main engine and space shuttle orbiter main propulsion system testing; to participate in NASA's activities in the fields of applications and environmental research; and to cooperate with other government agencies resident on the NASA-owned base by providing institutional and technical support necessary to conduct remote sensing, environmental and oceanographic research and technical activities. This project will provide NASA with a system that can serve as an added tool to conserve energy, and to save manpower and utility operating costs in the conduct of the mission. Specifically, this project provides for automated monitoring and control of HVAC, high temperature hot water, sewage treatment, and 60-Hertz electrical power systems to increase efficiency in both energy and manpower utilization.

At the time that NSTL was built, natural gas was plentiful and economical, especially in that location. This situation fostered use of natural gas in a mode which, by present standards, would not be considered "energy efficient". It is now expected that the price of natural gas will rise sharply, at a time when consumption at NSTL is also expected to increase rapidly because of increased scheduled activities. Site population is expected to double during FY 1977 to support NASA activities involving shuttle testing, and U.S. Navy operations. This population increase, together with other needs, will place a high demand on energy consumption. While the duration of the shuttle testing is limited, the long-term population increase at NSTL is significant and will be reflected in higher energy needs.

Providing a UCS at NSTL will reduce both natural gas and electricity consumption. The energy savings resulting from the UCS will be realized in the following areas:

1. Building utilities can be automatically turned on and off, thereby allowing conservation of electricity and gas during periods of low demand.

2. Electrical loads, such as those required by air-handling units, can be cut off or cycled as appropriate to reduce the total electrical loads during peak power demand times.

3. UCS allows for control of temperatures, such as the outlet temperature from the high temperature hot water generating plant, thus enabling the heat load to be matched with the proper demand and thereby conserving energy.

4. Operating energy efficiency of the high temperature hot water plant will be increased by operating one, two or three generators as needed instead of operating the three generators concurrently all the time.

Providing a UCS will also save manpower. Presently, the maintenance staff travels from point to point to monitor the condition and operating efficiency of equipment, and to start and stop utility systems. The NSTL

utility systems are over 10 years old and since the deactivation following the end of the Apollo program in 1970, only a minimum amount of maintenance has been performed. More frequent inspections are now required to ensure that the equipment is operating properly and reliably and that unscheduled repairs are held to a minimum. The combination of the expected increase in site population and the presently deteriorated systems will necessitate even more frequent inspections. A UCS will provide a central focus to monitor equipment so that failures can be identified more rapidly and to ensure that manpower is not wasted in travel time. Operational trends can also be observed and reviewed so that a plan for more efficient energy use can be developed. Additionally, having a central location from which to monitor this equipment will free staff members to better maintain the equipment.

Combined energy and manpower savings in FY 1979 are estimated to be $155,000 to $160,000; at this rate the project cost will "pay out" in about three to four years. Installing the UCS now will ensure efficient and more reliable service, and more economical energy and manpower use so that cost savings can be realized as soon as possible. Since NSTL supports both NASA and other government agency programs, the UCS is particularly important in that reducing utility operating and maintenance costs would be beneficial to NASA and the other government agencies as well.

PROJECT DESCRIPTION:

This project provides sensors and controls in various utility systems (HVAC, high temperature hot water, sewage treatment and 60-Hertz electrical power) connected through a communications network to a central monitoring location supported by a computer. These sensors will be located in 17 buildings (shown in the attached location plan). Approximately 400 sensors and status signals will supply information concerning humidity, temperature, water flow rates, equipment status, power consumption, and other data to the central monitoring station.

Existing service cabling will provide the communications network. A microdata processor will transmit data between the sensors and the central monitoring station; 17 remote data processors will then be provided. These processors will feed the data into a computer providing automated scanning and limit checking controls at the central monitoring station. The computer will include a standard keyboard, cathode ray tube display, and a line printer to allow the operator to monitor and control the utilities from the central control station located at the Central Heating Plant.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				77,000
HVAC subsystem	LS	---	---	66,000
60-Hertz power subsystem	LS	---	---	11,000
Equipment				543,000
Remote units	LS	---	---	74,000
Monitor and control station	LS	---	---	208,000
Utilities/UCS checkout	LS	---	---	83,000
Sensors, signal transmitters and controls	LS	---	---	178,000
Fallout Shelter (not feasible)	---	---	---	---
Total				620,000

LIST OF RELATED GRAPHICS:

Vicinity Map
Location Plan

OTHER EQUIPMENT SUMMARY: None

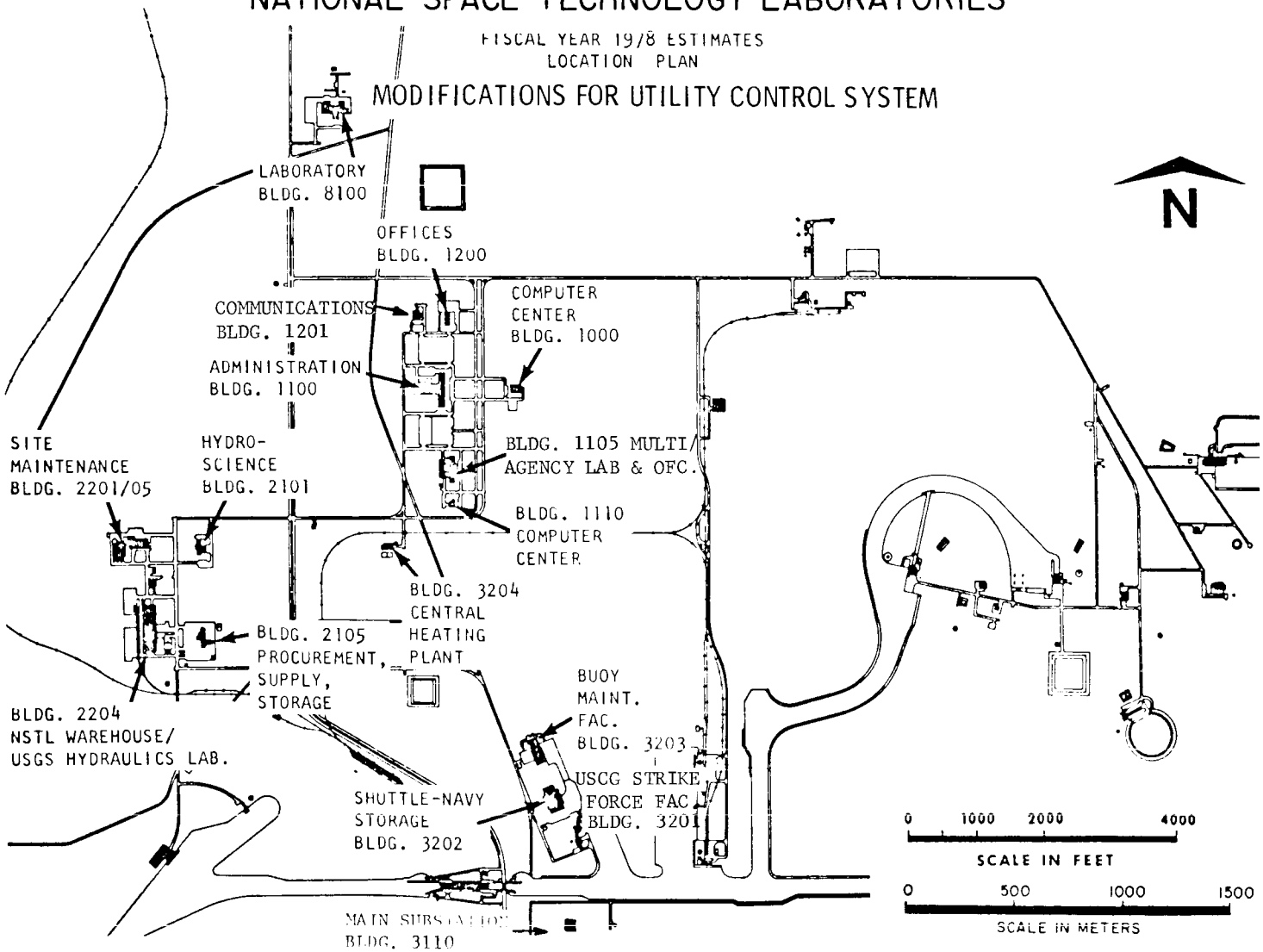
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is envisioned that the UCS provided by this FY 1978 project will result in maximum cost savings for the areas where it is installed. The project, as described above, is fully operable by itself and will not require future funding. However, for this type of project, full optimization may not be definable until operation of the system begins and actual experience is obtained. Additional funds may therefore be required in the future if this data indicates that extension of the system can be justified in terms of additional energy and manpower savings.

NATIONAL SPACE TECHNOLOGY LABORATORIES

FISCAL YEAR 1978 ESTIMATES
LOCATION PLAN

MODIFICATIONS FOR UTILITY CONTROL SYSTEM



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

LARGE AERONAUTICAL FACILITIES

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Construction of national transonic facility (LaRC)	23,500,000	CF 9-3
Modification of 40- by 80-foot subsonic wind tunnel (ARC)	13,500,000	CF 9-17
Total	37,000,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Large Aeronautical Facilities	
	FY 1978 CoF ESTIMATE: $37,000,000

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide for the construction and modification of critically needed large aeronautical research and development testing facilities. This need and the planning related to these large aeronautical facilities has been supported jointly by NASA and the Department of Defense (DoD). These facilities are included in a joint program/plan to provide for essential major and unique aeronautical test facilities capabilities required over the next two decades. The facilities will have the testing capability necessary for the pursuit of research and the development of technology that will be needed if we are to continue to provide this country with superior and more fuel-efficient military and civil aircraft.

The NASA Large Aeronautical Facilities included in this program/plan are:

1. Construction of National Transonic Facility (NTF). This is a high Reynolds number transonic tunnel to be located at Langley Research Center (LaRC), Virginia, which will combine into a single facility the capabilities needed to satisfy the research needs of NASA and the development needs of the DoD and the aerospace industry.

2. Modification of 40 x 80-Foot Subsonic Wind Tunnel. This is a full scale wind tunnel located at Ames Research Center (ARC), California, dedicated primarily to investigating flight characteristics of rotorcraft and V/STOL aircraft, and supplies the research needs of NASA and development needs of the DoD and the aeronautical industry.

The NASA FY 1978 request provides the second funding increment for the Construction of the National Transonic Facility (NTF) at LaRC and the second funding increment for the Modification of the 40 x 80-Foot Subsonic Wind Tunnel. In the FY 1977 budget, $25 million was provided to initiate long-lead procurement

of equipment and related construction for the NTF. There is also available from FY 1977 appropriations $6.0 million for application against the Modification of the 40 x 80-Foot Tunnel. A Fiscal Year 1978 need of $13.5 million is included in these estimates. Future years Construction of Facilities (CoF) resources will, of course, be needed to complete both of these facilities.

Environmental impact statements (EIS) have been prepared for both facilities and are being circulated as amendments to the institutional EIS's for both LaRC and ARC. For both facilities, operating noise is the major concern with respect to possible impact on the local environment. Additionally, the venting of cold nitrogen gas from the NTF is of significant concern. In both cases, measures to reduce these impacts to acceptable levels are being incorporated into the designs.

Current schedules which are predicated on the funding increments outlined in this budget estimate indicate the completion of the NTF and modifications to the 40 x 80-Foot Subsonic Wind Tunnel in mid-CY 1981. Upon completion of these two facilities, this nation will have new aerodynamic testing capabilities to successfully meet the challenges inherent in the development of a new generation of flight vehicles designed for high performance and efficient operation in the full range of speeds and flight profiles.

LANGLEY RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

LOCATION PLAN

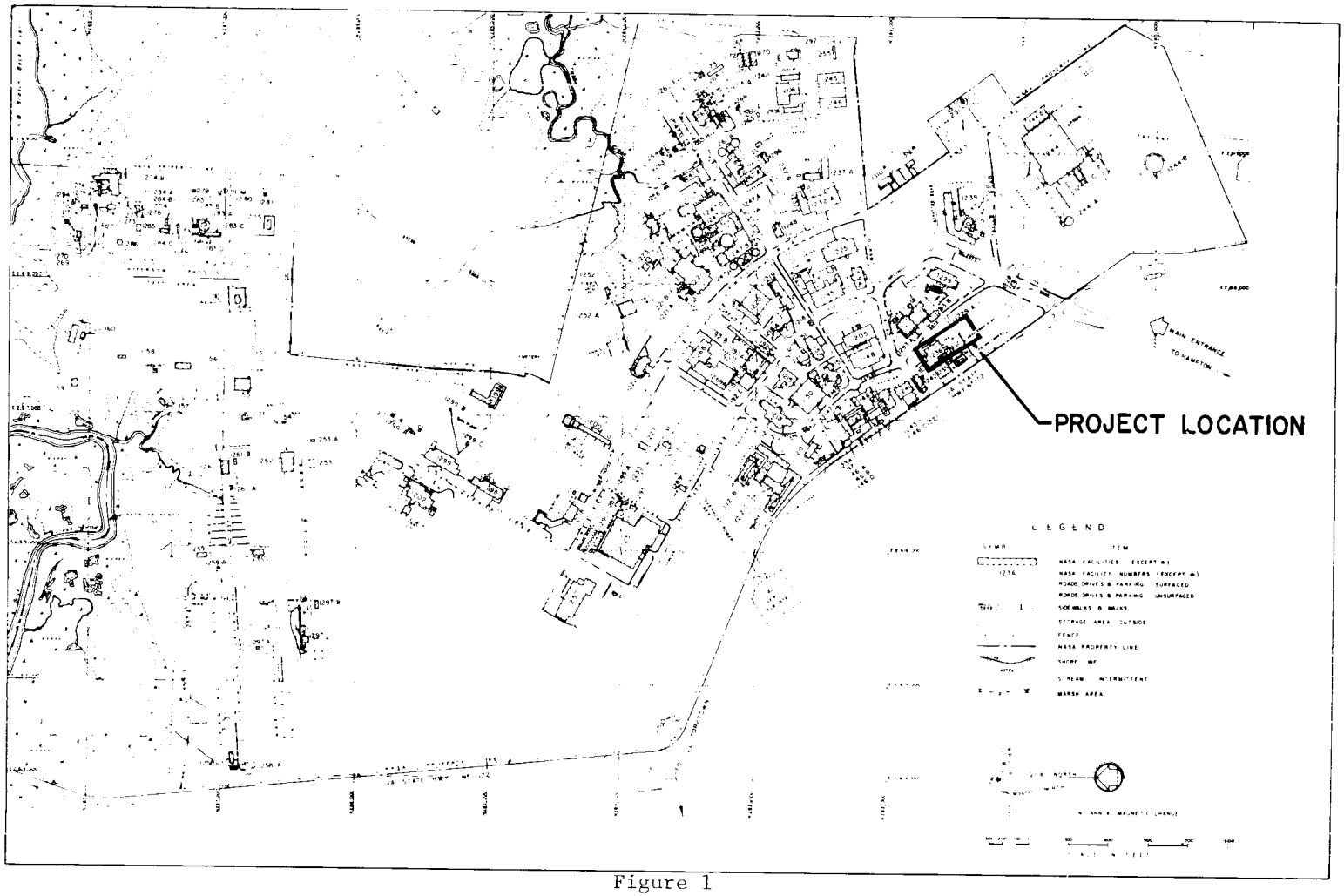


Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Construction of National Transonic Facility
INSTALLATION:	Langley Research Center
	FY 1978 CoF ESTIMATE: $23,500,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	5,500,000	25,000,000	30,500,000
Other affiliated funding	---	4,942,000	4,942,000
Total	5,500,000	29,942,000	35,442,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the incremental facilities work begun with FY 1977 resources for the National Transonic Facility (NTF) at the Langley Research Center (LaRC). This facility, a transonic wind tunnel which will satisfy the research needs of NASA and the development testing needs of DoD and the aerospace industry, will provide the capability to test a broad spectrum of aeronautical vehicles, including civilian, commercial, military, and space vehicles at up to full scale Reynolds numbers. It will incorporate a cryogenic approach for achieving such a high Reynolds number without excessive model loads or power requirements by using the evaporation of liquid nitrogen to obtain a low temperature test medium in an otherwise conventional fan-driven closed circuit wind tunnel. With temperature as a test variable,

the facility will allow clear separation of aeroelastic, Mach number, and Reynolds number effects on the aerodynamic performance of aircraft configurations. The ability to separate these effects has heretofore been unattainable in ground facilities. Thus, the new tunnel provides an entirely new realm of research capabilities in both Reynolds number and the ability to investigate independently significant aerodynamic parameters.

The FY 1977 increment provided for demolition and disposal of that portion of the 4' x 4' Supersonic Wind Tunnel (4' x 4' SWT) (located on the NTF site) which will not be reused, and construction of new foundations for the NTF. It also provided for the first increments of the tunnel pressure shell fabrication and erection, and the tunnel structure components fabrication. Additionally, FY 1977 funding provided for liquid nitrogen storage, tunnel cooling coils, and the first increment of the drive system, as well as fan components, the model support system and the electrical systems.

Fiscal year 1978 funding provides for the second increment of the tunnel pressure shell fabrication and erection, and the tunnel structure components fabrication. It also provides for tunnel structure components installation, special piping systems, the second increment of the drive system, and the test section side access system.

The relationship of the FY 1977, FY 1978 and future fiscal year resources is summarized in Figure 7.

PROJECT JUSTIFICATION:

An urgent need has developed over recent years for several new facilities for aerodynamic testing at transonic speeds and at flight Reynolds numbers. In spite of spectacular advances in aerodynamics during the last 20 years, a number of leading aircraft developments have encountered difficulty because of misleading or inadequate wind tunnel testing in the transonic range. The need for new facilities is supported by the U.S. Department of Defense, the U.S. Aerospace Community, and by the North Atlantic Treaty Organization Advisory Group for Aerospace Research and Development (AGARD). It stems from the recognition that experimental data obtained from existing low Reynolds number transonic wind tunnels often lead to inadequate conclusions regarding flight vehicle performance predictions. This results from the fact that a vehicle traveling at transonic speeds experiences supersonic air flow velocities over portions of the vehicle surface area. This leads to unsteady surface flow conditions such as Reynolds number sensitive shock/boundary layer interaction. The transonic flight environment is common to a broad spectrum of flight vehicles, such as civilian, commercial, military, and space. This "Reynolds number sensitive" aerodynamic environment is generally not amenable to analytical study, and thus requires accurate experimental data at or near flight Reynolds numbers for an adequate solution.

A wind tunnel which will permit accurate experimental measurement at transonic speeds approaching flight Reynolds numbers is necessary for the continuing development of new technology. It will allow increases

in efficiency, performance, size and range of civil and military aircraft, the basis for maintaining world leadership in aircraft design and U.S. superiority in military flight vehicles. Thus, the urgency of the new testing capability suggests that this facility be completed at the earliest possible time.

The capability to simulate full scale Reynolds numbers on a model in a wind tunnel at Mach numbers near 1.0 requires a workable test section size of 8.2 x 8.2 feet (2.5 meters x 2.5 meters) with a maximum operating pressure of 130 psia (896,000 newtons per square meter). It also requires run times sufficiently long to permit accurate data measurements for the complete spectrum of aerodynamic research. The quality of the test air flow should be of the highest practical level. There are no known wind tunnels in existence in the United States or Europe that will satisfy these requirements. The need for an aeronautical test facility with these capabilities was confirmed in FY 1977 when $25 million was authorized and funded for the first increment of construction. This request is for funds to finance the continuation of work on a facility recognized as essential for adequate transonic aeronautical testing of the future.

PROJECT DESCRIPTION:

This project consists of the second increment of construction on a fan-driven closed circuit wind tunnel as shown in Figure 4. It will be 200 feet (61 meters) long, 48 feet (14.6 meters) wide, varying in diameter from 40 feet (12.2 meters) to 11 feet (3.4 meters), and will have an operating pressure range of 14.7 psia (101,400 newtons per square meter) to a maximum of 130 psia (896,000 newtons per square meter) and an operating temperature range of 155°F to -300°F (341.5°K to 88.7°K). Cryogenic temperatures will be obtained by evaporating liquid nitrogen that has been injected into the tunnel circuit. Thus, cold nitrogen gas will be used as a test medium. The cryogenic approach has been identified as the most effective energy conserving technique for achieving high Reynolds numbers without excessive model loads. The tunnel pressure shell will be fabricated from either nickel or stainless steel and will be insulated internally to efficiently contain the cold gas. A fixed-pitch single-stage fan will drive the tunnel air flow through a 8.2 x 8.2-foot (2.5 meter x 2.5 meter) slotted test section to produce Mach numbers ranging from 0.2 to 1.2.

A three dimensional model support and angle-of-attack system (Figure 5) having an angle range of 29 degrees will be incorporated in the test region. A roll mechanism will be an integral part of the support system and will be capable of rolling the model through 180 degrees. Windows in the walls of the slotted test section will be provided for remote television view of the model under test.

The NTF (Figure 2) will be constructed on the site of the currently existing 4' x 4' SWT and will incorporate the electric motor drive system now in that tunnel. The motors in that system will provide approximately half the total operating power required, and are rated at 47,000 HP (35,062 kW) for continuous duty. They are capable of 70,000 HP (52,220 kW) for run times up to 10 minutes. A two-speed gear

system (Figure 6) will be provided to efficiently match the fan with motors at both ambient and the full range of attainable cryogenic temperatures. A speed control system will also be provided to achieve a constant torque from the motor over a wide range of revolutions per minute, thus improving the power characteristics of the motors for this new application. A new 60,000 HP synchronous drive motor (44,760 kW) (10 minute rating) will be installed to provide the additional power required to achieve the higher Reynolds numbers. The facility will use the existing cooling tower, pumps, auxiliary equipment and buildings. A new two-story shop addition (Figure 3) of approximately 33,500 square feet (3,112 meters^2) will be provided to accept the larger transonic test section. The shop will include space for a control and data acquisition room and for improved model preparation area. Adequate controls, process monitors, and data acquisition systems are included in this project.

A liquid nitrogen storage and supply system will accommodate nitrogen flows to the tunnel at rates up to about 1,100 lbs. per second (499 Kg per second). This flow is required to remove the heat generated by the fan during constant cryogenic temperature operation. Additionally, a pressure control and venting system is provided to maintain constant pressure during data gathering. The vent will feed into an exhaust stack acoustically designed to satisfy environmental standards.

Due to the size and complex nature of this facility, it has been considered appropriate to plan its financing in progressive increments over several fiscal years, as shown in Figure 7. The first increment, totaling $25 million, was provided in FY 1977. Analyses of project schedules and project management capabilities indicate that such a funding approach will not adversely affect the operational schedule for this large facility. Completion is presently envisioned as being mid-1981, a milestone heavily contingent upon the FY 1978 increment of funding. Preliminary engineering estimates indicate that the total ultimate cost of this facility may be $65-70 million, depending on problems encountered, and on the time of construction and ultimate degree of cost escalation encountered. Considerable preliminary engineering, special studies and design have already been completed. Actual construction was initiated in December 1976.

Both the design and construction of this project are being managed on a "work package" basis. Each of the "work packages" contains all elements of work to be accomplished through separate procurement. Each is separately scheduled and subject to separate cost control. This approach is particularly effective for an extremely complex facility in which diverse materials, fabrication techniques and construction trades necessitates superior management of understanding and supervision of all elements of the work. Identification of smaller increments of the total job results in better project management, improved competition, and better functional and cost-effective designs.

The FY 1978 request will provide for continuation of several elements of the project started with FY 1977 resources, and will cover the start of several additional work packages. Included in the FY 1978 increment will be the continuation of fabrication and erection of the tunnel pressure shell, which will form the

general aerodynamic shape of the tunnel circuit and be built of rolled and welded steel plate designed to withstand the extreme temperature and pressure fluctuations encountered during test operations. Also included in this increment will be continuation of the fabrication of the tunnel structure internal components and the start of their installation in the shell. Internal components to be fabricated using FY 1978 resources include the contraction section, high speed diffuser sections, fan section, and liquid nitrogen injection system. These, along with internal components provided with FY 1977 funds (test section, model support section, screens and turning vanes), will all be installed in the tunnel shell using FY 1978 funds.

Equipment to be provided with FY 1978 resources includes the special piping system, the lube oil systems, the cooling water system, the high pressure compressed air system, the vacuum system, and the nitrogen admission and venting systems, all of which will be fabricated and installed using this funding increment. Fabrication of the tunnel drive system which was started with FY 1977 funding also will be continued with this funding increment. This includes speed control system fabrication, fan drive fabrication, and rewinding the existing motors (4' x 4' SWT). Installation of all elements of the tunnel drive system, both new and elements recovered from the existing facility, will be accomplished using this increment of funding. Additionally, these resources will be used to provide the test section side access system. The side access system consists of retractable access chambers which, coupled with gate valves that isolate the test section from the rest of the tunnel circuit, permits safe access to the model by operating personnel without returning the entire tunnel to ambient conditions.

An environmental impact statement (EIS) for this project has been prepared. As indicated in the EIS, proper design and construction, as well as adequately controlled operation of the completed facility, will mitigate possible environmental impacts, such as noise, venting of large volumes of nitrogen gas, and the possible formation of ground fog caused by cold nitrogen gas venting. This will be accomplished to a degree sufficient to meet environmental standards. Although several studies and final design pertaining to these areas of concern are not yet complete, preliminary findings indicate that acoustical treatments of the tunnel drive system and the vent stack will reduce noise to acceptable levels. Similar efforts, including pilot vent stack operation, although not complete, indicate that the nitrogen can be satisfactorily vented without adverse effects under most operational conditions. However, there may be occasions when the mode of tunnel operation will have to be modified due to atmospheric conditions which could, when the cold nitrogen gas is vented, lead to a ground fog "problem". Work is continuing to develop the most effective combination of equipment and operational parameters to satisfactorily deal with these problem areas.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				17,100,000
Tunnel pressure shell: materials, fabrication, and erection (Increment II)	LS	---	---	11,900,000
Tunnel structure components fabrication (Increment II)	LS	---	---	3,700,000
Tunnel structure components installation	LS	---	---	1,500,000
Equipment				6,400,000
Special piping system	LS	---	---	3,000,000
Tunnel drive system (Increment II)	LS	---	---	3,200,000
Test section side access system	LS	---	---	200,000
Fallout Shelter (not feasible)	---	---	---	---
Total				23,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Perspective View
Figure 3 - Second Floor Plan and Tunnel Layout
Figure 4 - Tunnel Aerodynamic Lines
Figure 5 - Test Section Elevation
Figure 6 - Fan Drive System
Figure 7 - Funding Plan

OTHER EQUIPMENT SUMMARY:

Existing collateral equipment consisting mainly of the electric drive motors and a portion of the building for the 4' x 4' SWT will be used in this facility. The total "book value" of the 4' x 4' SWT is about $4,942,000. The estimated replacement value of the 4' x 4' SWT is $20 million, of which about $14 million will be reused in the NTF. Although no other noncollateral equipment is required to complete this facility and operate it for its intended purpose, it is anticipated that special mounting "jigs" and data gathering devices will be used in conjunction with future aerodynamic test programs. Since the details of these test programs have not yet been developed, the specific items of additional specialized noncollateral equipment cannot yet be identified. However, it is anticipated that some of this equipment will be provided from existing inventories and other items will be purchased as the special need arises.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete the construction of the National Transonic Facility, some $15-20 million of additional funding will be required.

LANGLEY RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

PERSPECTIVE VIEW

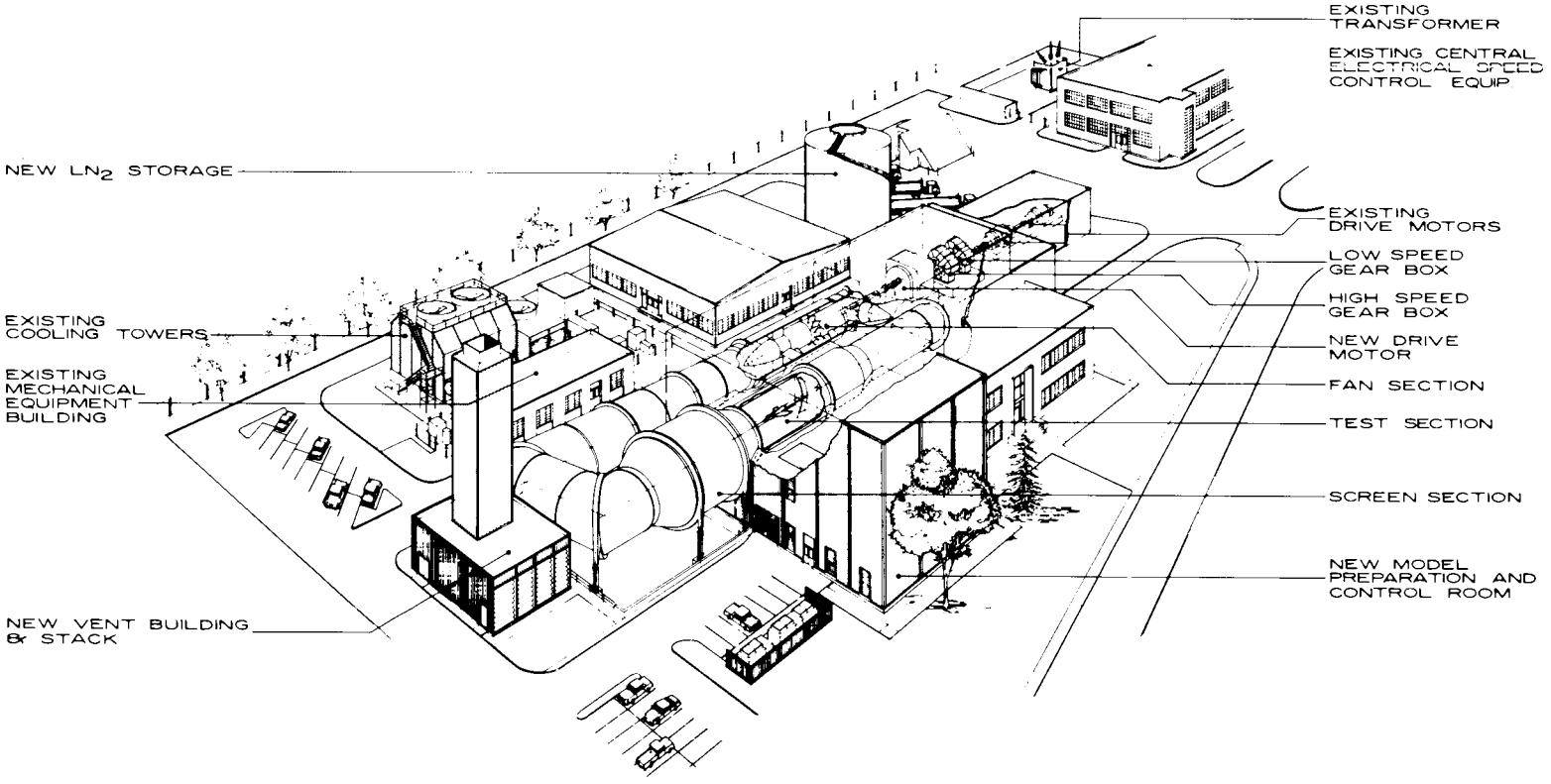


Figure 2

LANGLEY RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

SECOND FLOOR PLAN AND TUNNEL LAYOUT

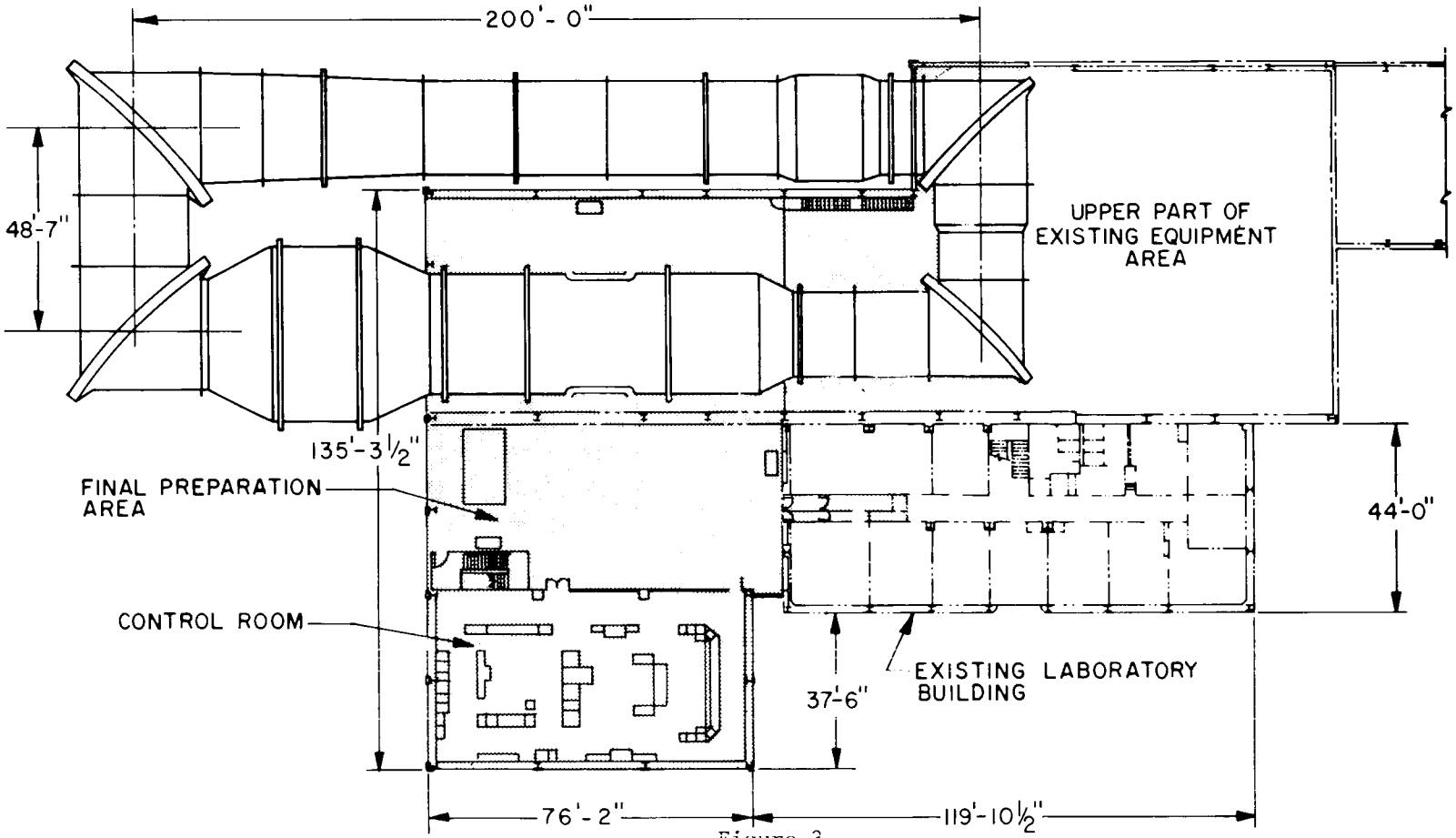


Figure 3

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FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

AERODYNAMIC LINES

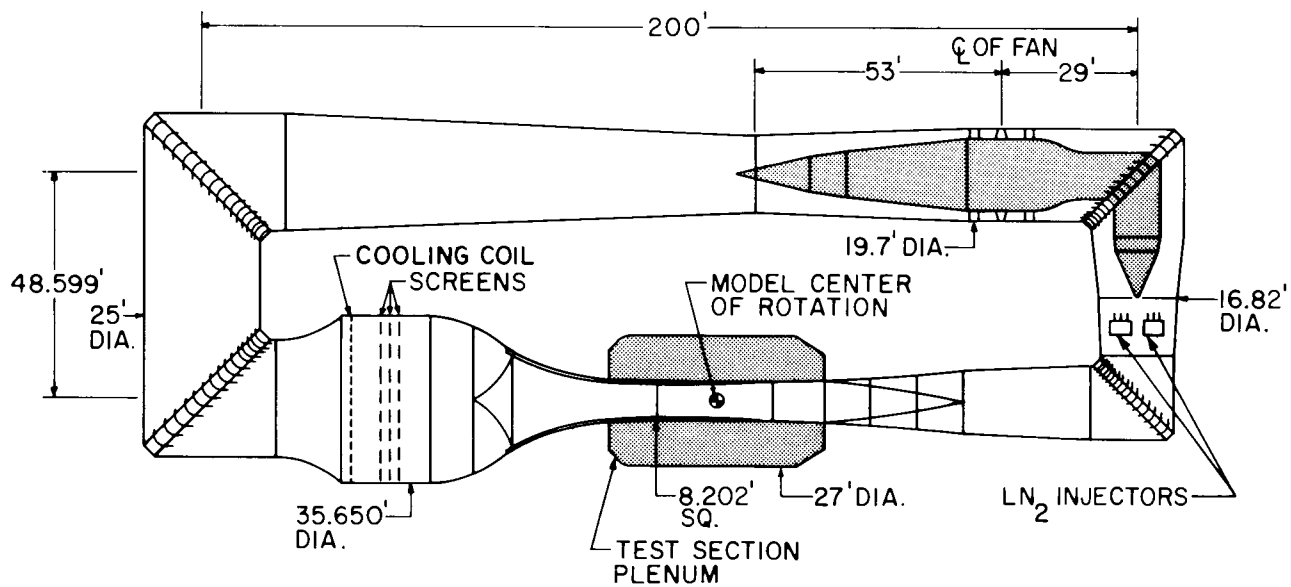

Figure 4

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FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

TEST SECTION ELEVATION

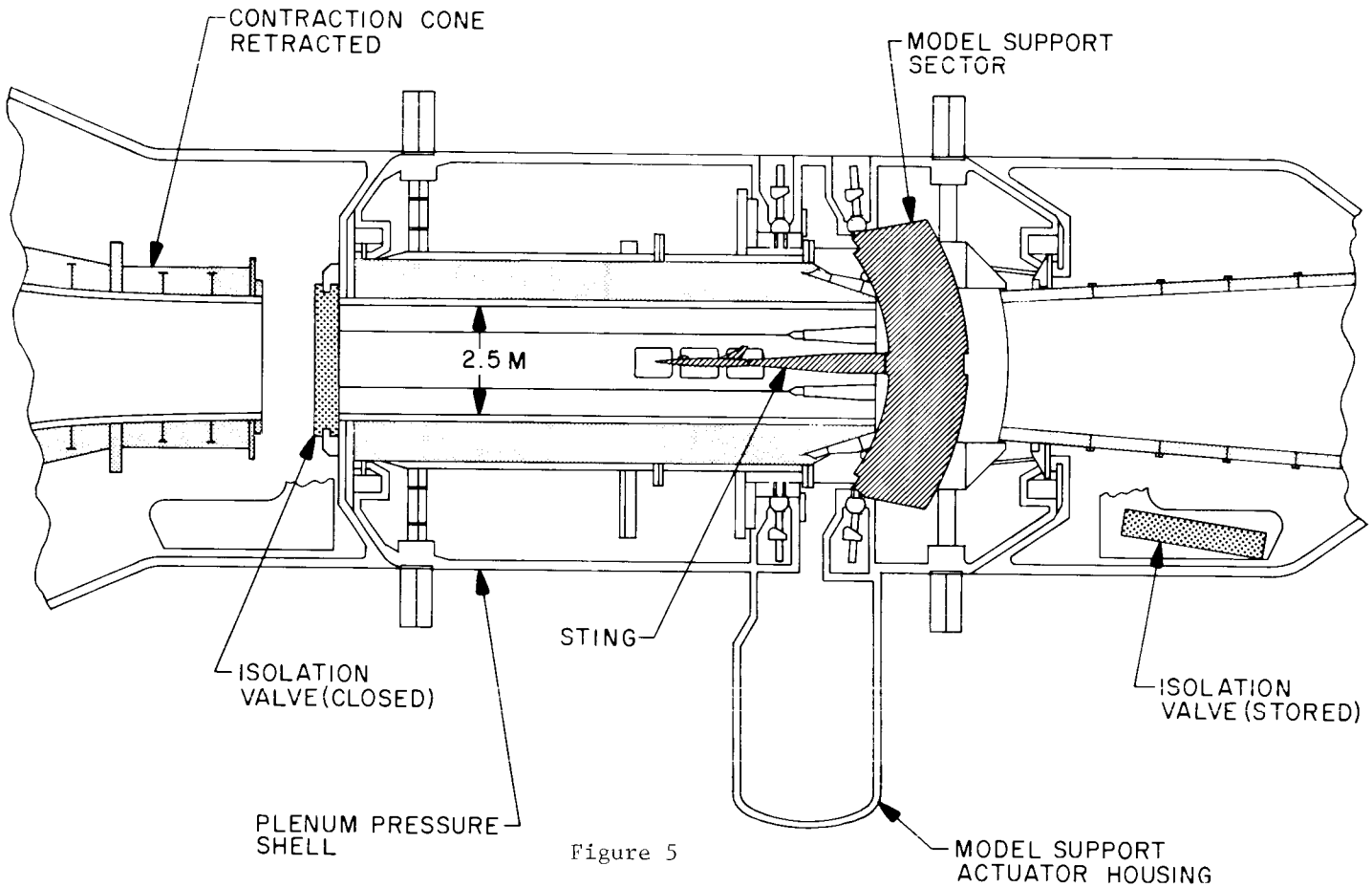

Figure 5

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FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

FAN DRIVE SYSTEM

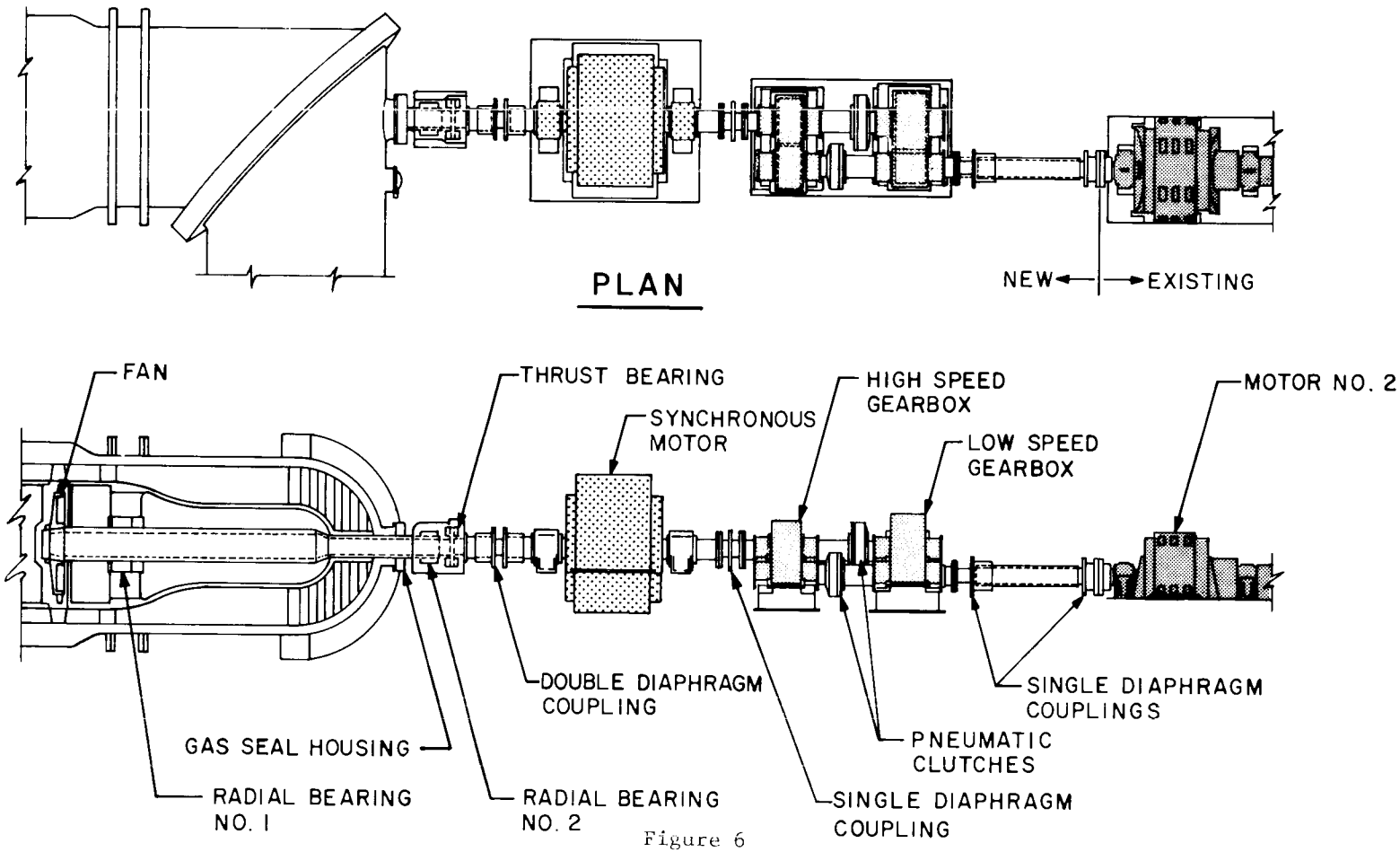

Figure 6

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FISCAL YEAR 1978 ESTIMATES

CONSTRUCTION OF NATIONAL TRANSONIC FACILITY

FUNDING PLAN
(Millions of Dollars)

	Fiscal Year			
	1977	1978	Future	Total
CONSTRUCTION	14.2	17.1	11.1	42.4
Demolition, piles, and foundations	1.4	---	---	1.4
Sitework and building	---	---	3.4	3.4
Tunnel pressure shell	7.7	11.9	4.9	24.5
Tunnel structure components fabrication	4.4	3.7	---	8.1
Tunnel structure components installation	---	1.5	---	1.5
Insulation and liner	---	---	2.8	2.8
Nitrogen storage	.7	---	---	.7
EQUIPMENT	10.8	6.4	5.4	22.6
Special piping system	---	3.0	---	3.0
Cooling coil	.3	---	---	.3
Tunnel drive system	6.5	3.2	---	9.7
Fan components	1.9	---	---	1.9
Model support system	.8	---	---	.8
Process control system	---	---	2.4	2.4
Data acquisition and research instrumentation	---	---	2.9	2.9
Test section side access system	---	.2	---	.2
Model handling equipment	---	---	.1	.1
Electrical systems	1.3	---	---	1.3
TOTAL	25.0	23.5	16.5*	65.0

*NOTE: Some $15-20 million is estimated at this time.

BASE LINE ESTIMATE

Figure 7

AMES RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40 x 80 FT SUBSONIC WIND TUNNEL
LOCATION PLAN

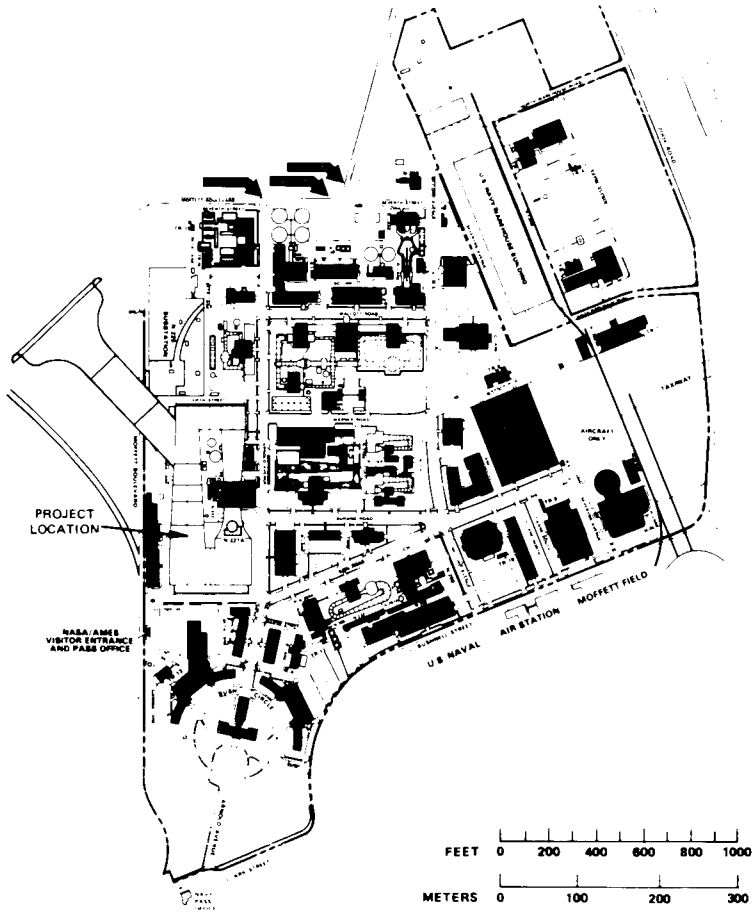

Figure 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modification of 40- by 80-Foot Subsonic Wind Tunnel
INSTALLATION:	Ames Research Center
	FY 1978 CoF ESTIMATE: $13,500,000

LOCATION OF PROJECT: Moffett Field, Santa Clara County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	2,208,000	6,000,000	8,208,000
Other affiliated funding	---	16,736,000	16,736,000
Total	2,208,000	22,736,000	24,944,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the second increment of funding for the modification of the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel at Ames Research Center (ARC), Moffett Field, California, to provide the capability for testing of advanced rotorcraft at speeds to 300 knots (154 meters per second) and for the addition of a new 80 x 120-foot (24.4 x 36.6 meter) test section for full scale wind tunnel testing of vertical and short takeoff and landing (V/STOL) aircraft in the speed range of 5 to 110 knots (2.6 to 56 meters per second). The location of the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel is shown in Figure 1.

The existing facility is limited in terms of both the maximum test speed obtainable, 200 knots (103 meters per second), and test section size, 40 x 80-foot (12.2 x 24.4 meter). To increase the test speed from 200 knots

to the needed 300 knots (154 meters per second), the existing 36,000 HP (27,000 kW) wind tunnel drive motors will be replaced with 135,000 HP (101,000 kW) motors. Also, the present 6-bladed, fixed-pitch fans will be replaced with 15-bladed, variable pitch fans. With the new drive system, the maximum fan tip speed will be 377 feet per second (115 meters per second) rather than the 600 feet per second (180 meters per second) with the existing system. (In combination with the sophisticated fan design and with the variable-pitch blades incorporated in this modification, the reduction in tip speed minimizes the major source of noise generated by the facility. For example, the noise generated by the new fan system at 200 knots will be at least 20 dBA lower than at present.) These changes, along with associated structural modifications, will provide the increased test speeds required in the 40 x 80-foot test section.

For full scale testing of V/STOL aircraft, a new 80 x 120-foot (24.4 x 36.6 meter) test section "leg" will be added to the 40 x 80-foot (12.2 x 24.4 meter) subsonic wind tunnel (Figure 2). For the 80 x 120-foot (24.4 x 36.6 meter) test section configuration, air will be drawn in from the atmosphere through an entrance opening approximately 360 x 130 feet (110 x 40 meter), pass through the test section and the main drive section, and will be exhausted to the atmosphere through louvers to be installed in the south wall of the existing 40 x 80-foot (12.2 x 24.4 meter) subsonic wind tunnel. Flow diversion vanes and louvers and adjustable turning vanes must be installed to permit operation in either 40 x 80 mode or in the 80 x 120 mode to ensure that the flow is smooth and uniform during both modes of operation (Figure 3).

To permit siting of the new test section leg, acquisition of approximately 5 acres of land belonging to the Pacific Gas and Electric Company (PG&E) and the relocation of a portion of the Ames' electrical power substation are required. In order to obtain the PG&E property, an equal amount of Ames' land will be traded to PG&E for their property. The land trade with PG&E has been agreed upon by both parties concerned. The land presently planned to be traded is shown in Figure 4. Plot B (NASA property) will be traded for Plot A (PG&E property). The part of the Ames' substation to be relocated will be built adjacent to Plot B. Plot C shown in Figure 4 is Navy property and a "Land Use Agreement" with the Navy will be obtained by NASA for use of that property.

The FY 1977 increment provided for the initiation of the procurement for the main drive motors and controls, the fan and stator blades, the fan hub and variable pitch mechanism, and the relocation of part of the Ames' electrical power substation. It is planned to incrementally fund these long lead items over four fiscal years. The second increment of funding for the long-lead items is included in this FY 1978 funding request. In addition, the FY 1978 funding also provides for the initial site work, structural modifications, and the new balance and model support system for the 80 x 120-foot (24.4 x 36.6 meter) test section. The relationship of the FY 1977, FY 1978, and future resources is summarized in Figure 7.

Considerable engineering and special feasibility studies have already been completed, and the results implemented in the project design. The final design for the repowering was completed in late 1976. Final design for the addition of the new test section leg is about 30% complete and is scheduled to be completed by mid-1978. The initial effort in the final design for the new test section leg will cover the critical, long lead items that are included in this budget request.

PROJECT JUSTIFICATION:

Modifications to the existing 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel will provide a national facility with a capability for both research and development testing of full scale rotorcraft systems at speeds to 300 knots (154 meters per second) and for full scale testing of vertical and short takeoff and landing aircraft in the speed range from 5 to 110 knots (2.6 x 56 meters per second). This requirement has become critical in the past decade. During that time, both civil and military rotorcraft have advanced significantly in speed capability, and can no longer be adequately evaluated in any existing test facility. Also, the technology of such VTOL and STOL aircraft as the Advanced Harrier AV-8B and the Navy Multi-Mission V/STOL aircraft have advanced to the point that full scale testing of flight configuration is now required (in the absence of adequate wind tunnel facilities) to investigate and resolve the very complex problems of propulsion system/airframe structure/control interactions so that development of these vehicles can proceed effectively and economically.

The usefulness of wind tunnel testing prior to flight testing has been demonstrated in a wide variety of test programs conducted in this facility in the past 3 to 5 years. Testing has included V/STOL aircraft such as OV-10A, XV-5, H-126, and AV-8B; CTOL aircraft such as F-14, F-15, F-111B, and A-37; rotorcraft such as XV-15, AH-56A, and ABC flight rotor; propulsion systems such as Q-Fan and J-79; recovery devices such as B-77 drogue chute and full scale parawings; and the space shuttle orbiter.

The growing limitations of current test facilities for such testing were recognized in 1967 by the Aeronautics and Astronautics Coordinating Board (AACB) when it initiated studies that ultimately led to this plan, to modify the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel. Initially, comprehensive studies were made of the feasibility of constructing a new full scale wind tunnel to achieve the defined testing requirements; however, the cost was found to be more than $300 million in 1973 dollars, an amount considered excessive. Moreover, it was determined during this period that the technology was now available to permit the design of a new drive system to fit into the drive support structure of the existing facility and achieve most of the desired testing requirements. Therefore, it was decided to defer further considerations of a new full scale wind tunnel. The approach involving modification of the existing facility, as described in this project, was presented to and approved by the AACB in 1973.

It was also determined that modifications requiring a shut-down of the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel could be accomplished within an acceptable period of 8 months or less. Due to the heavy utilization of the 40 x 80-Foot Subsonic Wind Tunnel, the impact of the required down-time on projected test programs has been carefully analyzed. It has been determined that the primary impact would be on the NASA

long-range test programs which at present have no critical due dates. There are no known programs from other agencies that would need to be accomplished during the 8-month period.

A primary need in connection with the higher speed capability is to investigate advanced high speed rotor systems. In rotorcraft systems such studies are important in examining aerodynamics/dynamic interactions in minimizing structural and associated safety problems, reducing rotorcraft noise and improving flight performance in civil transport and military mission roles. These are all factors that strongly affect the potential utilization of rotorcraft as air transportation systems. Military operations impose stringent requirements on landing and takeoff performance. The Rotor Systems Research Aircraft (RSRA) and the XV-15 are examples of advanced rotorcraft which require the increased speed capability of the modified facility.

The primary need for a larger subsonic test section is based on the fact that VTOL and STOL aircraft as well as the larger rotorcraft encounter wall blockage problems and large downwash angles which are associated with powered lift. Conventional aircraft also require a large test section to study the performance of high-lift devices which are Reynolds number sensitive and difficult to reproduce accurately at less than full scale. The mechanical and structural aspects of high-lift systems such as air leaks and deflection under load can significantly affect test results of aerodynamic performance. For V/STOL aircraft, the main problem is usually the propulsion system and its interaction with the aircraft. The main components of the propulsion system (rotor or fan blades, inlets, vectoring devices, etc.) operate in the range of Reynolds numbers where significant variations in aerodynamics occur. In addition, there are important aeroelastic, mechanical, and structural aspects of these propulsion systems that require extensive experimental studies using full scale or flight hardware. The major technical risks of V/STOL aircraft employing low disk loading rotor systems are associated with dynamic loads, dynamic stability, and control of the rotor system. These characteristics are highly dependent on the unsteady aerodynamic force imputs to the rotor and on the dynamic characteristics of the rotor and its control system including backlash, break-out forces and nonlinear effects. For V/STOL aircraft employing high disk loading, direct lift propulsion systems, the main problem areas are in hovering and in the transition to wing supported flight. In this transition, the lift propulsion system is generally required to operate in a highly distorted, unsteady, and turbulent flow field, with resulting high vibratory loads on fan blades, and possible catastrophic failures in flight due to fan or engine stalling. It is therefore essential that the characteristics of the propulsion system as installed in the aircraft be determined prior to committing the hardware to flight. Failure to do this may result in serious deficiencies going undiscovered until the occurrence of a disastrous in-flight failure. The Tilt Rotor Research Aircraft (XV-15) now being developed is an example of a low disk loading V/STOL aircraft which requires full scale wind tunnel testing.

It is projected that such test programs will continue in the foreseeable future--both before and after these facility modifications are made--with about 2/3 of the programs being tested in the 80 x 120-foot test section when it becomes operational. To meet the continuing demand, the 40 x 80-Foot Subsonic Wind Tunnel

is operating two shifts per day, five days per week. After modification, the 40 x 80/80 x 120-Foot Subsonic Wind Tunnel complex will continue to be operated on two shifts. The staff, at that time, is projected to be 56 civil service and 8 contractor personnel, the same as presently assigned to the facility.

The projected utilization of the modified 40 x 80-Foot Subsonic Wind Tunnel will involve approximately 70% for research problems, such as: rotor aerodynamic/dynamic interactions; aerodynamic/propulsion interactions; engine/airframe integration; V/STOL propulsion control systems; and noise and gust alleviation. Approximately 30% utilization is projected for the development problems of rotorcraft and V/STOL aircraft involving configuration definitions, system integration and evaluation, and performance improvement.

Successful developmental testing of civil and military advanced rotorcraft and V/STOL aircraft now being scheduled requires that the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel be repowered to increase the maximum wind speed from 200 to 300 knots (103 to 154 meters per second) and be modified to incorporate a new 80 x 120-foot (24.4 x 26.6 meters) test leg by early FY 1981. To achieve that objective, procurement of long-lead items - fan system, test section system, and drive motors - must be initiated by early FY 1978. Construction funding in subsequent fiscal years are also required to complete this project.

PROJECT DESCRIPTION:

Figures 1 and 2 present a location plan and plan view, respectively, of the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel. Repowering will increase the maximum wind speed of the 40 x 80-foot test section from 200 to 300 knots (103 to 154 meters per second). This increased capability will be achieved by replacing the six existing 6,000 HP (4,500 kW) induction motors with six 22,500 HP (16,800 kW) synchronous motors, and the existing 6-bladed, fixed-pitch fans with 15-bladed, variable-pitch fans (see Figures 3 and 5). The wind tunnel will be repowered within the existing drive section structure using the existing main drive supports which will require only minor modifications to withstand the additional loads imposed by the heavier and more powerful motors and fans. Frequency control for varying fan speed will be provided through the use of the existing motor generator set which will require some modification. The combination of variable-pitch fans and frequency control will provide the 40 x 80-foot (12.2 x 24.4 meter) test section with a precisely controlled speed range of 5 to 300 knots (2.6 to 154 meters per second). The existing wind tunnel shell will require structural reinforcement to support increased air loads.

The 80 x 120-foot (24.4 x 35.6 meter) test section capability will be accomplished by adding a new "leg" to the existing tunnel circuit just upstream of the drive motor section (see Figure 2). The new leg will include the new test section (Figure 6), necessary transitions and flow directing structure and sound muffling treatment required to avoid adverse acoustical impact on the environment and surroundings of Ames Research Center. In this operating configuration, air will be inducted at the entrance cone, flow through the 80 x 120-foot

(24.4 x 36.6 meter) test section, the drive motor section, and portions of the existing wind tunnel circuit, and will be exhausted to the atmosphere through exit vanes to be installed in the existing tunnel downstream from the drive motors (Figure 2).

Due to the size and complex nature of this facility, it has been considered appropriate to plan its financing in progressive increments over several fiscal years, as shown in Figure 7. The first increment, totaling $6 million, was provided in FY 1977. Analyses of project schedules and project management capabilities indicate that such a funding approach will not adversely affect the operational schedule for this large facility, scheduled for completion in mid-1981. Preliminary engineering estimates indicate that the total ultimate cost of this facility will probably be about $80 to $85 million, depending on the time of construction and the ultimate degree of cost escalation encountered. Considerable preliminary engineering, special studies and design have already been completed.

Both the design and construction of this project are being managed on a "work package" basis. Each of the "work packages" contains all elements of work to be accomplished through separate procurement. Each is separately scheduled and subject to separate cost control. This approach is particularly effective for an extremely large and complex project such as this. Identification of smaller increments of the total job results in better project management, improved competition, and better functional and cost-effective designs.

The FY 1978 budget request will provide for the continuation of the elements of the project initiated with FY 1977 resources, and will cover the start of several additional work packages. These work packages are: site development work; main drive assembly and installation; main drive power supply, nacelle, farings and spinner; the model support and balance system for the new test section; and structural modifications and erection. Procurement of other elements of this project will follow as necessary.

The environmental impact of the proposed modifications has been studied and evaluated in detail, and it is concluded that there will be no adverse impact on the environment at Ames or its surroundings. The control of noise and vibration, the only environmental problems associated with the operation of the present facility, has been taken into consideration in the design of the modifications. It is estimated that these noise and vibration levels will be significantly lower with the operation of the modified facility than with the existing facility. The Ames Research Center's Environmental Impact Statement is being amended to cover the Modification of the 40 x 80-Foot (12.2 x 24.4 meter) Subsonic Wind Tunnel.

Energy requirements of the modified facility will be significantly greater than for the existing facility, due primarily to the increase in drive power (36,000 HP to 135,000 HP). However, various energy saving techniques are being incorporated in this modification to minimize that impact. It is estimated that with these energy saving techniques, the energy usage of the facility will increase from about 6,500 to about 14,500 megawatt hours per year rather than to about 25,000 megawatt hours per year without inclusion of those

techniques. The Center commitment is to absorb that level of usage without increasing the currently projected energy level. This would be accomplished by restricting the operation of some other major facilities at the Center.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				2,000,000
Site work and utilities	LS	---	---	100,000
Structural modifications	LS	---	---	1,100,000
Structural erection	LS	---	---	800,000
Equipment				11,500,000
Main drive assembly and installation	LS	---	---	500,000
Main drive system (Increment II)	LS	---	---	900,000
Main drive power supply	LS	---	---	500,000
Fan and stator blades (Increment II)	LS	---	---	1,300,000
Fan hub and variable pitch mechanism (Increment II)	LS	---	---	1,000,000
Nacelle, faring, and spinner	LS	---	---	1,200,000
Substation relocation (Increment II)	LS	---	---	700,000
Model support and turntable	LS	---	---	3,900,000
Model balance system	LS	---	---	1,500,000
Fallout Shelter (not feasible)	---	---	---	---
Total				13,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Plan View
Figure 3 - Vanes, Louvers, and Fan Drive System
Figure 4 - Land Transactions

Figure 5 - New Fan Drive Unit
Figure 6 - 80x120-Foot Test Section
Figure 7 - Funding Plan

OTHER EQUIPMENT SUMMARY:

Existing collateral equipment consisting mainly of the model support system, balance, motor generator sets and rheostat, and the existing 40 x 80-Foot Subsonic Wind Tunnel will be used with this modification project. The total "book value" of the 40 x 80-Foot Subsonic Wind Tunnel is approximately $16,700,000. Existing non-collateral equipment valued at $1.4 million which consists primarily of computers will be used.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete this project, some $60.5 to $65.5 million additional will be required in future fiscal years.

AMES RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40 x 80 FT SUBSONIC WIND TUNNEL

PLAN VIEW

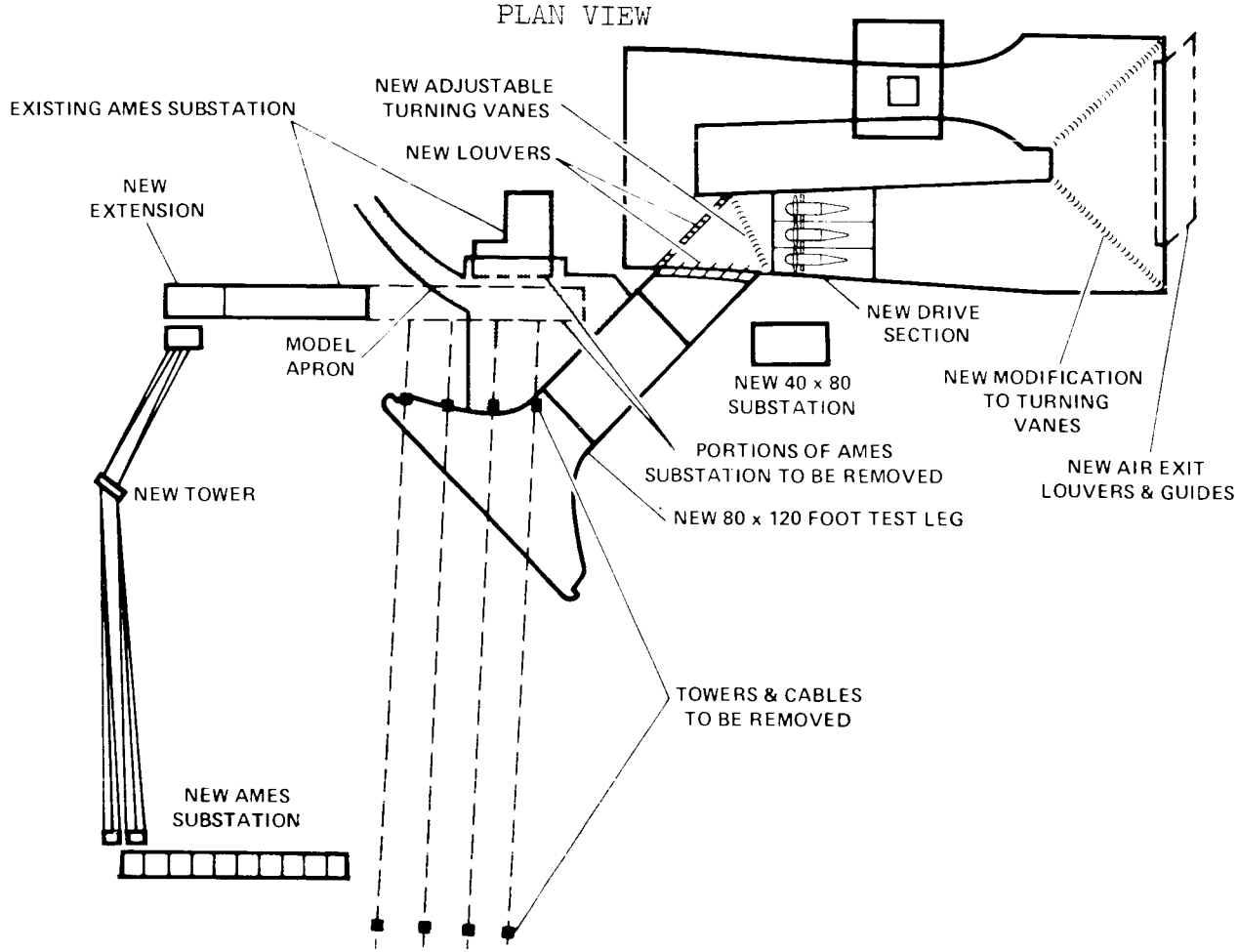

Figure 2

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FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40 x 80 FT. SUBSONIC WIND TUNNEL

VANES, LOUVERS, AND FAN DRIVE SYSTEM

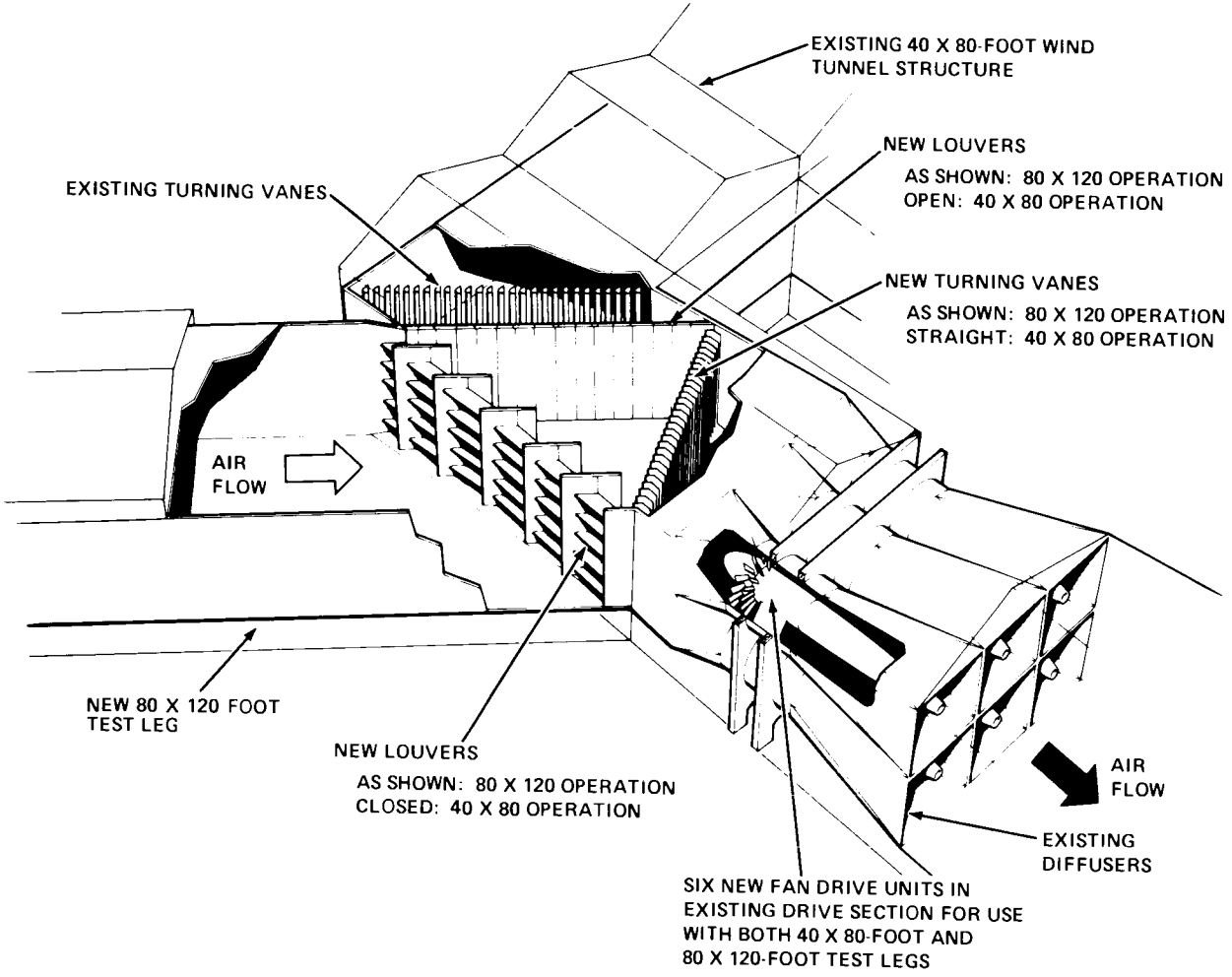


Figure 3

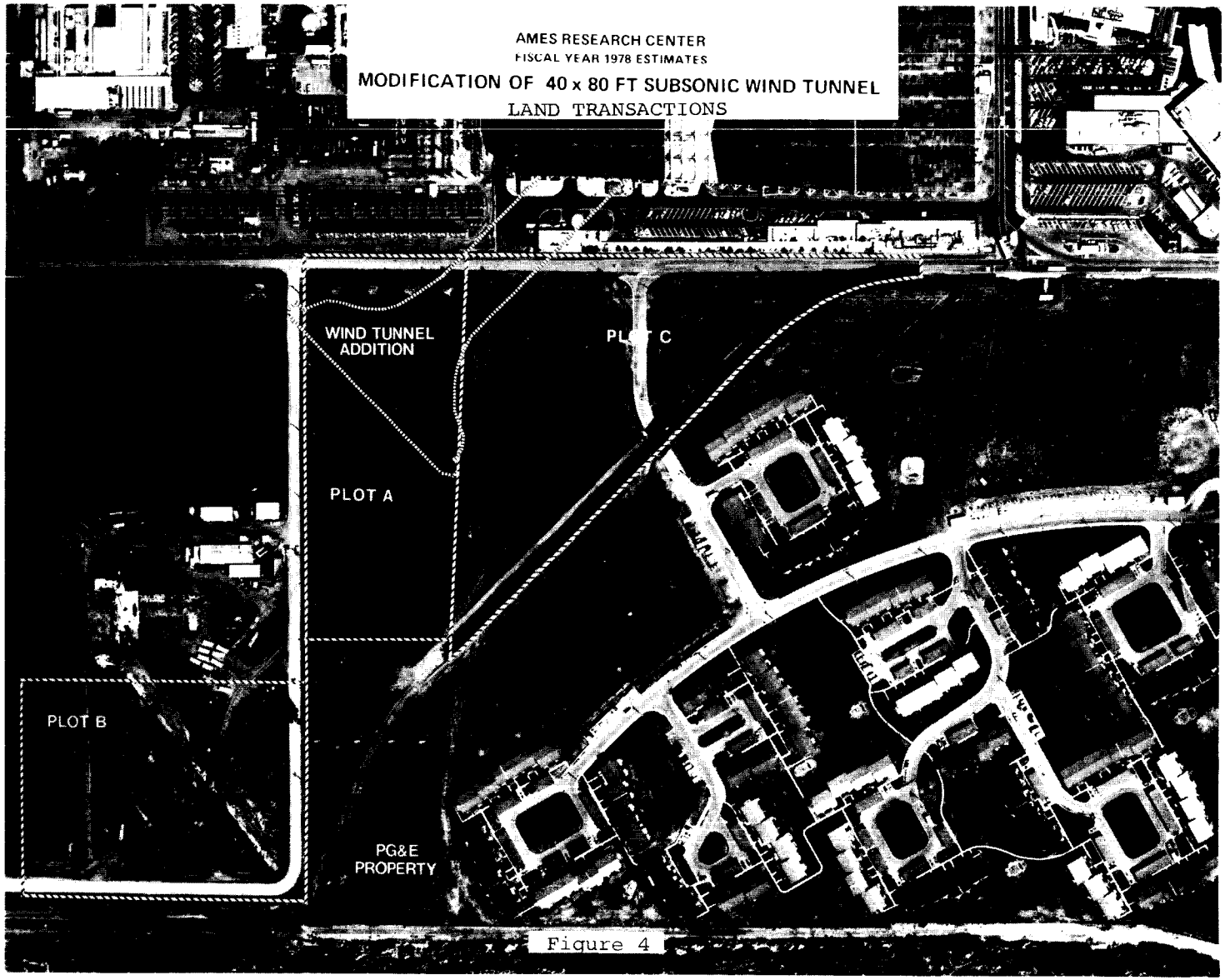

AMES RESEARCH CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATION OF 40 x 80 FT SUBSONIC WIND TUNNEL
LAND TRANSACTIONS
WIND TUNNEL ADDITION
PLOT C
PLOT A
PLOT B
PG&E PROPERTY

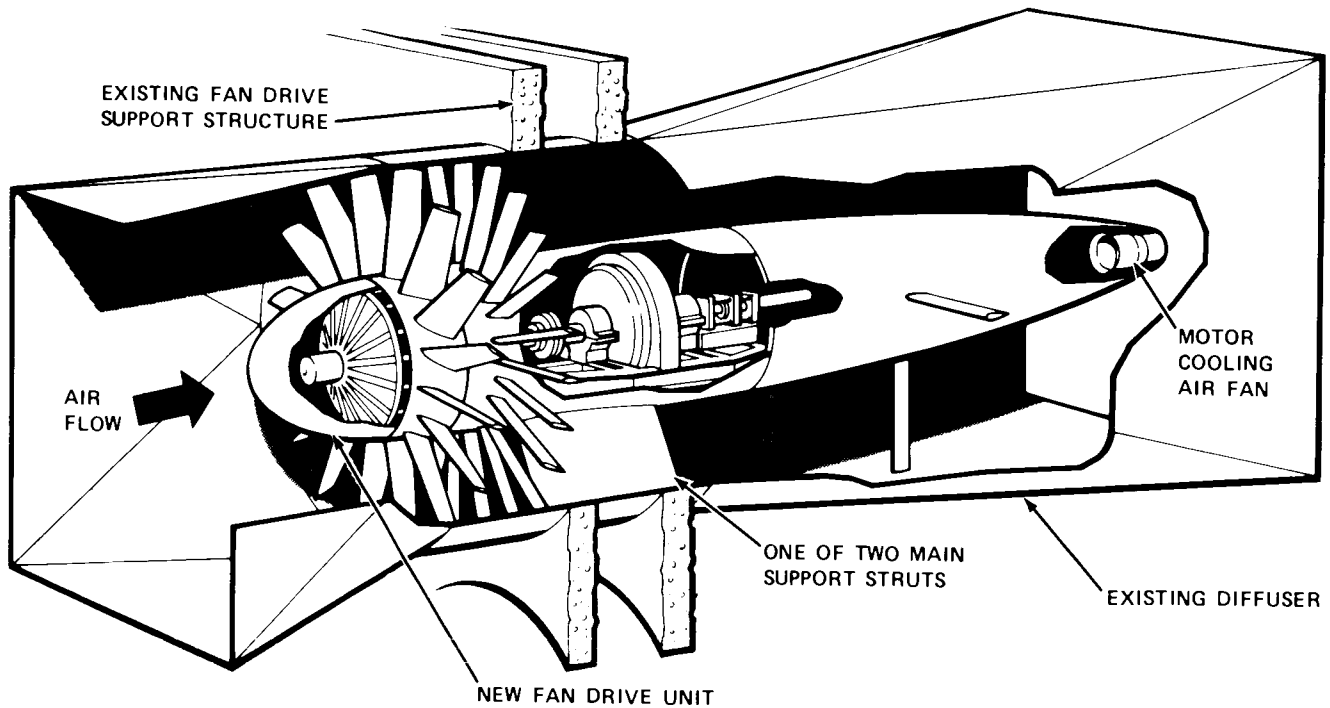
Figure 4

AMES RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40 x 80 FT. SUBSONIC WIND TUNNEL

NEW FAN DRIVE UNIT



22,500 HORSEPOWER ELECTRIC MOTOR
40-FOOT DIAMETER 15-BLADE VARIABLE-PITCH FAN, AND 23-BLADE STATOR
CENTER BODY – 17.5-FOOT MAX DIAMETER BY 138.5 FEET LONG
DRIVE UNIT WEIGHT: 400,000 LBS.

Figure 5

AMES RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40 x 80 FT. SUBSONIC WIND TUNNEL

80 x 120 ft TEST SECTION

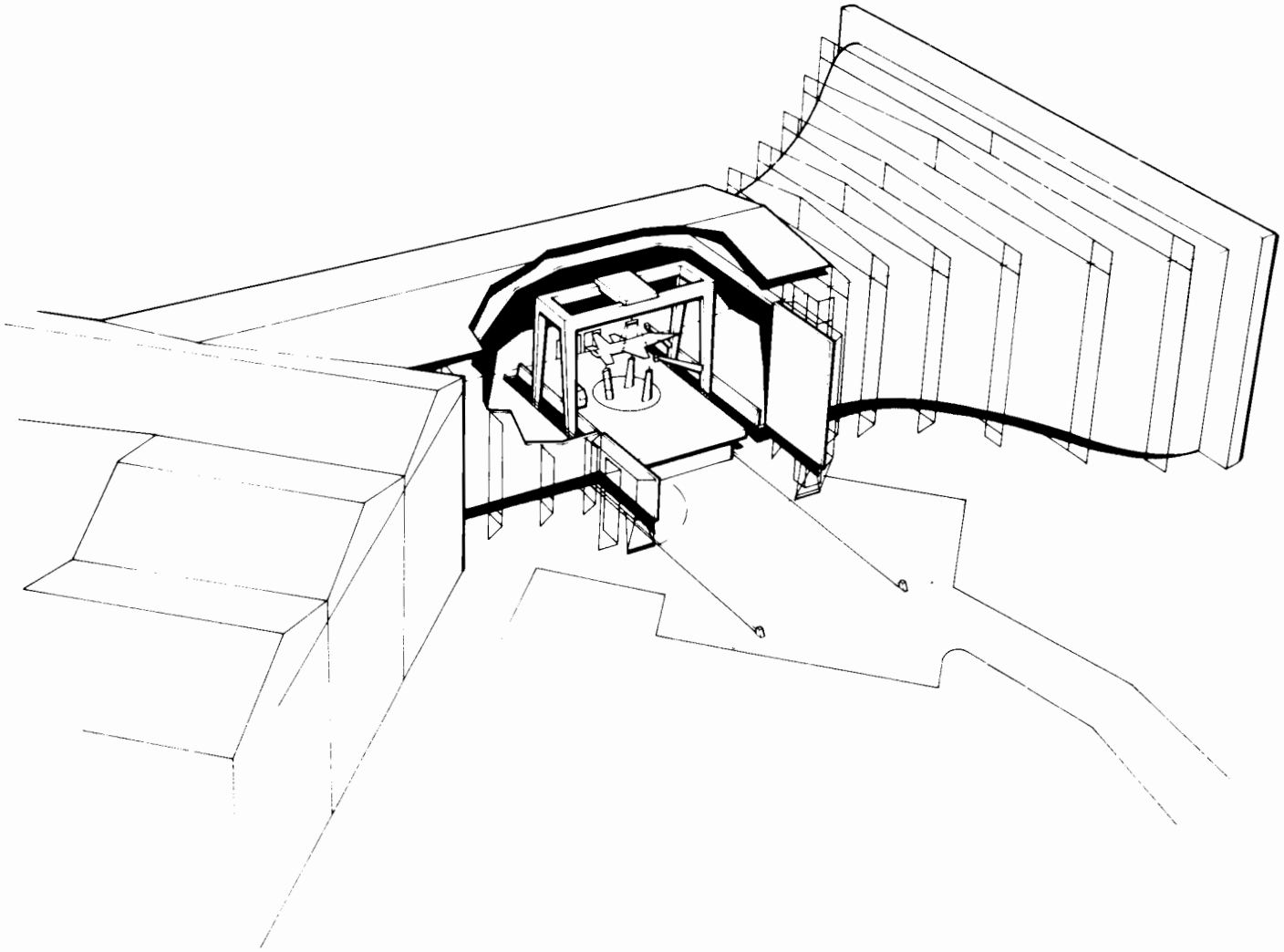


Figure 6

AMES RESEARCH CENTER

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF 40- by 80-FOOT SUBSONIC WIND TUNNEL

FUNDING PLAN
(Millions of Dollars)

	Fiscal Year			
	1977	1978	Future	Total
CONSTRUCTION	---	2.0	28.3	30.3
Site work and utilities	---	.1	.5	.6
Piles and concrete	---	---	.8	.8
Structural modifications	---	1.1	10.6	11.7
Structural erection	---	.8	7.3	8.1
Painting and finishing	---	---	1.0	1.0
Fire protection	---	---	.4	.4
Acoustic treatment	---	---	7.2	7.2
Miscellaneous mechanical	---	---	.5	.5
EQUIPMENT	6.0	11.5	35.6	53.1
Main drive assembly and installation	---	.5	4.8	5.3
Main drive system	2.7	.9	7.3	10.9
Main drive power supply	---	.5	2.1	2.6
Fan and stator blades	1.3	1.3	5.3	7.9
Fan hub and variable pitch mechanism	1.5	1.0	2.5	5.0
Nacelle, fairings, and spinner	---	1.2	1.1	2.3
Electric installation	---	---	2.9	2.9
Substation relocation	.5	.7	1.8	3.0
Model handling system	---	---	1.4	1.4
Model auxiliary systems	---	---	.9	.9
Test section doors and floor panels	---	---	1.1	1.1
Model support and turntable	---	3.9	---	3.9
Model balance system	---	1.5	1.8	3.3
Data acquisition and operation control systems	---	---	2.6	2.6
TOTAL	6.0	13.5	63.9	83.4

Figure 7

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

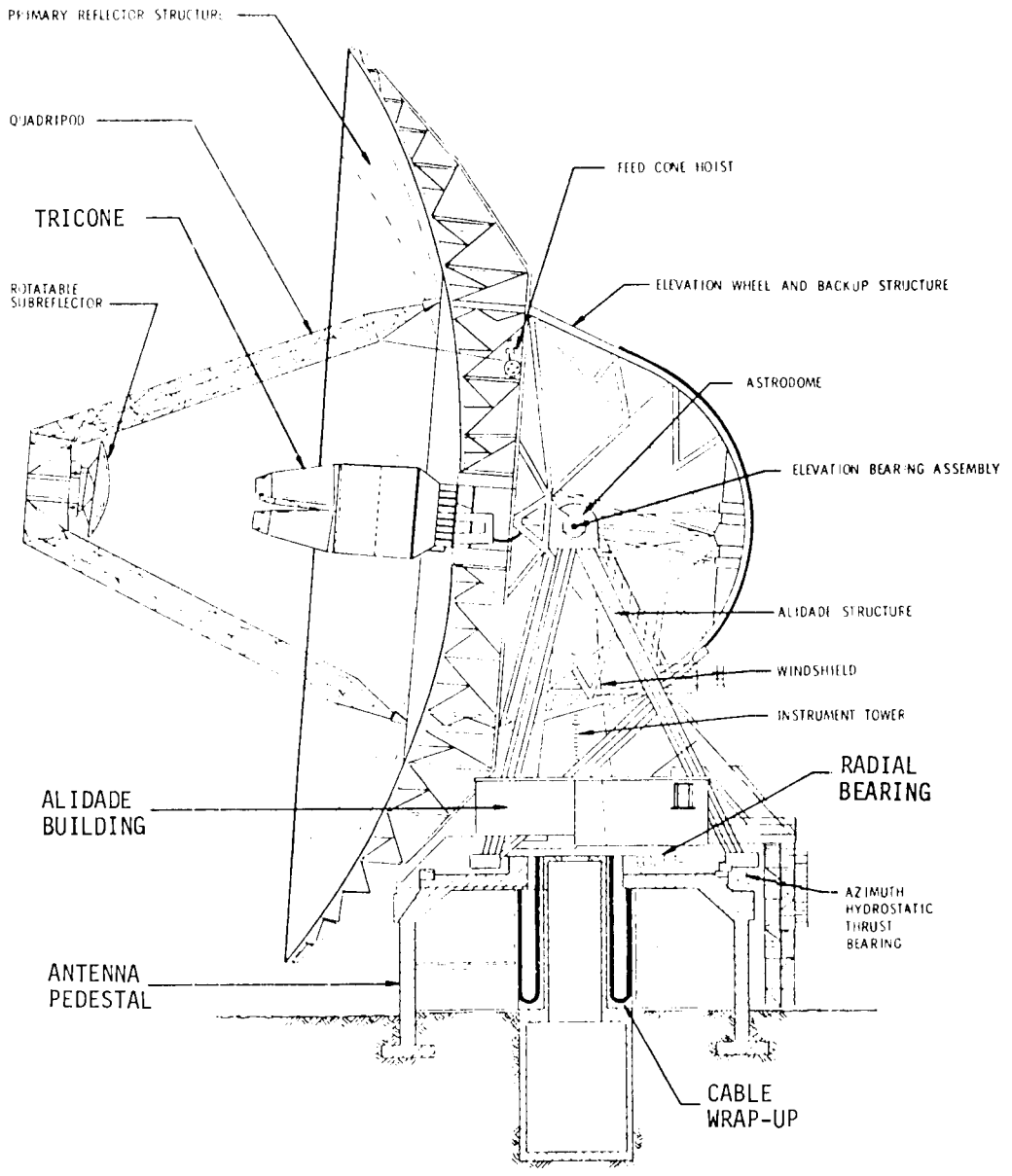
SUMMARY

VARIOUS LOCATIONS

	Amount	Page No.
Office of Tracking and Data Acquisition:		
Rehabilitation and modification of 64-meter antenna components.....	1,750,000	CF 10-1

JET PROPULSION LABORATORY
FISCAL YEAR 1978 ESTIMATES

REHABILITATION AND MODIFICATION OF 64 METER ANTENNA COMPONENTS
TYPICAL 64 METER ANTENNA CONFIGURATION



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of 64-Meter Antenna Components
INSTALLATION:	Jet Propulsion Laboratory
	FY 1978 CoF ESTIMATE: $1,750,000

LOCATION OF PROJECT: Goldstone, California; Canberra, Australia; and Madrid, Spain

COGNIZANT HEADQUARTERS OFFICE: Office of Tracking and Data Acquisition

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	234,000	935,000	1,169,000
Other affiliated funding	---	51,749,000	51,749,000
Total	234,000	52,684,000	52,918,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the rehabilitation and modification of elements of the existing 64-meter antenna subnet consisting of three stations located at Goldstone, Canberra and Madrid. The major elements to be accomplished by this project are the replacement of the radial bearing wearstrip at Goldstone; modification of the antenna chilled water loops at the three stations; modification of antenna equipment rooms and relocation of tricone equipment at Canberra and Madrid; modification of the pure water storage facilities for the high power transmitter (100 - 400 kW) at the three stations; and, rehabilitation and modification

(mechanical, electrical, and structural) of the operations control and support buildings at Canberra and Madrid. Energy conservation and safety criteria will be considered in all aspects of this project.

PROJECT JUSTIFICATION:

The 64-meter antenna subnet, located in California, Australia, and Spain, provides the principal science data link for missions to the planets. The high power transmitter's command capability, unique to this subnet, is also essential to the critical phases of missions such as Viking, Mariner, Jupiter, Saturn (MJS), and Pioneer Venus. Reliable performance by this subnet is therefore required for successful conduct of the planetary missions. This program is extremely important in maintaining the continued reliability of this essential subnet.

PROJECT DESCRIPTION:

The existing wearstrip at Goldstone is badly worn and has had recent failures of the attaching hardware. These failures required 16-hour blocks of antenna downtime in order to accomplish repair on an emergency basis. Due to the worn condition, bearing preload has been reduced from 330,000 lbs to 200,000 lbs to minimize wear and extend life. This reduction in preload requires that the antenna be stopped and the azimuth hydrostatic bearing lowered when wind velocity reaches 45 mph.

The existing antenna heating, ventilating and air conditioning (HVAC) assemblies at Goldstone, Canberra, and Madrid were designed and built to accommodate a specific and fixed heating and cooling requirement. Utilization of the antennas during the past several years has shown the requirement not as fixed, but extremely variable. This change is due to the relocation of both personnel and equipment and the introduction of additional equipment thus unbalancing the HVAC loading. The rigidly installed system does not have the capability to respond to these changing loads, and is not compatible for control by a utility control assembly. An additional modification will be made to the HVAC assemblies controlling the temperature and humidity for the master equatorial system. The master equatorial system is required for all precise pointing modes of track such as blind pointing for acquisition.

The existing cold air supply for the hot deck of these assemblies is provided by a freon direct expanison compressor unit. During summer operation in high humidity environment the unit is subject to icing/freeze-up causing a loss of both temperature and humidity control. This has occurred at each of the subnet stations. Temperature stability is extremely important to the proper operation of the master equatorial system. Accuracy of this unit can only be obtained after it has been temperature-stabilized for a period of four to five days. Therefore, there would be a loss of tracking capability for at least this period of time after the freon unit failure was corrected. This possible failure is eliminated when the freon unit is replaced with a chilled water cooled air handler.

HVAC assembly reliability is in jeopardy due to the lack of redundancy of supply and return hoses in the cable wrap-up areas. The hoses and the piping in these areas are to be remanifolded to provide for ready switch-over to the installed spares for the critical flow paths for immediate failure recovery.

The modification of the antenna equipment rooms and relocation of tricone equipment at Canberra and Madrid is required because of limited working space in the tricone, which has produced congested and unsafe working conditions. In addition, access for calibration and maintenance of this equipment will then be available during tracking operations because this area is not subject to movement. This effort will provide improved working conditions and establish the same Radio Frequency (RF) configuration as at Goldstone, DSS 14. As a result, special documentation and procedures for nonstandard configurations will be avoided, thereby reducing the risk to the NASA Mission Set. This equipment has been relocated at DSS 14 in order to clear up safety and code violations.

The large pure water storage tanks at the three 64-meter antenna sites are not provided with any system for purity monitor and control. There is no ability to recycle stored water through a filter/purification loop in conjunction with the large storage tank. Because of the inability to continuously process the stored water the purity level deteriorates and makes the water virtually unusable as the necessary backup supply for the high power transmitter sybsystem.

A small amount of contamination in the cooling water can **render** a $150,000 klystron unrepairable. These modifications are therefore required to increase reliability while decreasing maintenance costs.

The rehabilitation and modification of operations control and support buildings at Canberra and Madrid is required to replace worn and obsolete items and to meet current building code regulations due to changes in building occupancy and operational modes.

The major categories to be rehabilitated, modified, or replaced are: 1) building exterior/interior envelope including roofs; 2) space heating equipment and auxiliaries; 3) air conditioning equipment and auxiliaries; 4) electronic equipment; and 5) miscellaneous electrical (primarily electromechnical) equipment. In addition, the associated control systems, fire protection systems, and power distribution systems will be modified as required.

At DSS 42/43 the antenna support building air conditioning is provided by eleven units that have been in operation for almost 15 years and which require an increasing amount of preventative and corrective maintenance work. Replacement with a central station type plant will not only almost eliminate the corrective maintenance costs but will also reduce the preventative maintenance and operation costs.

This overall project will result in more reliable operation at these locations and in lower maintenance and operation costs. Energy conservation and safety criteria will be adequately considered in all of the above tasks.

PROJECT COST ESTIMATE:

	Unit of Measure	Quanity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1,750,000
Wearstrip replacement	LS	---	---	100,000
Antenna Water Systems	LS	---	---	440,000
Goldstone	LS	---	---	(150,000)
Canberra	LS	---	---	(150,000)
Madrid	LS	---	---	(140,000)
Antenna equipment room modifications	LS	---	---	260,000
Canberra	LS	---	---	(135,000)
Madrid	LS	---	---	(125,000)
Structural rehabilitation and modifications	LS	---	---	235,000
Canberra	LS	---	---	(140,000)
Madrid	LS	---	---	(95,000)
Mechanical rehabilitation and modifications	LS	---	---	380,000
Canberra	LS	---	---	(225,000)
Madrid	LS	---	---	(155,000)
Electrical rehabilitation and modifications	LS	---	---	335,000
Canberra	LS	---	---	(200,000)
Madrid	LS	---	---	(135,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				1,750,000

LIST OF RELATED GRAPHICS:

Typical 64-Meter Antenna Configuration
Site Plan DSS 14, Goldstone
Site Plan DSS 42/43, Canberra
Site Plan DSS 61/63, Madrid

OTHER EQUIPMENT SUMMARY:

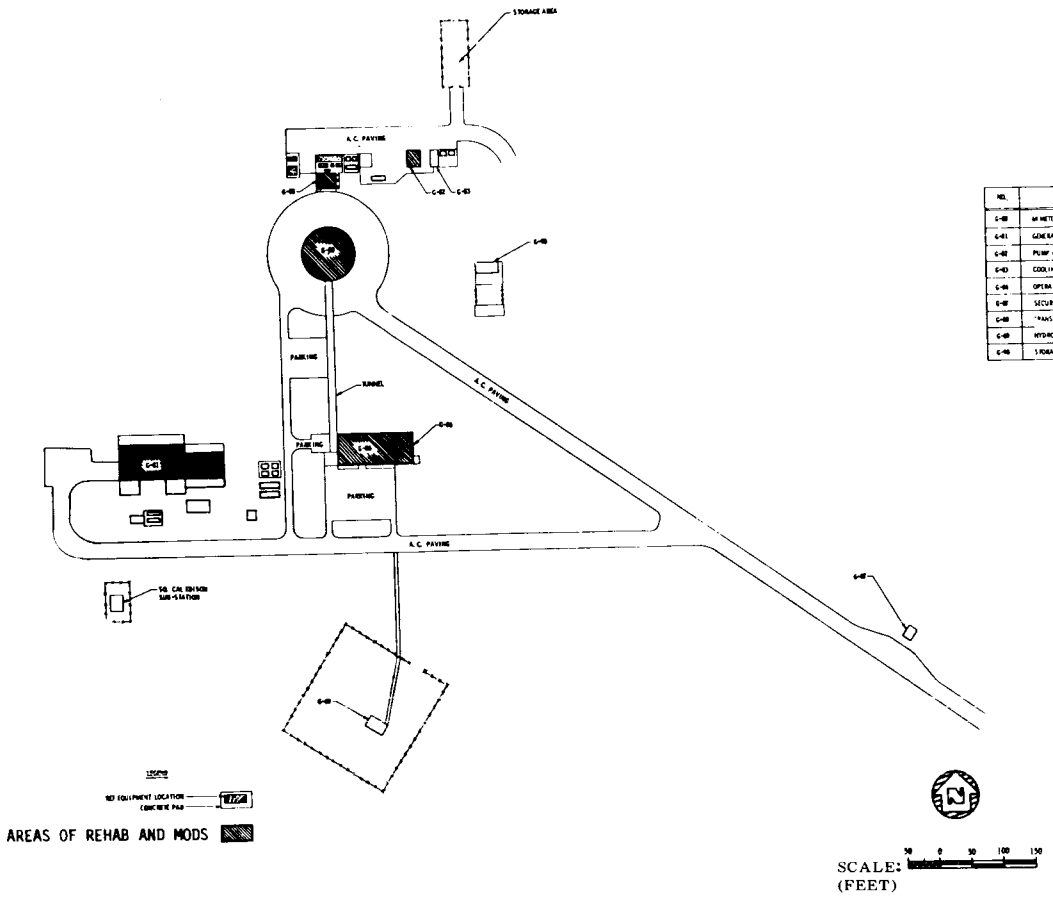
No other collateral or noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

For presently planned usage, there are no currently foreseen future funding requirements necessary to complete this specific project. However, additional rehabilitation and modifications of these large and complex antenna systems may be anticipated.

JET PROPULSION LABORATORY
FISCAL YEAR 1978 ESTIMATES

REHABILITATION AND MODIFICATION OF 64 METER ANTENNA COMPONENTS
DSS 14 SITE PLAN
GOLDSTONE, CALIFORNIA



NO.	DESCRIPTION
G-00	64 METER ANTENNA (PEDESTAL & ALIDADE BLDGS)
G-01	GENERATOR BLDG
G-02	PUMP HOUSE
G-03	COOLING TOWER
G-04	OPERATIONS SUPPORT BLDG
G-05	SECURITY BLDG
G-06	TRANSFORMER RECTIFIER BLDG
G-07	HYDROGEN MASER BLDG
G-08	STORAGE BLDG

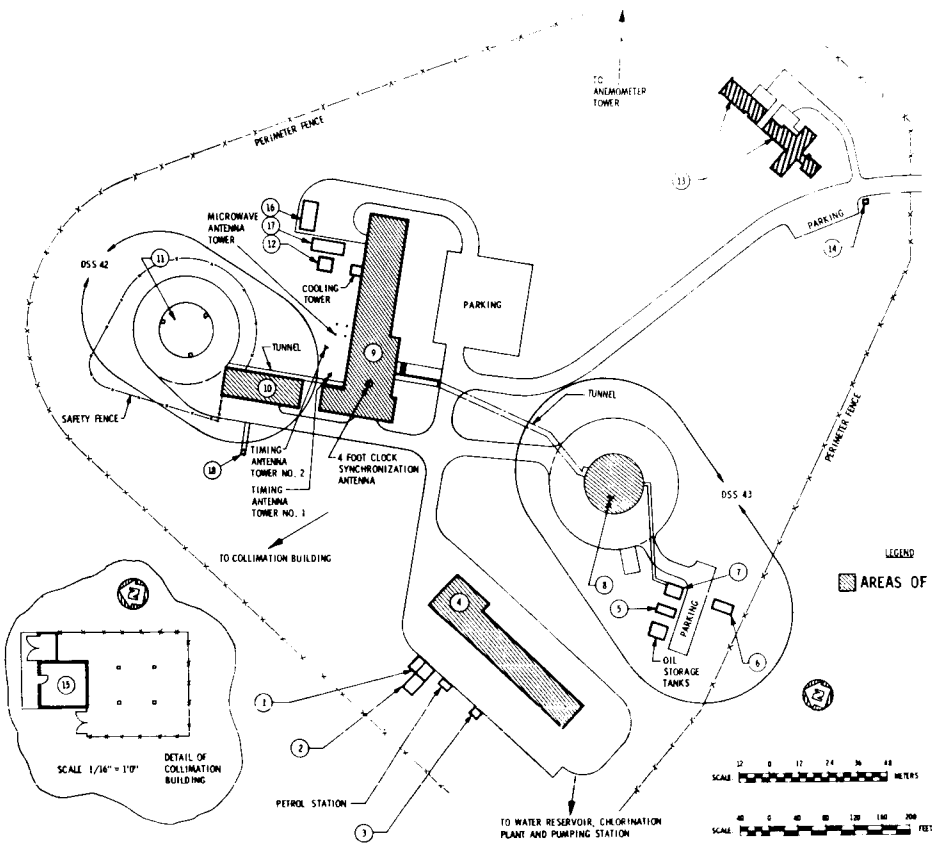
JET PROPULSION LABORATORY

FISCAL YEAR 1978 ESTIMATES

REHABILITATION AND MODIFICATION OF 64 METER ANTENNA COMPONENTS

DSS 42/43 SITE PLAN

CANBERRA, AUSTRALIA



ITEM	DESCRIPTION
1	SITE CARE BUILDING
2	STORAGE BUILDING
3	FLAMMABLE STORAGE BUILDING
4	POWER PLANT BUILDING
5	COOLING TOWER
6	SHIM GRINDING BUILDING
7	PUMP HOUSE BUILDING
8	64 M ANTENNA
9	OPERATIONS AND ENGINEERING BUILDING
10	ANTENNA SUPPORT BUILDING
11	26 M ANTENNA (POLAR MOUNT)
12	ANTENNA SUPPORT FACILITIES BUILDING
13	MESSING AND SLEEPING (SLEEPING) (MESSING)
14	SECURITY BUILDING
15	COLLIMATION BUILDING
16	CAR PORT AND STORAGE BUIDLING
17	STORAGE BUILDING
18	WEATHER STATION

LEGEND

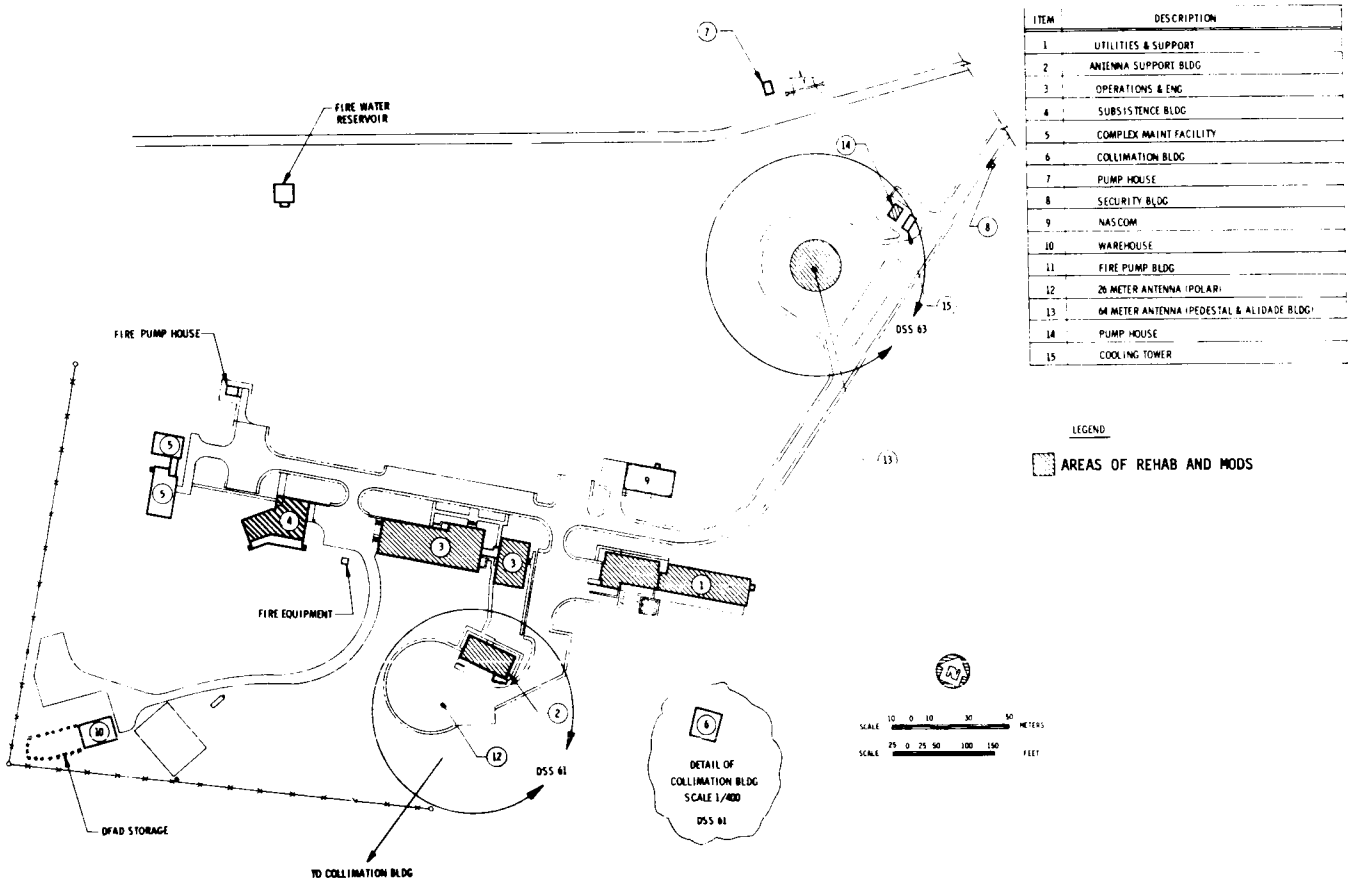
AREAS OF REHAB AND MODS

JET PROPULSION LABORATORY
FISCAL YEAR 1978 ESTIMATES

REHABILITATION AND MODIFICATION OF 64 METER ANTENNA COMPONENTS

DSS 61/63 SITE PLAN

MADRID, SPAIN



ITEM	DESCRIPTION
1	UTILITIES & SUPPORT
2	ANTENNA SUPPORT BLDG
3	OPERATIONS & ENG
4	SUBSISTENCE BLDG
5	COMPLEX MAINT FACILITY
6	COLLIMATION BLDG
7	PUMP HOUSE
8	SECURITY BLDG
9	NASCOM
10	WAREHOUSE
11	FIRE PUMP BLDG
12	26 METER ANTENNA (POLAR)
13	64 METER ANTENNA (PEDESTAL & ALIDADE BLDG)
14	PUMP HOUSE
15	COOLING TOWER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SPACE SHUTTLE FACILITIES

	Amount	Page No.
Office of Space Flight:		
Summary		CF 11-1
Launch and Landing Facilities:	44,520,000	
Modifications to launch complex 39 (KSC)	40,700,000	CF 11-4
Modifications for solid rocket booster processing facilities (KSC)	1,730,000	CF 11-15
Rehabilitation of barge channels (KSC)	2,090,000	CF 11-21
Ground Test Facilities:	860,000	
Modifications for crew training facilities (JSC)	860,000	CF 11-26
Manufacturing and Final Assembly Facilities:	18,610,000	
Modification of manufacturing and final assembly facilities for external tanks (MAF)	18,610,000	CF 11-33
Minor Facilities:	1,750,000	
Rehabilitation and modification of shuttle facilities at Various Locations	1,750,000	CF 11-43
Total	65,740,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Space Shuttle Facilities

INSTALLATION: Various Locations

FY 1978 CoF ESTIMATE: $65,740,000

LOCATION OF PROJECT: Locations are identified in the following documentation.

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	12,748,000	98,362,000	111,110,000
Other affiliated funding	---	817,850,000	817,850,000
Total	12,748,000	916,212,000	928,960,000

The above is summary data only for the projects included in this submittal. For clarification purposes it is noted that prior to FY 1978 a total of $27.2 million has been made available for shuttle for planning and design in addition to a total of $260 million for shuttle facilities construction.

SUMMARY PURPOSE AND SCOPE:

The purpose of these projects is to modify and add to existing government-owned facilities and to construct a limited number of new facilities necessary to support the Space Shuttle Program. As in prior years, this shuttle facility package includes all major facility requirements which are unique to the Space Shuttle Program. All requirements are tied to a shuttle program milestone or "need date". Included in this package are all

facility requirements needed to achieve that initial operational capability as set forth in the project documentation and/or the assumptions on which total shuttle facility needs have been based and projected.

In FY 1978, the shuttle facilities proposed are again primarily for launch and landing requirements at John F. Kennedy Space Center (KSC). The work includes continuing modifications to Launch Complex 39 and the Solid Rocket Booster processing facilities which were initiated with prior year resources. The LC 39 work includes: completion of the second mobile launch platform that was initiated with FY 1977 resources; the first but a major phase of modification to Pad B to support space shuttle flights planned in late 1982 and beyond; and modification for the High Bays 1 and 2 of the Vehicle Assembly Building for the final mating, integration and checkout of the space shuttle vehicle components (orbiter, external tank and solid rocket boosters) and the external tank processing and storage requirements. As a continuation of the FY 1977 project, it is also planned to modify the Gemini parachute building, M7-657, to provide capability for receiving, refurbishing and repacking the SRB parachutes. This item was also requested in FY 1977, but a reduction in the appropriation resulted in deferral to FY 1978. The request for KSC also includes rehabilitating and dredging the Banana River barge channel to restore it to its original depth and width thereby allowing passage of barges that will deliver the external tanks and spent SRB casings to the launch site.

Fiscal Year 1978 requirements at other locations include continuing modifications for crew training and external tank manufacturing and final assembly. Also included are minor rehabilitation and modification projects which are required to support the Space Shuttle Program and are therefore considered unique space shuttle projects.

PROJECT JUSTIFICATION:

Fiscal Year 1977 and prior years' CoF projects for the Space Shuttle Program authorized modification and construction of facilities for technological development, space shuttle main engine tests, manufacturing, ground tests, and launch and landing. Construction of the technological facilities, engine test facilities, orbiter manufacturing and final assembly facilities and certain ground test facilities are complete and the facilities are operational. Construction of the orbiter landing facilities, Phases I and II, are also complete. The remaining facilities authorized in prior years are in the final design or construction phases.

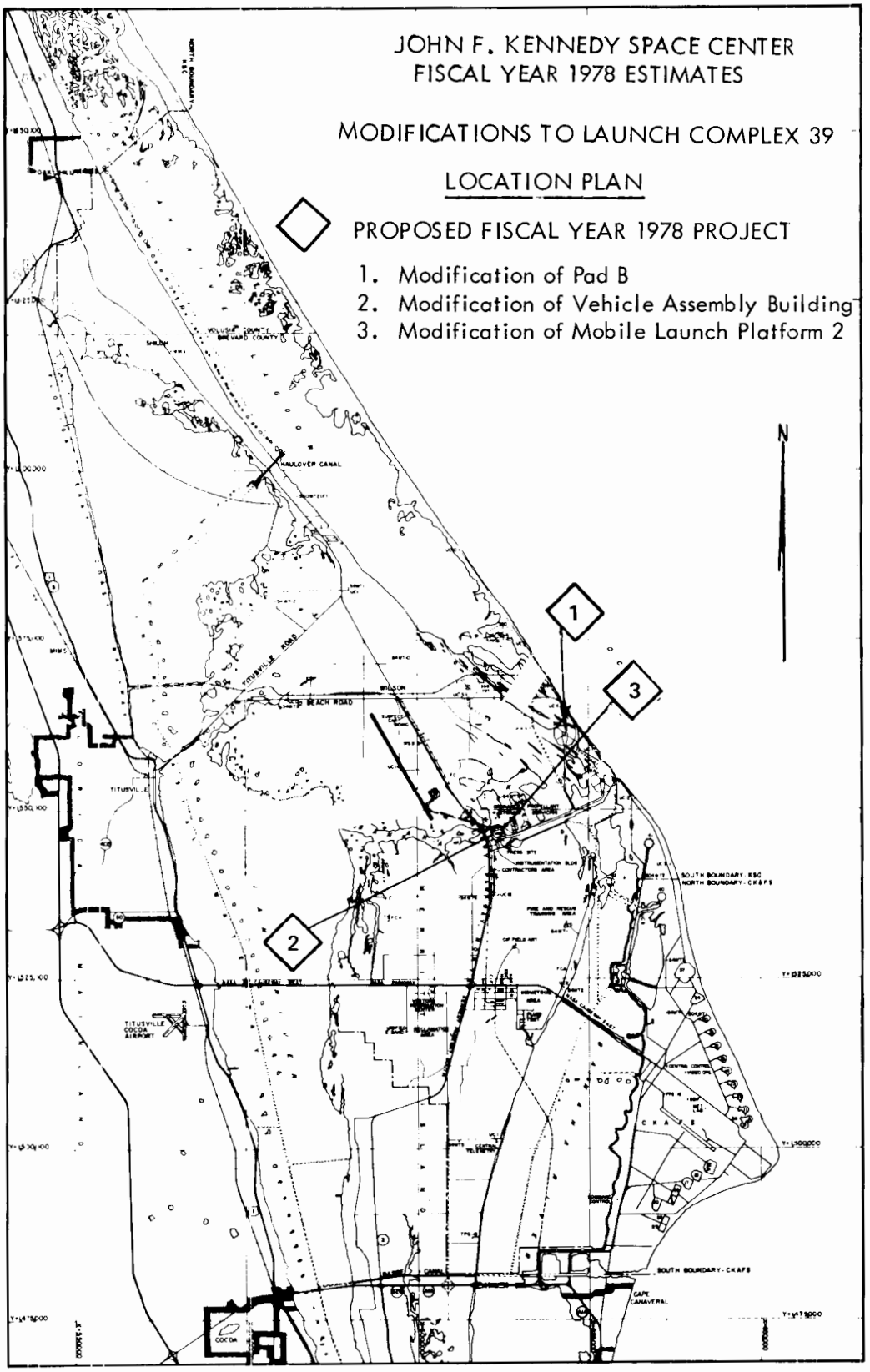
The FY 1978 request is intended primarily to continue modifications to provide launch capability for the shuttle vehicle at KSC. These facilities are needed for the initial operations as well as for the transition into the operational phase at the launch and landing site. The request for the first phase of Pad B modification continues the transition to provide launch capability to support higher flight rates at KSC. The Pad B work, which is complex and prolonged, is planned to be operational by January 1983 when the launch rate is envisioned to exceed 20 flights per year. At that time it will be needed to support the planned launch requirement in late FY 1982 and beyond as well as to provide needed operational reliability and flexibility.

The remaining projects in FY 1978 are intended primarily to support the manufacturing and final assembly of the space shuttle external tank at Michoud and crew training activities at the Johnson Space Center. A project for rehabilitation and modification of existing facilities uniquely required to support the shuttle program is also included.

Current space shuttle planning is based on achieving a first manned orbital flight in mid-1979 and attaining a flight capability at the Kennedy Space Center of approximately 23 missions in CY 1982. This FY 1978 request is necessary to meet specific interior milestones directly related to these major milestones. The individual project descriptions specify those respective milestones to which the facility is related.

PROJECT COST ESTIMATE:

Launch and Landing Facilities	44,520,000
Modifications to Launch Complex 39, Kennedy Space Center, Florida	40,700,000
Modifications for Solid Rocket Booster Processing Facilities, Kennedy Space Center, Florida	1,730,000
Rehabilitation of Barge Channels, Kennedy Space Center, Florida	2,090,000
Ground Test Facilities	860,000
Modifications for Crew Training Facilities, Johnson Space Center, Texas	860,000
Manufacturing and Final Assembly Facilities	18,610,000
Modification of Manufacturing and Final Assembly Facilities for External Tanks, Michoud Assembly Facility, Louisiana	18,610,000
Minor Facilities	1,750,000
Rehabilitation and Modification of Shuttle Facilities, Various Locations	1,750,000
Total	65,740,000


JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATIONS TO LAUNCH COMPLEX 39
LOCATION PLAN
PROPOSED FISCAL YEAR 1978 PROJECT
1. Modification of Pad B
2. Modification of Vehicle Assembly Building
3. Modification of Mobile Launch Platform 2
N
1
2
3
HAULOVER CANAL
TITUSVILLE ROAD
BEACH ROAD
WILSON
TITUSVILLE
TITUSVILLE COCOA AIRPORT
COCOA
SOUTH BOUNDARY - KSC
NORTH BOUNDARY - CKAFS
SOUTH BOUNDARY - CKAFS
CAPE CANAVERAL

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications to Launch Complex 39
INSTALLATION:	John F. Kennedy Space Center
	FY 1978 CoF ESTIMATE: $40,700,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	7,480,000	63,820,000	71,300,000
Other affiliated funding.....	---	501,538,000	501,538,000
Total.....	7,480,000	565,358,000	572,838,000

SUMMARY PURPOSE AND SCOPE:

This project continues modifications to Launch Complex 39 begun with FY 1975 resources and continued with FY 1976 and FY 1977 resources to support space shuttle operations. The FY 1975 and FY 1976 projects provided for modifying two high bays in the Vehicle Assembly Building, the Launch Control Center, one mobile launch platform, and Launch Pad "A". The FY 1977 project provided for additional modifications to Pad "A" to reduce high acoustic levels generated by the space shuttle main engines and solid rocket boosters so that payloads will not be damaged during launch. FY 1977 resources also provided for the start of modifications to the second mobile launch platform (MLP-2). This year's project provides for completing the second mobile launch platform, modifying the two remaining high bays in the Vehicle Assembly Building (VAB), and beginning modifications to Launch Pad "B".

PROJECT JUSTIFICATION:

The Space Shuttle program has been planned and developed to make maximum use of existing facilities and equipment. The orbiter, external tank and solid rocket boosters (SRB's) will be mated, integrated and checked out on a modified mobile launch platform inside the modified Vehicle Assembly Building (VAB). The shuttle will then be transported to the modified launch pad. Previous appropriations provided funds for modifying mobile launch platform 1 (MLP-1), two high bays in the VAB, Launch Pad "A", and beginning modifications to MLP-2. Program requirements now dictate the completion of MLP-2, the modification of two more high bays in the VAB, and the start of modifications to Launch Pad "B".

The second mobile launch platform (MPL-2) is necessary to support the checkout and operation of the second orbiter (refurbished orbiter no. 101), currently scheduled to arrive at Kennedy Space Center about mid-CY 1981. At that time, the orbiter must undergo extensive checkout and integration with the facility, ground support equipment and launch processing system to prepare it for launch operations. Subsequently, both MLP-2 and the second orbiter (refurbished orbiter no. 101) will be used to support the scheduled flights in late CY 1981 and beyond. At that time, the planned flight rate requires that two mobile launchers be in operation to support the space shuttle missions. The FY 1977 budget submittal requested funds to complete MLP-2 modifications. The appropriations provided, however, made it necessary to defer modifications of the propellant, high-pressure gas and other launch systems. This FY 1978 request provides for implementing these systems to complete MLP-2.

Based on the requirement to launch 40 flights per year from KSC, four high bays (HB's) of the VAB will be required: HB's 2 and 4 for external tank (ET) operations and HB's 1 and 3 for mating, integration and checkout of the shuttle vehicle. HB's 2 and 4, that will process the external tanks, have also been selected to assemble the large SRB segments before movement into HB's 1 and 3 for the final stacking, mating, integration and checkout of the whole shuttle vehicle. Prior year resources from the solid rocket booster (SRB) processing facility project provided the necessary modification in HB's 2 and 4 for the SRB functions involved. Prior year resources from the LC 39 project also provided the required modifications in HB 4 for the external tank processing operations, and in HB 3 for the mating, integration and checkout of the shuttle vehicle. This FY 1978 project provides for modifying HB 2 to receive, store and checkout the external tanks, and HB 1 to mate, integrate and checkout the space shuttle vehicle. This request completes all foreseeable work in the VAB for the cited functions in support of space shuttle program requirements.

Program and safety requirements necessitate that construction activities for HB's 1 and 2 be completed as soon as possible but not later than the fourth quarter of CY 1979 to preclude concurrent construction

activities with increased buildup of SRB processing operations in adjacent areas. Safety considerations require, for example, that construction activities not be carried out in HB's 1 and 2 while SRB segments are stored in HB 4 and SRB stacking and mating are being performed in HB 3. These safety restrictions necessitate that construction activities, involving welding, cutting and installing large platforms, be completed before the beginning of extensive SRB processing in the VAB, which is presently planned to begin in late CY 1979. While some SRB operations are now planned in late CY 1978 and during CY 1979, these are limited in scope since they are to support only three developmental flights in CY 1979. Construction activities would have to be scheduled around these operations. However, deferral of this project by one year will impose unrealistic limitations on construction activities, greatly increase construction costs, expose personnel to hazardous conditions, and jeopardize either the ability to meet program requirements on time or the ability to implement the required modifications in a reasonable and effective manner. FY 1978 funding, on the other hand, will permit construction to be implemented with minimum interference with SRB processing and preclude unnecessary risks, satisfy safety considerations and complete the work economically, effectively and ahead of the schedule to support the higher flight rates.

During the operational phase of the shuttle program, two launch pads will be needed to support the planned launch rate of 40 missions per year from the Kennedy Space Center. After the initial six development flights planned in CY 1979 and early CY 1980, the space shuttle operational phase begins. The launch rate increases gradually from five operational flights in 1980 to the full rate of 40 flights in 1984. Prior year resources provided for completing Pad "A" which is planned to satisfy the Design, Development, Test and Evaluation (DDT&E) phase of the program and accommodate the operational phase requirement through early CY 1982. At that time, the launch rate dictates a second launch pad is required. This project provides the first but major phase of the modifications required to bring Pad "B" into operation by January 1983.

The space shuttle vehicle undergoes vital operations on the launch pad preceding final countdown and launch. These prelaunch activities include: final vehicle systems checkout, propellant loading of the external tank, loading of the hypergolic fuels in the auxiliary propulsion systems pods, loading of power reactants, cooling and life support fluids, payload changeout in certain instances or insertion into the orbiter payload bay, and boarding of the crews into the orbiter. This project provides the first and major phase of the modification of Pad "B" necessary to carry out these vital prelaunch operations leading to the actual launch of the space shuttle vehicle.

The requirement for Pad "B" to be operational by January 1983 is a critical milestone for the shuttle program. For over three years prior to that date, the shuttle development and operations programs will be dependent on a single pad (Pad "A") and subject to the problems and attendant risks of potential pad damage and corrective modifications. Also, the turnaround techniques, procedures and efficient timelines for higher launch rates are being developed in the earlier years and most likely will not be perfected prior to Pad "B" activation. The present shuttle processing timelines do not account for any large

variations of on-pad operations for Air Force "factory-to-pad" programs, JPL planetary missions and weather impacts because these factors are unknown at this time. These preceding unknowns indicate growing program risks as the launch rate increases and therefore, the need for the second launch pad mounts. The 1982 launch rate of 23 missions/year introduces a significant risk with any potential launch pad delays and, the need for the second pad (Pad "B") becomes firm by January 1983.

Construction and activation of the launch pad involves extensive, complex and prolonged effort. It includes construction of a tall fixed service tower, a massive changeout room, significant modifications to the pad deflector and substantial modifications to the launch systems. Once the construction activities are completed, critical launch support systems, including swing arms and umbilicals will have to be installed and fitted and the pad will then be integrated and checked with the ground support equipment and the launch processing systems. Based on experience with Pad "A", the Pad "B" construction/activation effort will require approximately five years to complete, making FY 1978 programming of this first phase of the effort necessary.

PROJECT DESCRIPTION:

This project provides for completing modifications to MLP-2 begun with FY 1977 funds, modifying HB's 1 and 2 in the VAB, and beginning modifications to Launch Pad "B".

Mobile Launch Platform 2

This is the second major increment for the modification of existing mobile launch platform 2. Prior years resources including FY 1977 will provide for the removal of the 380-ft. (115.8 m) umbilical tower as well as the basic structural modifications to provide three exhaust openings for the space shuttle main engines and the two SRB's. This FY 1978 project provides for completing the modifications to this facility and to integrate the prior years work in such a way as to produce a completed project. The work includes extensively modifying the liquid propellant systems, the high pressure gaseous system (oxygen, nitrogen, hydrogen and helium), the pneumatic and environmental control systems as well as modification to the electrical, instrumentation and control system. These modifications are essential to reroute and rehabilitate the launch systems involved to match the configuration of the space shuttle vehicle resting on the mobile launcher.

High Bays 1 and 2 - VAB

High Bay 1 will be modified to provide the necessary facilities for mating, integrating and checking out the orbiter, external tank and SRB's. Structural modifications include removing, modifying and reinstalling large extensible platforms so they will accommodate the space shuttle configuration. Structural framing in

HB 1 will be modified to accommodate the orbiter wing span. Towers "D" and "E" will be modified to provide the required laboratory and shop space to support integration activities. Related mechanical systems, piping, power, lighting, equipment and instrumentation grounding, and fire alarm and communications systems will also be modified as required to support shuttle operations.

The extensible platforms in HB 2 will be removed and stored, and the area will be modified to provide facilities for external tank operations. The existing jib cranes and support framing will be removed, and two vertical checkout/storage structures for the external tank will be constructed. Areas in Tower "B" will be modified to provide laboratory and shop space required to support external tank checkout. The existing pneumatic, environmental control and water systems in Tower "B" will be extended to HB 2. Related electrical and mechanical systems will also be modified.

Launch Pad B

Modifications to Launch Pad "B" that will be started with this project include constructing a fixed service tower, an orbiter flame deflector; and modifying existing structural, facility mechanical and electrical systems.

The fixed service tower will be built from salvaged sections of the umbilical tower removed from the mobile launch platform configured for Saturn V launches. This structure, which provides the basic services to the vehicle before launch, will be relocated to the west side of the pad. Two high speed elevators, also salvaged, will be modified and installed in the tower. A hammerhead crane removed from the mobile launch platform will be mounted on top of the service tower to handle and support ground support equipment.

The existing Saturn V flame deflector will be modified to accommodate exhaust from the SRB's. A new fixed flame deflector will be constructed in the existing flame trench to accommodate the exhausts from the orbiter main engines. In addition, two new flame containers mounted on rails on both sides of the flame trench will be constructed for SRB exhaust spillover. The LOX and LH_2 spheres and the high pressure gas bottles will also be refurbished. The existing emergency egress system will be modified to provide a means of safe egress from the shuttle in the event of an emergency during checkout or countdown.

The work also includes a high pressure water injection system at the pad to provide capability for reducing the acoustic noise levels generated during launch. The system includes construction of an elevated storage tank, with approximately 300,000 gallons (1,135,000 liters) capacity, and water distribution piping and nozzle spray system. Related modifications to MPL-2 to accommodate this water system are also included.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	40,700,000
Mobile launch platform 2 launch systems	LS	---	---	4,900,000
Modifications to vehicle assembly building	LS	---	---	8,700,000
Modifications to high bay 1 and 2	LS	---	---	(7,210,000)
Auxiliary access platforms	LS	---	---	(990,000)
Launch systems	LS	---	---	(400,000)
Remove and store high bay 2 platforms	LS	---	---	(100,000)
Modifications to Pad B	LS	---	---	27,100,000
Site preparation, piles and foundations	LS	---	---	(8,450,000)
Construct fixed service tower	LS	---	---	(5,630,000)
Install pad elevators	LS	---	---	(199,000)
Install hammerhead crane	LS	---	---	(161,000)
Modify and construct flame deflector	LS	---	---	(1,800,000)
Refurbish storage vessels	LS	---	---	(293,000)
Lightning protection and emergency egress	LS	---	---	(890,000)
Flame containers	LS	---	---	(2,100,000)
Acoustic reduction system	LS	---	---	(7,577,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				40,700,000

LIST OF RELATED GRAPHICS:

Location Plan
Mobile Launcher Perspective
Vehicle Assembly Building
Pad B Perspective

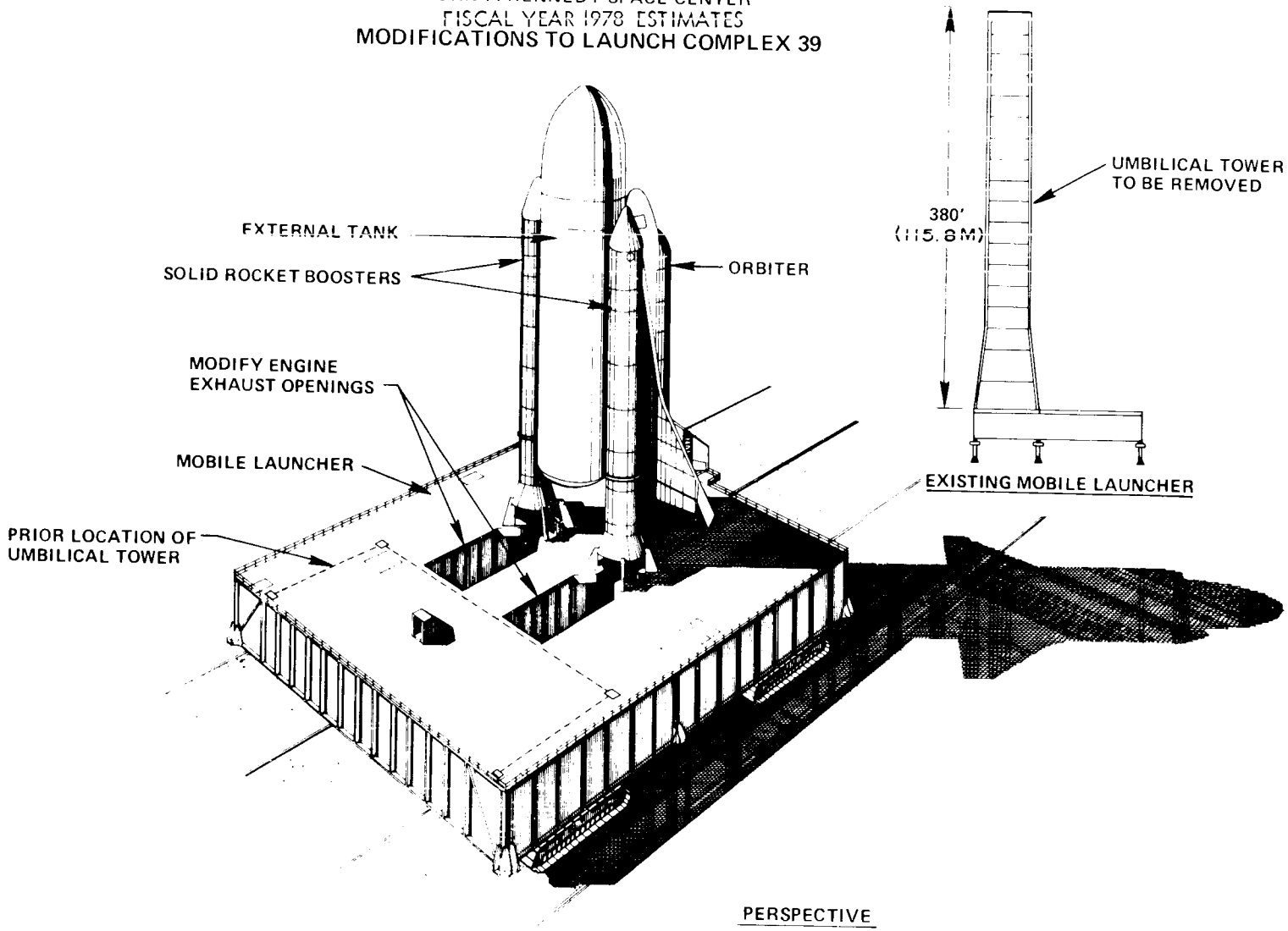
OTHER EQUIPMENT SUMMARY:

It is anticipated that approximately $16 to 20 million of R&D resources will be required to provide non-collateral equipment (for initial operations of the facilities included in this project.) This equipment includes such items as handling and access equipment, swing arms, umbilicals, hold down arms, ground support equipment, simulators, special communications and launch systems that are closely related and sensitive to the flight hardware.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that $19 to 20 million will be required in future CoF programs to complete Pad "B". Additional resources may also be required for modification of a third mobile launcher should this requirement be later validated for the increased flight rates, however, this amount is not included in the estimated future funding indicated above.

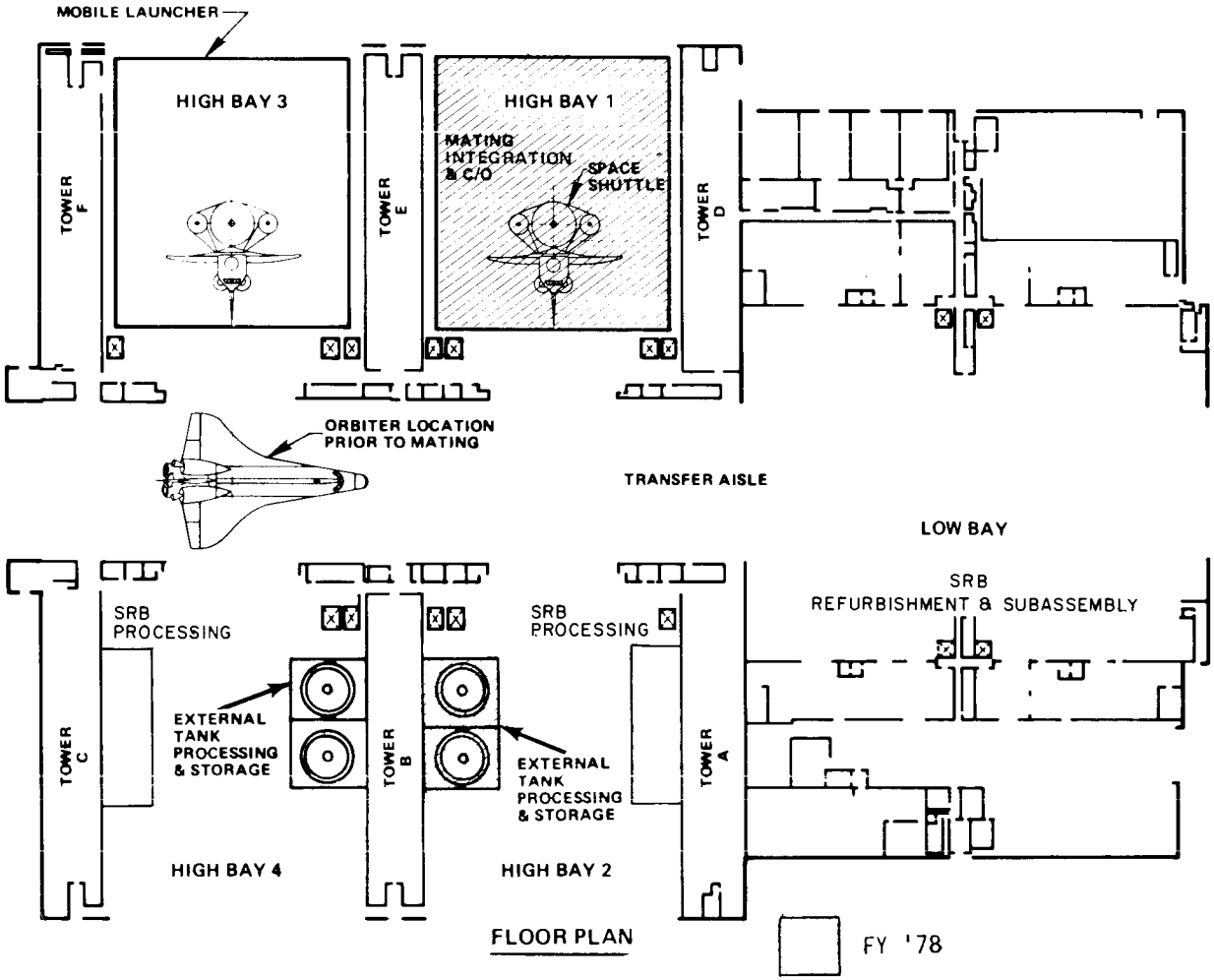
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATIONS TO LAUNCH COMPLEX 39



MOBILE LAUNCHER

JOHN F. KENNEDY SPACE CENTER, NASA
FISCAL YEAR 1978 ESTIMATES

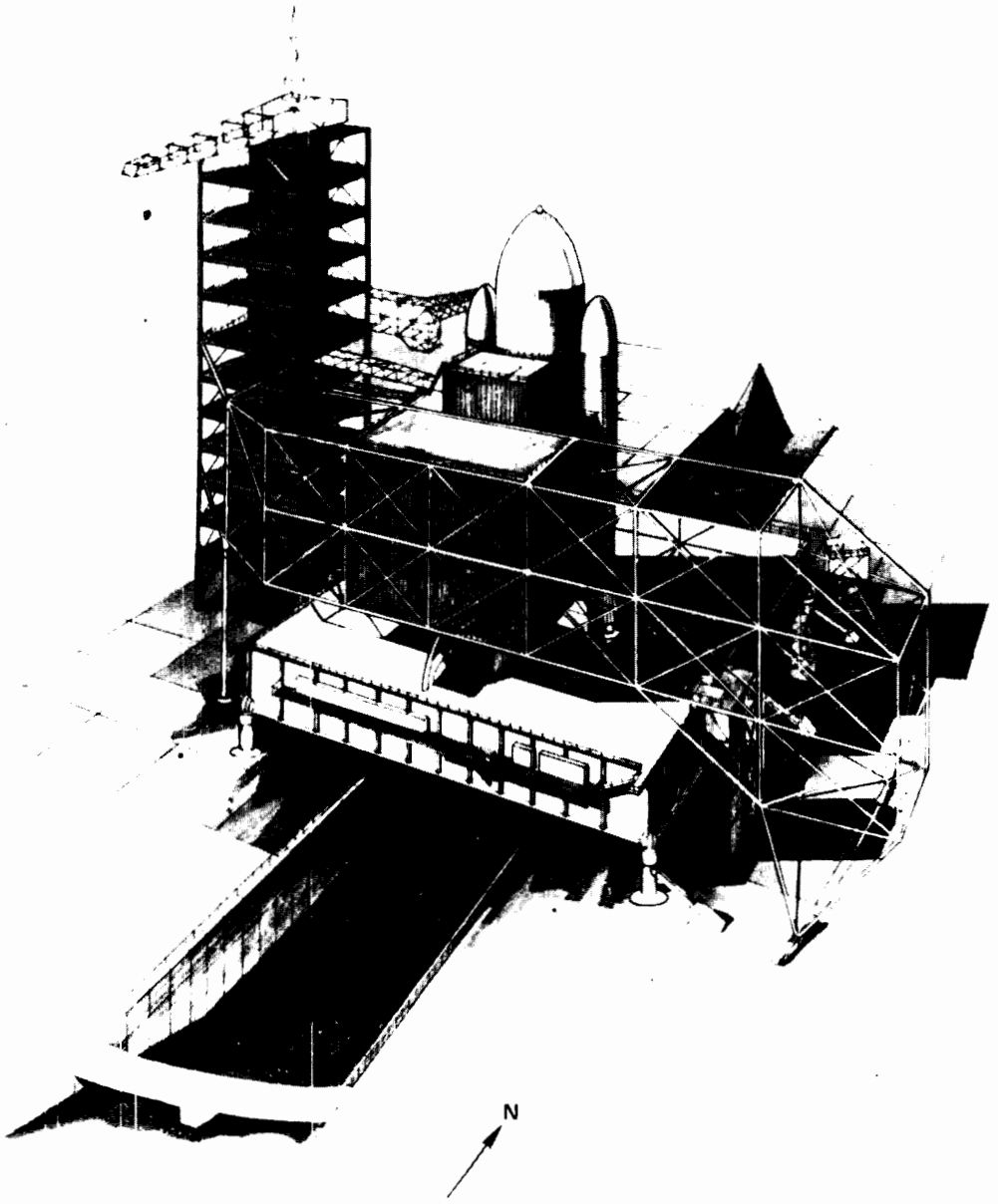
MODIFICATIONS TO LAUNCH COMPLEX 39



VEHICLE ASSEMBLY BUILDING - PLAN

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
MODIFICATIONS TO LAUNCH COMPLEX 39

CF 11-14

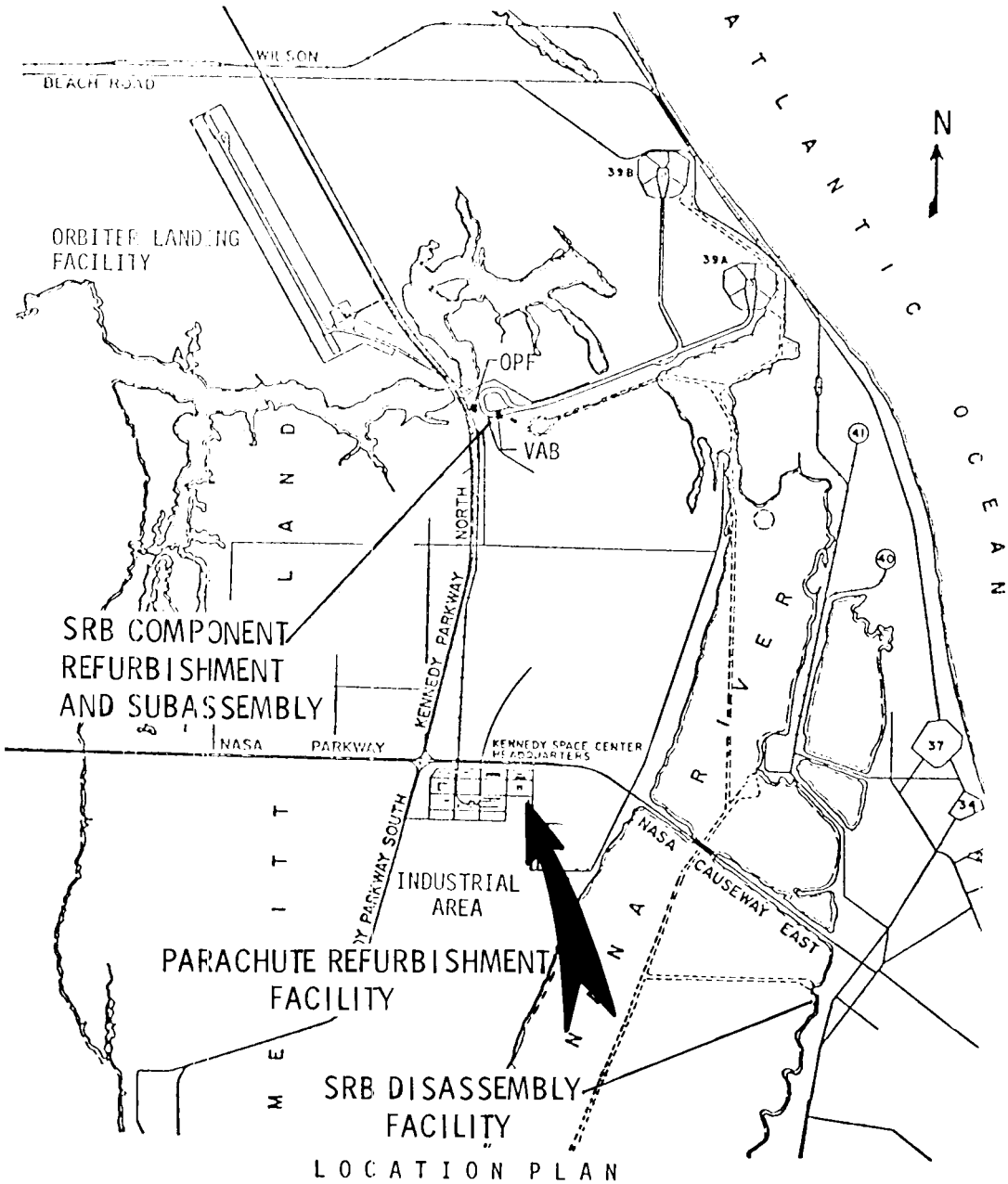


PERSPECTIVE

PAD B

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS FOR SOLID ROCKET BOOSTER PROCESSING FACILITIES



LOCATION PLAN

PROJECT TITLE:	Modifications for Solid Rocket Booster Processing Facilities
INSTALLATION:	John F. Kennedy Space Center
	FY 1978 CoF ESTIMATE: $1,730,000

LOCATION OF PROJECT: Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,440,000	13,940,000	15,380,000
Other affiliated funding	---	156,340,000*	156,340,000
Total	1,440,000	170,280,000	171,720,000

*Reflects "book value" of entire VAB, as well as Hangar AF, Barge Dock, and Building M7-657.

SUMMARY PURPOSE AND SCOPE:

This project continues modifications begun with FY 1976 and FY 1977 resources for solid rocket booster (SRB) processing facilities. The FY 1976 project provided modifications for SRB large segment assembly facilities in the Vehicle Assembly Building (VAB). The FY 1977 project provided modifications at Cape Canaveral Air Force Station (CCAFS) necessary for recovery, retrieval, cleaning and disassembly of the SRB's, and modifications of the VAB low bay areas at the Kennedy Space Center (KSC) essential for the SRB subassembly and refurbishment operations. This FY 1978 project provides modifications to Building M7-657, KSC (the former Gemini Parachute

Building) necessary to support the essential functions of receiving, cleaning, refurbishing and reassembling the SRB parachutes so that they can be reused for subsequent shuttle flights. While this item was included in the FY 1977 budget request, it had to be deferred because of a concurrent reduction in the FY 1977 appropriations and an increase in the fire protection requirements in the VAB related to the FY 1976 SRB Processing Facilities project.

PROJECT JUSTIFICATION:

The shuttle vehicle consists of an orbiter, an external tank and two solid rocket boosters. During launch the SRB's, together with the orbiter's main engines, provide the thrust required for lift-off. After lift-off and before the vehicle goes into orbit, the SRB's will burn out, separate from the orbiter and the external tank, and descend via parachutes to a recovery area in the ocean. The SRB casings and parachutes will be retrieved by ship and returned to land for subsequent reuse. When they arrive at the Parachute Refurbishment Facility, the parachutes will be unloaded, defouled, washed, dried, repaired, repacked and sent to the VAB for reassembly into an SRB nose cone for use on a subsequent flight. The facility modifications proposed by this project are required to carry out these necessary refurbishment operations.

Engineering analysis indicates that modifying the former Gemini Parachute Building (the existing facility) is more cost-effective than constructing a new facility. A new facility is estimated to cost more than twice as much as the proposed modifications. The proposed facility (Building M7-657) was selected for this purpose because it was originally designed to process smaller parachutes for the Gemini program. The facility must be operational to support the first manned orbital flight (FMOF) currently scheduled for mid-1979. With a construction/activation period of 18 months, construction must be started by late CY 1977. This project thus requires FY 1978 funding.

PROJECT DESCRIPTION:

The former Gemini Parachute Building (Building M7-657) in the KSC industrial area (see location plan) will be modified and enlarged to receive, clean, refurbish and repack retrieved parachutes. This building is approximately 200 feet long by 50 feet wide (61.0 m by 15.2 m) and was originally designed as a parachute packing facility to support the Gemini program. The existing Building M7-657 will be modified to support parachute inspection and repair functions, and to provide equipment storage and administrative support.

Two new additions to the facility will be constructed: one 8,000-square foot (743-sq.m.) open addition and one 12,000-square foot (1,115-sq.m.) enclosed addition. These new additions will support parachute defouling, washing, drying and packing. An overhead monorail system will be installed throughout the facility to provide horizontal handling and transport capability for parachutes being processed. Parachute washer and dryer systems will be constructed in the open addition. Expanded utility systems including water supply, fire alarm,

communications and air conditioning will also be provided. A perspective drawing of the modified facility reflecting the flow of the SRB parachute refurbishment functions is included.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				1,730,000
Site work	LS	---	---	110,000
Architectural/structural	LS	---	---	625,000
Mechanical systems	LS	---	---	265,000
Electrical systems	LS	---	---	160,000
Wash and dry systems	LS	---	---	570,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				1,730,000

LIST OF RELATED GRAPHICS:

Location Plan at KSC
Site Plan
Parachute Facility Perspective

OTHER EQUIPMENT SUMMARY:

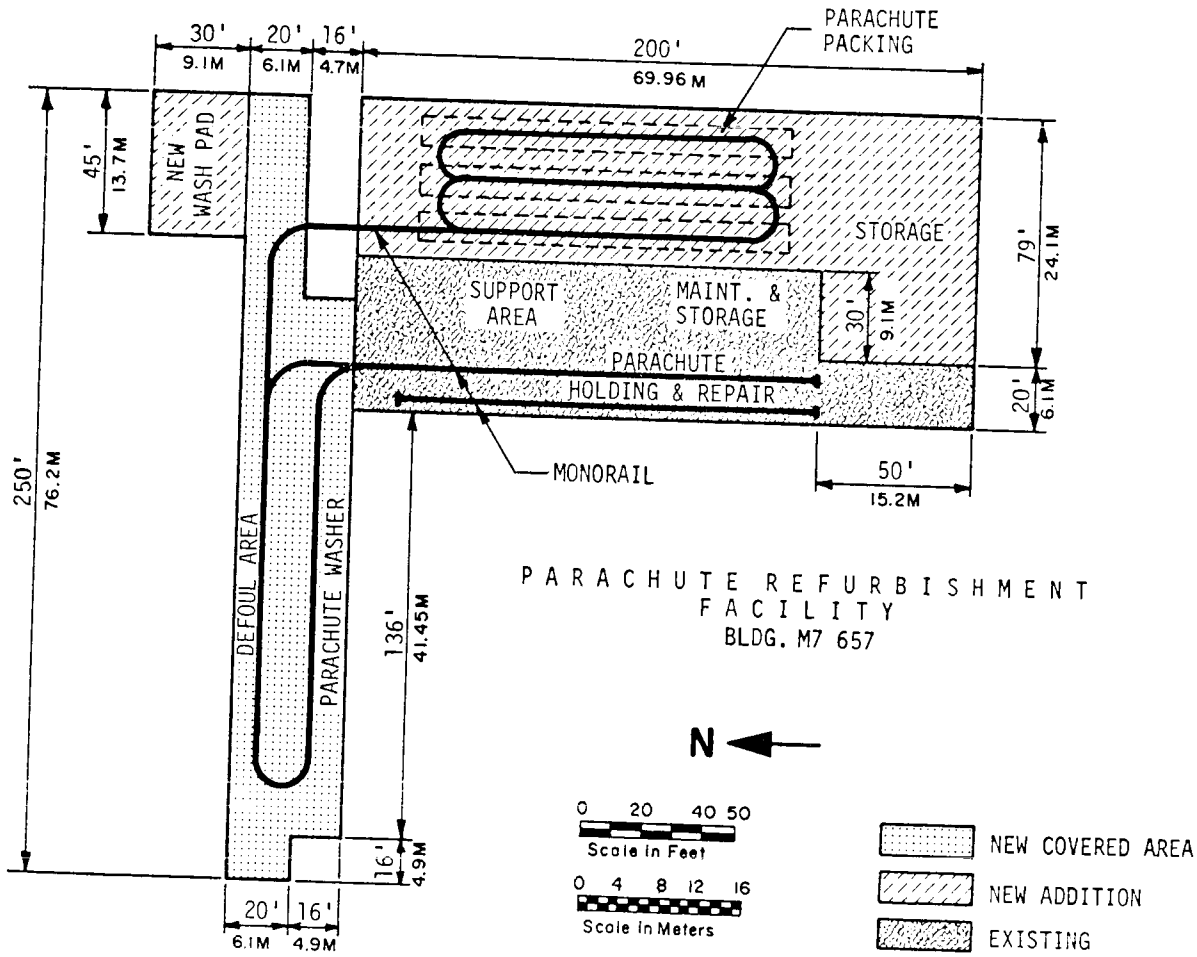
It is estimated that approximately $300,000 in R&D resources will be required to provide noncollateral equipment (transporters, dollies, pallets, sewing machines) for this portion of the SRB processing facilities.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete SRB Processing Facility requirements to support the 40 mission-per-year operational phase of the Space Shuttle program, some additional resources may be necessary, but the details and extent of these potential needs cannot now be estimated.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

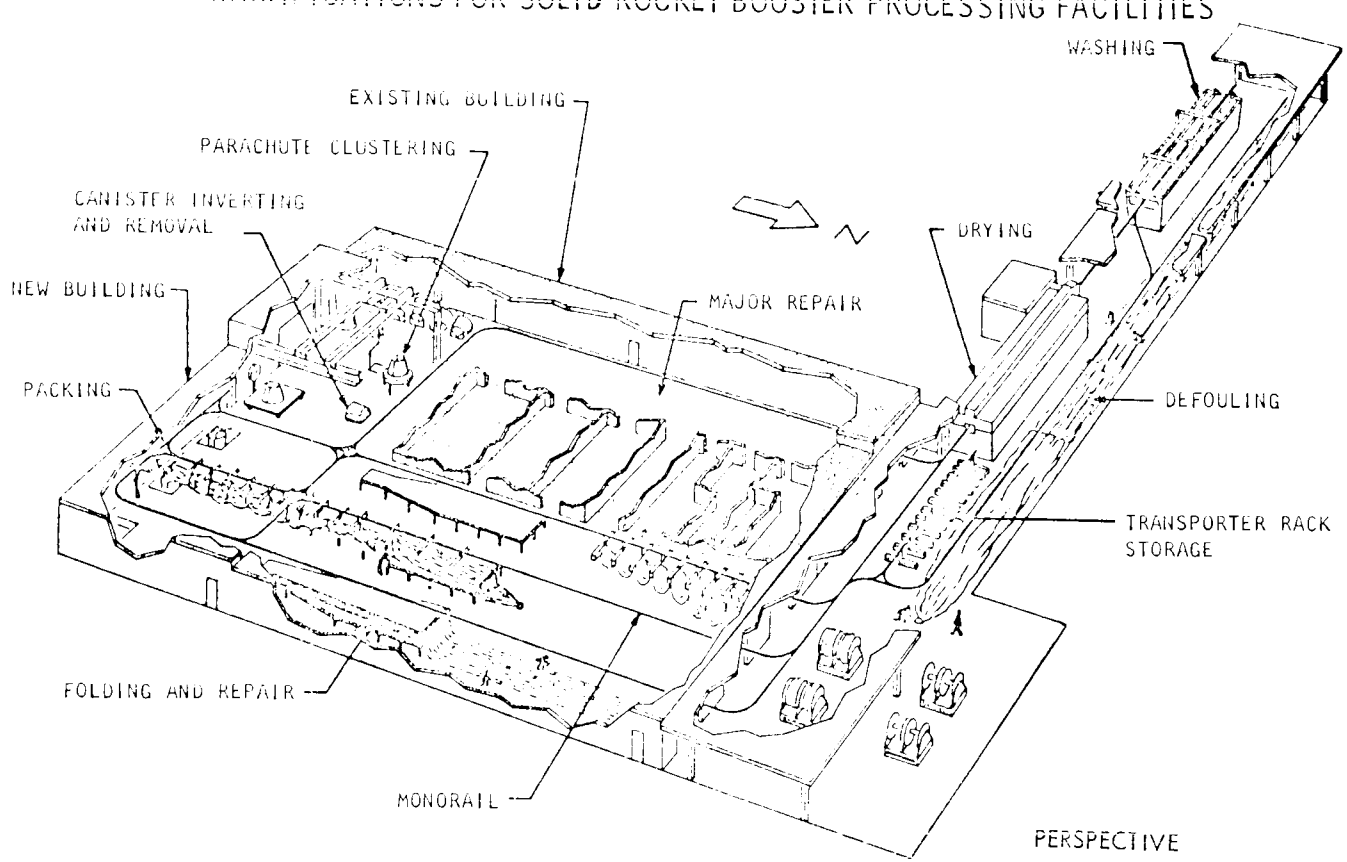
MODIFICATIONS FOR SOLID ROCKET BOOSTER PROCESSING FACILITIES



SITE PLAN

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS FOR SOLID ROCKET BOOSTER PROCESSING FACILITIES

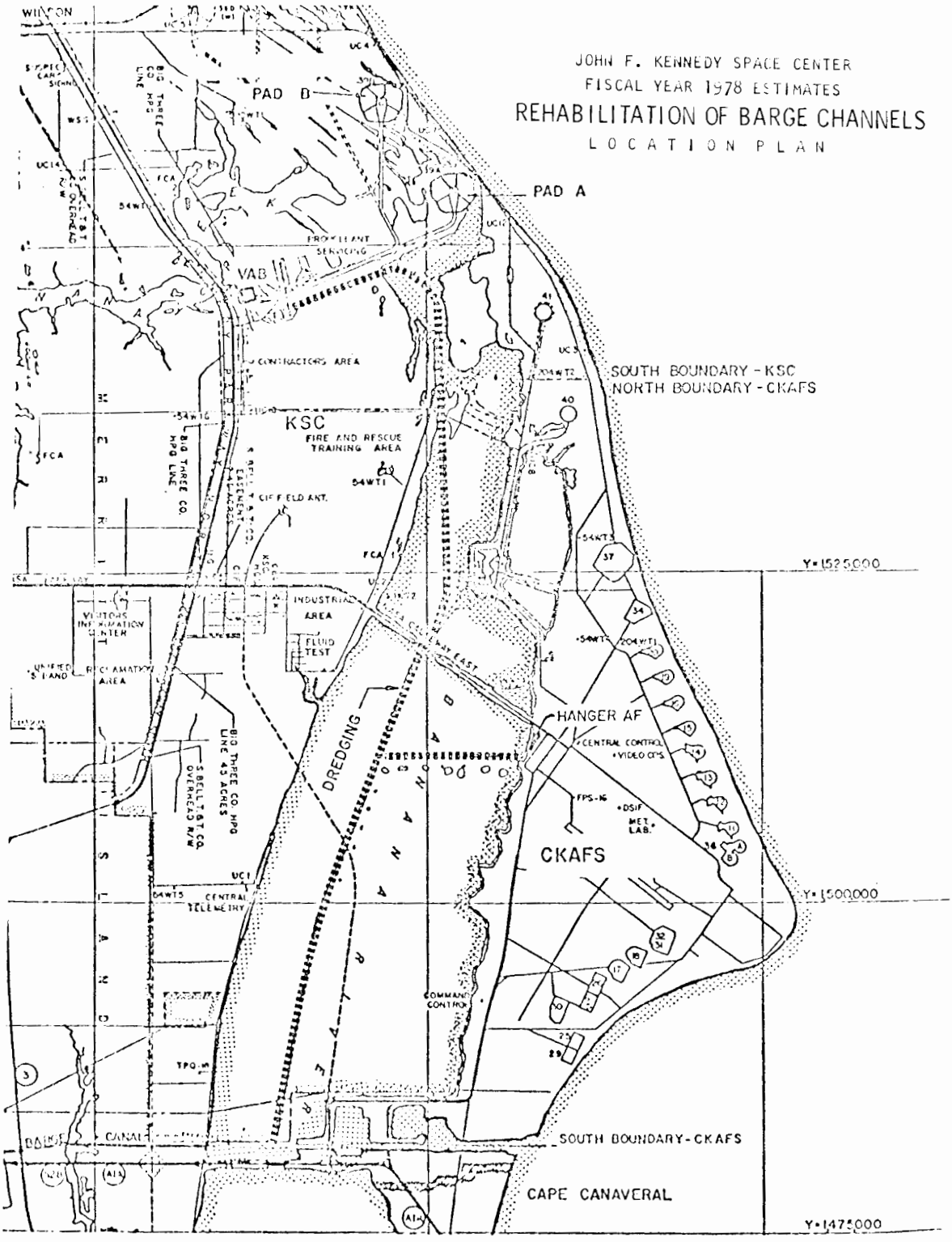


PARACHUTE FACILITY (BLDG M7-657)

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

REHABILITATION OF BARGE CHANNELS

LOCATION PLAN



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Rehabilitation of Barge Channels
INSTALLATION:	John F. Kennedy Space Center
FY 1978 CoF ESTIMATE:	$2,090,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	148,000	---	148,000
Other affiliated funding	---	3,095,000	3,095,000
Total	148,000	3,095,000	3,243,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to dredge and rehabilitate 17.2 miles (27.7 km) of the Banana River channel from the barge canal to the turning basins at the Saturn Dock, Cape Canaveral Air Force Station (CCAFS) and the Vehicle Assembly Building (VAB), Kennedy Space Center (KSC). The two turning basins at the cited locations will also be dredged and rehabilitated. The channel rehabilitation work is necessary to allow passage of barges delivering the external tanks for the space shuttle flights and towing solid

rocket booster casing for cleaning, refurbishing and reuse in shuttle launch operations. The project involves dredging to restore the existing channel to its nominal 125-foot width (38.1 m) and its control depth of 12 feet (3.7 m), disposing of spoil, and upgrading the channel marker system by adding new lighted buoys and increasing the intensity of existing lights.

PROJECT JUSTIFICATION:

The shuttle vehicle consists of an orbiter, an external tank and two solid rocket boosters (SRB's). The orbiter will arrive at KSC via 747 aircraft or from space, and the SRB's will arrive via rail. The external tank, however, because of its large size is planned to arrive from the Michoud Assembly Facility by barge. Since the external tank is expendable, each flight mission will require delivery of one external tank. To allow passage of barges transporting the external tank, the existing Banana River channel from the barge canal leading to and including the VAB turning basin must be redredged to a depth of 12 feet (3.7 m) and a width of 125 feet (38.1 m).

After the shuttle vehicle lift-off and before the orbiter goes into orbit, the SRB's will be separated from the external tank and the orbiter, and descend via parachutes to a recovery area in the ocean. The recovered SRB casings will be towed to the Saturn dock at CCAFS, where they will be removed from the water for cleaning, refurbishment and reuse. To permit passage of the ship towing the recovered SRB, the existing Banana River channel leading to the Saturn dock turning basin must also be dredged.

The channel was initially dredged to a 10-foot (3.1 m) depth in 1962, and to its present control depth of 12 feet (3.7 m) in 1969. Since then, the channel bottom has shifted and shoaling has occurred, causing high spots throughout the channel. Currently, the channel is only 8 to 9 feet (2.4 to 2.7 m) deep in most areas. For safe passage of the barges carrying the external tanks and SRB's, rehabilitating the channel to a minimum depth of 12 feet (3.7 m) is required.

The first manned orbital flight (FMOF) is currently scheduled for mid-1979. To support this major milestone the first flight external tank must be delivered to KSC during the third quarter of CY 1978 for the start of the final external tank checkout, and mating and integration of the shuttle launch vehicle. The channel must therefore be operational at that time to permit passage of the external tank barge. The dredging work is estimated to require 8-10 months and should therefore be started in the fourth quarter of CY 1977. This project thus requires funding in FY 1978.

PROJECT DESCIPTION:

This project provides for dredging and rehabilitating 17.2 miles (27.7 km) of the Banana River channel to restore it to its control depth of 12 feet (3.7 m) and its original width of 125 feet (38.1 m). The work involves excavating and removing approximately 750,000 cubic yards (573,000 cu.m.) of sediment; clearing and grubbing some 110 acres (44 hectares) of land; and constructing 230,000 cubic yards (176,000 cu.m.) of earthen dikes at nine preselected sites to dispose of the excavated material. In addition, construction of a weir at each disposal site will be required to regulate the flow of water returning to the Banana River. The work also includes upgrading the channel marker buoys and providing the necessary lighting to allow for safe passage of SRB and external tank barges during nighttime operations. An environmental impact assessment has been made, and the project scope provides for implementing the work to meet all known environmental considerations effectively.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				2,090,000
Excavation, dredging	CY	750,000	1.90	1,425,000
Clearing, grubbing	Acre	110	1,000.00	110,000
Diking	CY	230,000	1.25	288,000
Weirs	EA	10	17,000	170,000
Channel markers and lighting	LS	---	70,000	70,000
Disposal monitoring	LS	---	27,000	27,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,090,000

LIST OF RELATED GRAPHICS:

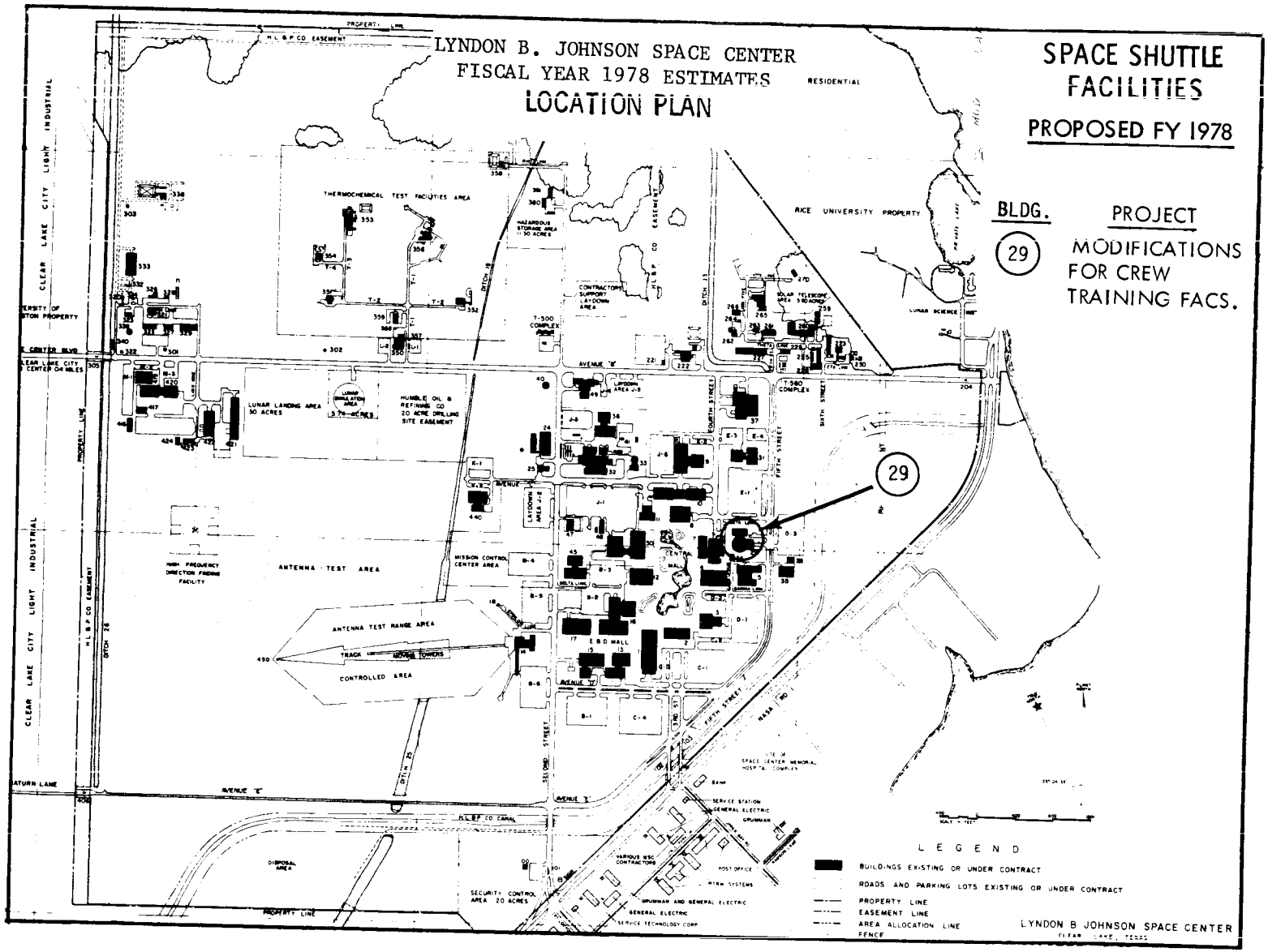
Location Plan

OTHER EQUIPMENT SUMMARY:

No additional equipment requirements are presently foreseen.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no currently foreseen future CoF funding requirements needed to complete this project. Future maintenance dredging at a cost of $200,000 to $400,000 required every two to three years will be paid for out of R&PM funds.


LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1978 ESTIMATES
LOCATION PLAN
SPACE SHUTTLE FACILITIES
PROPOSED FY 1978
BLDG.
PROJECT
29
MODIFICATIONS FOR CREW TRAINING FACS.
THERMOCHEMICAL TEST FACILITIES AREA
RICE UNIVERSITY PROPERTY
RESIDENTIAL
CLEAR LAKE CITY LIGHT INDUSTRIAL
LUNAR LANDING AREA 30 ACRES
HUMBLE OIL & REFINING CO 20 ACRE DRILLING SITE EASEMENT
ANTENNA TEST AREA
ANTENNA TEST RANGE AREA
CONTROLLED AREA
MISSION CONTROL CENTER AREA
E B D MALL
AVENUE "E"
AVENUE "F"
FIFTH STREET
SECOND STREET
H.L.&P. CO CANAL
DISPOSAL AREA
SECURITY CONTROL AREA 20 ACRES
PROPERTY LINE
LEGEND
BUILDINGS EXISTING OR UNDER CONTRACT
ROADS AND PARKING LOTS EXISTING OR UNDER CONTRACT
PROPERTY LINE
EASEMENT LINE
AREA ALLOCATION LINE
FENCE
LYNDON B JOHNSON SPACE CENTER

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications for Crew Training Facilities
INSTALLATION:	Lyndon B. Johnson Space Center
FY 1978 CoF ESTIMATE:	$860,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	163,000	1,250,000	1,413,000
Other affiliated funding	---	8,904,000	8,904,000
Total	163,000	10,154,000	10,317,000

Note: Specific funding data apply to Buildings 5 and 29. Affiliated funding applies to Building 29 only.

SUMMARY PURPOSE AND SCOPE:

This project continues work begun with FY 1975 and FY 1976 funds to modify existing flight crew training facilities at Johnson Space Center (JSC). The FY 1975 project provided for modifications to Building 5 to accommodate the orbiter aeroflight simulator and the shuttle mission simulator computer. The FY 1976 project provided for further modifications to Building 5 to accommodate the shuttle mission simulator and associated visual scene generation system. This FY 1978 project provides modifications to Building 29, the Flight

Acceleration Facility, for a water immersion facility. (This building houses the centrifuge, which is now inactive and has been declared surplus.) The water immersion facility is required to provide the capability necessary for the adequate training of space shuttle crews in an environment closely simulating the weightless conditions of outer space.

PROJECT JUSTIFICATION:

A key factor in the success of the manned space flight program to date has been the intensive flight crew training using mission simulators. Existing training facilities at Johnson Space Center have been specifically constructed and successfully used to support training for Gemini, Apollo and Skylab. These facilities can be modified to support training for shuttle missions.

This project will provide the capability to train space shuttle flight crews to perform extravehicular activities in a weightless environment. Flight crews must be trained to perform certain activities outside the spacecraft for direct mission support and for contingency operations affecting flight crew safety. It will be necessary, for example, to adjust instruments, check experiments, retrieve and replace film, or service satellites. These and similar activities will be scheduled before a mission begins. It is also necessary for crews to know how to cope with unscheduled problems that may arise outside the spacecraft such as assessing damage to the spacecraft or payload, repairing damaged components and rescuing stranded crews. As the Skylab program demonstrated, crews can handle many repairs outside the spacecraft if they have been properly trained. That training, to a large extent, proved most important to the successful completion of the Skylab program.

Experience has shown that in-the-water training of crews for these activities most closely simulates the weightless environment of outer space. A water immersion facility, such as the one this project provides at Johnson Space Center, will help crew members learn how to handle tools and equipment so as to work more effectively in outer space. It will also aid in compiling crew instruction manuals as procedures for performing tasks in a weightless environment are developed.

The water tank, which will be used for training for the remainder of the shuttle program, must be large enough to accommodate shuttle training articles such as the payload bay, airlock and crew module simulators. Although an existing tank at Marshall Space Flight Center (MSFC) is adequately sized, the results of reviews have shown that using the MSFC facility would be more expensive than providing a water immersion facility at JSC, where most of the other crew training takes place. Extensive modification, costing approximately $500,000 to $600,000, would be required to the building housing the tank at MSFC. Although the facility modification at MSFC would initially cost less than the proposed facility at JSC, the cost of transporting approximately 5 to 7 trainees and support personnel per week, associated per diem expenses, the cost of training time lost, as well as the added equipment and manpower requirements, would offset the initial

facility cost difference within two years of space shuttle operations. In addition, fragmenting crew training activities at two sites would tend to degrade the quality and effectiveness of integrated crew training plans and would most likely have an adverse effect on the flight schedules.

The project was included in NASA's FY 1977 CoF budget request. The Congressional action, while concurring in requirement's validity, deferred this item pending review by NASA of other possible locations for crew training activities. This review has now been completed and the findings have been delivered to the Congressional Committees. The report indicated a relocation would be too costly and unfeasible to support shuttle operations.

With the deferral of this project from FY 1977 to FY 1978, this work cannot be completed in time to support the first manned orbital flight. NASA has developed an alternative to support the requirements for the early development flights. Part task trainers (less than full task) will be used in an existing but small water immersion facility at JSC pending availability of this facility.

It is currently planned that this facility will be available to support the third manned orbital flight, presently scheduled for late CY 1979. Construction and activation of the facility will require approximately 15 months; it should therefore be operational approximately 9 months before the third manned orbital flight. To support this milestone, construction should be started in the fourth quarter of CY 1977, thus reflecting this FY 1978 programming.

PROJECT DESCRIPTION:

This project includes modifications to Building 29, the Flight Acceleration Facility, to provide a water immersion facility required for training shuttle flight crews and mission specialists. Maximum use will be made of existing facilities and equipment at JSC to provide an operable crew taining facility. Existing facilities that will be used with little or no modification include; a test control center, locker room, visitors' viewing room, work and administrative space, and shower facilities located in the support wings of Building 29. The existing equipment includes a 5-ton (4,536 kg) crane with monorail, environmental control consoles, breathing air system, a hyperbaric chamber, and related instrumentation and control system. The project provides for relocating and installing this equipment within this facility. Associated utility modifications and extensions will also be made.

The Flight Acceleration Facility is primarily a centrifuge rotunda with two attached support wings. A concrete rectangular water tank with interior dimensions of 30 feet by 78 feet by 25 feet deep (9.1 m by 23.8 m by 7.6 m) will be constructed inside the existing centrifuge rotunda building. The tank will be recessed 15 feet (4.6 m) below the ground floor level. A series of lighting portholes with associated

1,500-watt lamps, viewing portholes, and a ladder will be installed in the tank walls. A heating system will be installed. A platform will be constructed around the top of the tank and will be connected, by a ramp, to the existing second floor control room in one of the support wings. A sump pump and motor will be located in a pit adjacent to the tank. The tank will be drained through existing storm drains.

A partition will be constructed across the rotunda to separate the tank from the rest of the rotunda and prevent adversely affecting the adjacent area with humidity from the tank. The location and details of the facility are shown in the graphic section of this project.

PROJECT COST ESTIMATE:

	Unit of Measure	Quanity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				715,000
Demolition, excavation, piling and foundations	LS	---	---	280,000
Tank, concrete with portholes	GAL	420,000	0.45	189,000
Platforms, ladders, rails and ramp	LS	---	---	86,000
Partitions	SF	5,000	5.60	28,000
Electrical and mechanical utilities	LS	---	---	132,000
Equipment				145,000
Water heat and treatment plant	GAL	400,000	0.25	100,000
Installation of existing equipment	LS	---	---	45,000
Fallout Shelter (not feasible)	---	---	---	---
Total				860,000

LIST OF RELATED GRAPHICS:

Location Plan
Floor Plan

OTHER EQUIPMENT SUMMARY:

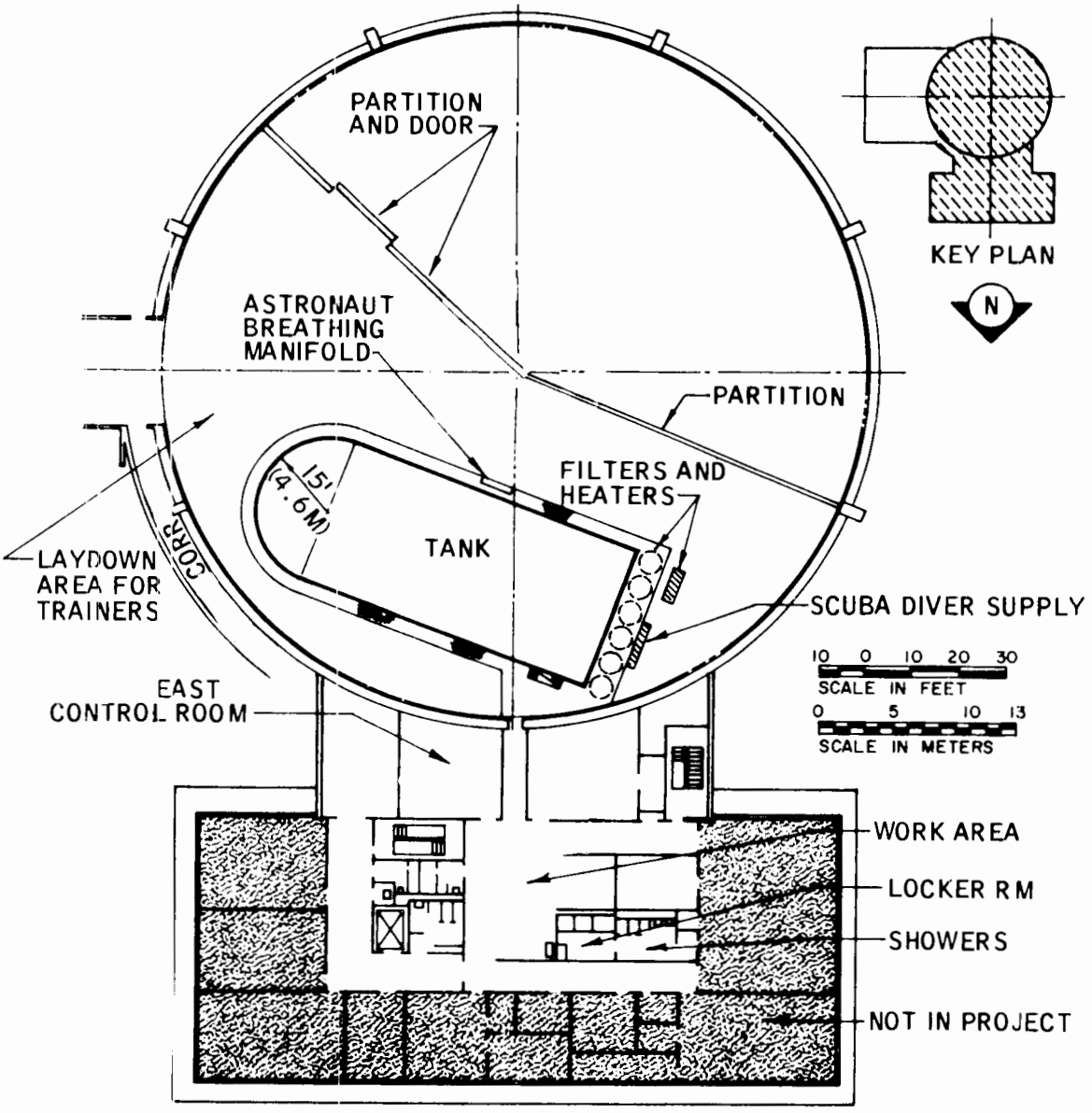
Existing collateral and noncollateral equipment at Johnson Space Center, estimated at a replacement value of approximately $210,000, will be used to make the facility operable. This equipment includes a hoist, crane, air compressor, portholes, hyperbaric chamber, television cameras, test instrumentation, and control consoles. In addition, orbiter trainers to be acquired from space shuttle R&D resources will be required for the initial operation. They are presently estimated to cost $3.9 million.

FUTURE CoF ESTIMATED REQUIRED TO COMPLETE THIS PROJECT:

There are no foreseeable future CoF funding requirements necessary to complete this project.

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS FOR CREW TRAINING FACILITIES
BUILDING 29
(WATER IMMERSION FACILITY)



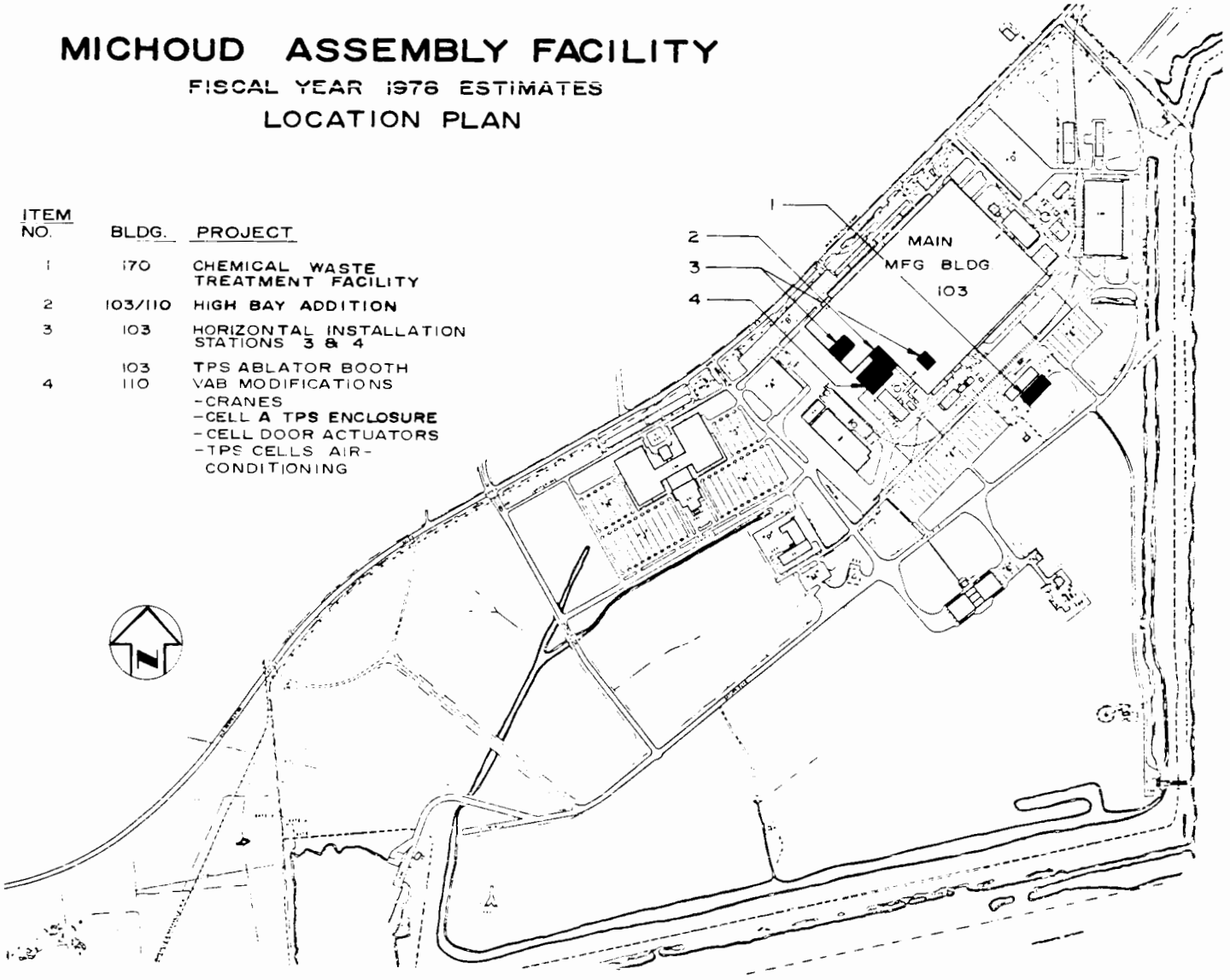
FLOOR PLAN

MICHOUD ASSEMBLY FACILITY

FISCAL YEAR 1976 ESTIMATES

LOCATION PLAN

ITEM NO.	BLDG.	PROJECT
1	170	CHEMICAL WASTE TREATMENT FACILITY
2	103/110	HIGH BAY ADDITION
3	103	HORIZONTAL INSTALLATION STATIONS 3 & 4
4	103 110	TPS ABLATOR BOOTH VAB MODIFICATIONS -CRANES -CELL A TPS ENCLOSURE -CELL DOOR ACTUATORS -TPS CELLS AIR-CONDITIONING



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modification of Manufacturing and Final Assembly Facilities for External Tanks
INSTALLATION:	Michoud Assembly Facility
	FY 1978 CoF ESTIMATE: $18,610,000

LOCATION OF PROJECT: New Orleans, Orleans Parish, Louisiana

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

COGNIZANT INSTALLATION: Marshall Space Flight Center

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	3,221,000	16,452,000	19,673,000
Other affiliated funding	---	146,933,000	146,933,000
Total	3,221,000	163,385,000	166,606,000

SUMMARY PURPOSE AND SCOPE:

This project continues the work begun with FY 1973, 1974 and 1977 resources to modify the manufacturing and final assembly facilities for space shuttle external tanks (ET's) at the Michoud Assembly Facility. These prior year resources provided modifications to the Main Manufacturing Building (103), the Vertical Assembly Building (110), and the Final Acceptance and Checkout Building (420) to produce space shuttle external tanks. The external tank is an essential component of the space shuttle vehicle in that it supplies the propellants to the orbiter's main engines that propel the orbiter into earth orbit. Each external tank is made up of three

components: a liquid hydrogen tank, a liquid oxygen tank and an intertank. In this context, the specific work involved in this external tank facility project is to provide the modifications essential to assemble these ET components, test and clean them, apply the thermal protection system (TPS) on their surface and assemble them into a complete external tank. The completed tank is then equipped with the necessary plumbing and electrical systems, checked and accepted, and prepared for shipment on a barge to the launch site for mating with the orbiter and solid rocket boosters that form the space shuttle vehicle.

Prior year resources provided the necessary facility work at Michoud to produce 24 to 28 external tanks per year except for a few capabilities such as the thermal protection system application facilities. In this instance, the TPS application capability as stated in the FY 1977 project provides for producing 10 to 14 tanks per year. This FY 1978 project primarily provides additional ET manufacturing facilities to bring the TPS application capability up to 28 tanks per year and to provide additional production and support facilities. Included in this project is a high bay addition between buildings 103 and 110 to house three TPS cells; construction of a chemical waste treatment facility; modification to the Vertical Assembly Building (110); and modifications of the Main Manufacturing Building (103) to provide two additional horizontal installation positions and a TPS booth.

PROJECT JUSTIFICATION:

The Michoud Assembly Facility is being modified to produce space shuttle external tanks, which supply the propellants to the orbiter main engines. The planning to date envisions providing the facilities required to produce 24 to 28 tanks per year as an intermediate target. This production rate will satisfy shuttle program requirements for the design, development, test and evaluation phase as well as for the early operational phase of the program. Prior year resources provided the modifications at Michoud necessary to achieve this production rate except primarily in the TPS application area. In this case, the TPS application facilities approved in previous years, as stated in the FY 1977 project, will provide a capability to produce 10 to 14 tanks per year. This production rate can support the flight missions from the Kennedy Space Center up to CY 1981. Current program requirements call for a flight mission profile exceeding 20 flights in CY 1982. To support program requirements, the TPS application capability at Michoud must be increased. This project provides an addition between buildings 110 and 103 that will house three TPS application cells. When completed, these cells, together with three included in prior years, will provide the required TPS application capability necessary to produce up to 28 external tanks per year.

The ET manufacturing operations at Michoud generates chemical wastes that must be disposed of in an effective and reliable manner. These wastes are currently being pumped into a holding pond where they are chemically treated, diluted and then injected into a 6,000-foot-deep (1,828.8 m) well. This arrangement was satisfactory in the Apollo era primarily because of the low production capacity needed (a few Saturn stages per year) at that time. The well has been prone to frequent clogging from the solid wastes involved. This was resolved

during the Apollo Program by periodic cleaning of the well with a special rig that must be scheduled for that purpose. With the high production rates required to support the space shuttle program, and the greatly increased chemical waste disposal requirements, this arrangement will not be satisfactory. If the well is clogged during the heavier shuttle use, the time required to schedule a rig for the cleaning operation (several months) will adversely impact the production capability and consequently the space shuttle launch operations. In addition, there is rising concern whether the deep injection well can satisfactorily meet the increased environmental protection standards of the future. This project therefore includes the construction of a chemical waste treatment facility that will provide for disposal of the chemical waste, on a long-term basis, in an effective and reliable manner and will also be in keeping with environmental policies affecting the disposal of such wastes. It will provide for adequately handling the wastes associated with a production level of 50 to 60 external tanks per year. A flow diagram for a proposed chemical waste treatment facility is shown in the graphic support for this project.

The Vertical Assembly Building (110), as currently being configured to support the space shuttle external tanks from prior resources, contains six cells: three for TPS application, one for hydrostatic testing of the liquid oxygen tank, one for cleaning and iriditing the ET components, and one for stacking and final assembly of all these components into a complete external tank. It is now being served by a 180-ton (163,296 kg) capacity existing bridge crane. The handling operations of lifting the various tank components from dollies into each cell and in between cells are such that this crane, as currently configured, cannot support the handling demands. This project provides for satisfying a portion of the material handling requirements by derating this crane from 180 tons (163,296 kg) to 60 tons (54,432 kg) so as to increase its speed and providing a 5-ton (4,536 kg) jib crane to service the cleaning cell. These modifications are required to support the great handling demands in the Vertical Assembly Building for the higher rates. In addition, the doors for three of the six cells will be equipped with power actuators so that production efficiency is increased to meet manufacturing flow requirements safely and effectively. Air conditioning modifications will also be necessary for the three TPS cells to meet the recently defined TPS application environment. The stacking cell must also be equipped with a small environmentally controlled enclosure to support applying the TPS on the joints between the liquid hydrogen tank and intertank (TPS closeouts) where such application in the main TPS cells is not possible.

Two modifications will be required in the Main Manufacturing Building (103). The first is to provide an environmentally controlled TPS booth necessary to form the ablator material and mold it to the exact shapes and sizes that will be later bonded to the tank surfaces. The ablator material is necessary to insulate the tank from the extremely hot aerodynamic environment encountered during launch of the shuttle vehicle. While the foam insulation is primarily applied by spraying in the TPS cells located in the Vertical Assembly Building, the tank design requirements call for bonding the ablator material on isolated and specific areas on the tank surface.

The second modification is required to provide two additional horizontal installation stations in building 103. These stations are used to install the plumbing and electrical systems on the completed external tank. While these facilities are geared for the higher rates of 50 to 60 tanks per year, it is necessary to implement the construction early to preclude interference between the construction and operation and to reduce safety hazards.

Program requirements call for space shuttle flight missions from Kennedy Space Center exceeding 20 flights per year in CY 1982. The external tanks to support these requirements must be delivered to the launch site 9 to 12 months before the mission dates to allow for the extensive prelaunch operational checkout and mating of the complete space shuttle vehicle. Allowing for the lengthy manufacturing and production activities at Michoud, and the transition period needed to reach the higher production rates required, the facilities must be in operation by late CY 1980. Construction and activation periods are estimated at three years, thus requiring a construction start in the FY 1978 time frame. Therefore, FY 1978 funding is necessary.

PROJECT DESCRIPTION:

This project provides for a continuation and extension of the work authorized in FY 1973, 1974 and 1977 and is required to provide operable facilities for external tank production at the rate of 24 to 28 tanks per year. This work includes a high bay addition between the Main Manufacturing Building (103) and the Vertical Assembly Building (110), construction of a chemical waste treatment facility, and modifications to buildings 103 and 110.

Specifically, the project provides the following:

(1) High Bay Addition Between Buildings 103 and 110: A 200-foot-long by 118-foot wide by 100-foot clear height (61.0 m by 36.0 m by 30.5 m) addition will be constructed between these two buildings, and three enclosed cells 48 feet long by 48 feet wide by 75 feet high (14.6 m by 14.6 m by 22.9 m) will be constructed therein. A pile-and-concrete foundation to support the building, cells and tooling will be provided. Work platforms, stairways and doors will be installed, and various mechanical systems such as air conditioning, fume abatement, fire detection, sprinkler, bridge crane, vacuum and utilities will also be provided.

(2) Construction of Chemical Waste Treatment Facility: A new chemical waste treatment facility is required to collect, separate, treat and otherwise make all of the various chemical compounds used in the production of the external tanks inert and readily disposable to meet environmental protection standards. Specifically, the facility will consist of a newly constructed and covered 500,000 gallon (1,893,000 liter) holding pond consisting of three compartments to hold the different concentrated chemicals as they reach the pond from the Main Manufacturing Building and the Vertical Assembly Building. Installation of mechanical pumps, a pretreatment system, carbon filters, an ion-exchange demineralizer system, and a chrome conversion system to convert

the pollutant chrome into an inert chrome hydroxide compound will be provided. Dewatering and mixing equipment will also be installed on a pile-supported concrete slab with a cover shelter above. This equipment will be used to make the chemical compounds inert before final disposal or reuse. The project will further include the installation of additional piping from the Vertical Assembly Building to the existing holding pond to carry rinse water from the cleaning cell of the Vertical Assembly Building.

(3) Modifications to the Vertical Assembly Building (VAB), Building 110:

(a) Crane Modifications: The speed of the existing 180-ton (163,296 kg) bridge crane will be increased by changing the number of cable drops and sheaves, which requires disassembly of the hoist system, shortening the cable, and reassembly. A new 5 ton (4,536 kg) jib crane and the associated steel structure for the cleaning cell will be procured and installed.

(b) Air Conditioning Modifications: An existing preheat system will be modified. The work includes adding filters, fans, controls, ducting, plenum chambers and platforms in the three TPS cells. Existing ducting and piping will be reworked as necessary.

(c) Door Actuators: Power door actuators for two TPS and one cleaning cell in the VAB will be procured and installed.

(d) Stacking Cell (A) Modification: A thermal protection system enclosure of approximately 160 square feet (14.9 sq.m.) will be installed between elevations 117.5 feet 127.5 feet (35.8 m to 38.9 m) in the final stacking position.

(4) Modifications to the Main Manufacturing Building (103): The Main Manufacturing Building will be modified to provide a TPS booth and additional horizontal installation areas. Specifically, the work includes:

(a) Thermal Protection System Application Booth Addition: A new ablator insulation application booth approximately 16 feet wide by 36 feet long by 8 feet high (4.9 m by 11.0 m by 2.4 m) will be constructed. Air inlet filters, a new air conditioning system, new ducting, plenum chambers and utilities will be provided.

(b) Horizontal Installation Stations No. 3 and 4: The concrete floor will be removed. A pile-and-concrete foundation to support the installation positions will be provided. Embedded rails for platforms, utilities, and high pressure gas will be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				18,610,000
Addition to buildings 103 and 110				13,600,000
Building	CF	2,180,000	1.95	(4,250,000)
Cell structures	EA	3	1,054,000.00	(3,162,000)
Foundations	LS	---	---	(2,022,000)
Air conditioning system	TONS	375	4,192.00	(1,572,000)
Process heating and ventilating system	CFM	49,000	9.87	(484,000)
Fume abatement system	LS	---	---	(460,000)
Fire detection system	LS	---	---	(136,000)
Fire sprinklers	EA	415	564.00	(234,000)
Vacuum system, breathing air system, boilers, oil storage and miscellaneous, mechanical systems	LS	---	---	(1,003,000)
Utility systems	LS	---	---	(277,000)
Chemical waste treatment facility	LS	---	---	2,600,000
Vertical Assembly Building modifications, building 110	LS	---	---	1,130,000
Horizontal installation positions, building 103	EA	2	190,000.00	380,000
TPS application booth, building 103	EA	1	900,000.00	900,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				18,610,000

LIST OF RELATED GRAPHICS:

Location Plan
Site Plan
Chemical Waste Treatment Facility

OTHER EQUIPMENT SUMMARY:

Special tooling (such as spray tooling, assembly tooling, unique work platforms, and special dollies) estimated to cost approximately $9 million will be needed and funded from R&D in future years to meet the initial operations. Existing Apollo tooling, with modifications as required, will be used to the maximum extent possible.

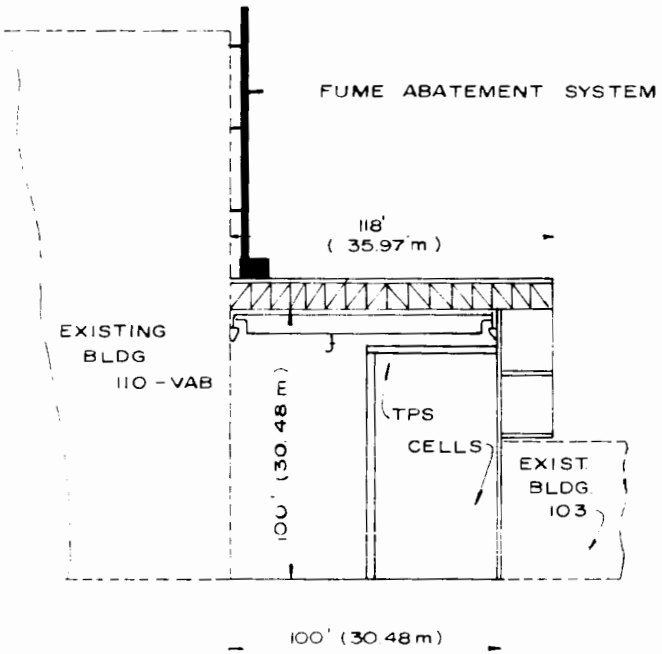
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Some $18-20 million of CoF resources may be required in future years to provide additional deionized water storage capacity for cleaning the external tanks, storage for 8 to 10 external tanks, additional crane handling capacity for increased tank production rates, a final weld enclosure, two additional TPS booths, an additional final acceptance and checkout station, possibly two additional TPS cells, additional modifications of one cell for spray-on ablator application, other support facilities, and finally conversion of another cell from oxygen to hydrogen. This is an increased estimate of future needs over that estimated in FY 1977 due to additionally forecasted requirements and increases in cost estimates as planning has refined criteria, and primarily due to further expansion of TPS requirements and residual "unknown" related facts.

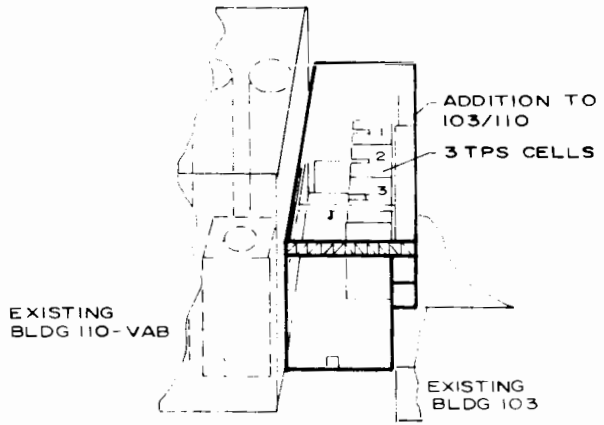
MICHOUD ASSEMBLY FACILITY

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES FOR EXTERNAL TANKS



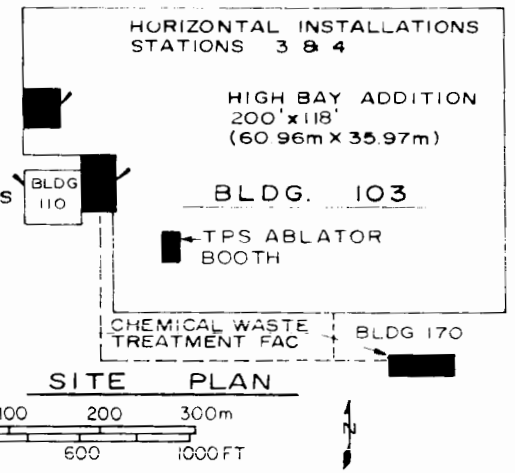
ELEVATION



PERSPECTIVE

VAB MODIFICATIONS

- CRANES
- TPS ENCLOSURE
- CELL DOOR ACTUATORS
- TPS CELLS AIR-CONDITIONING

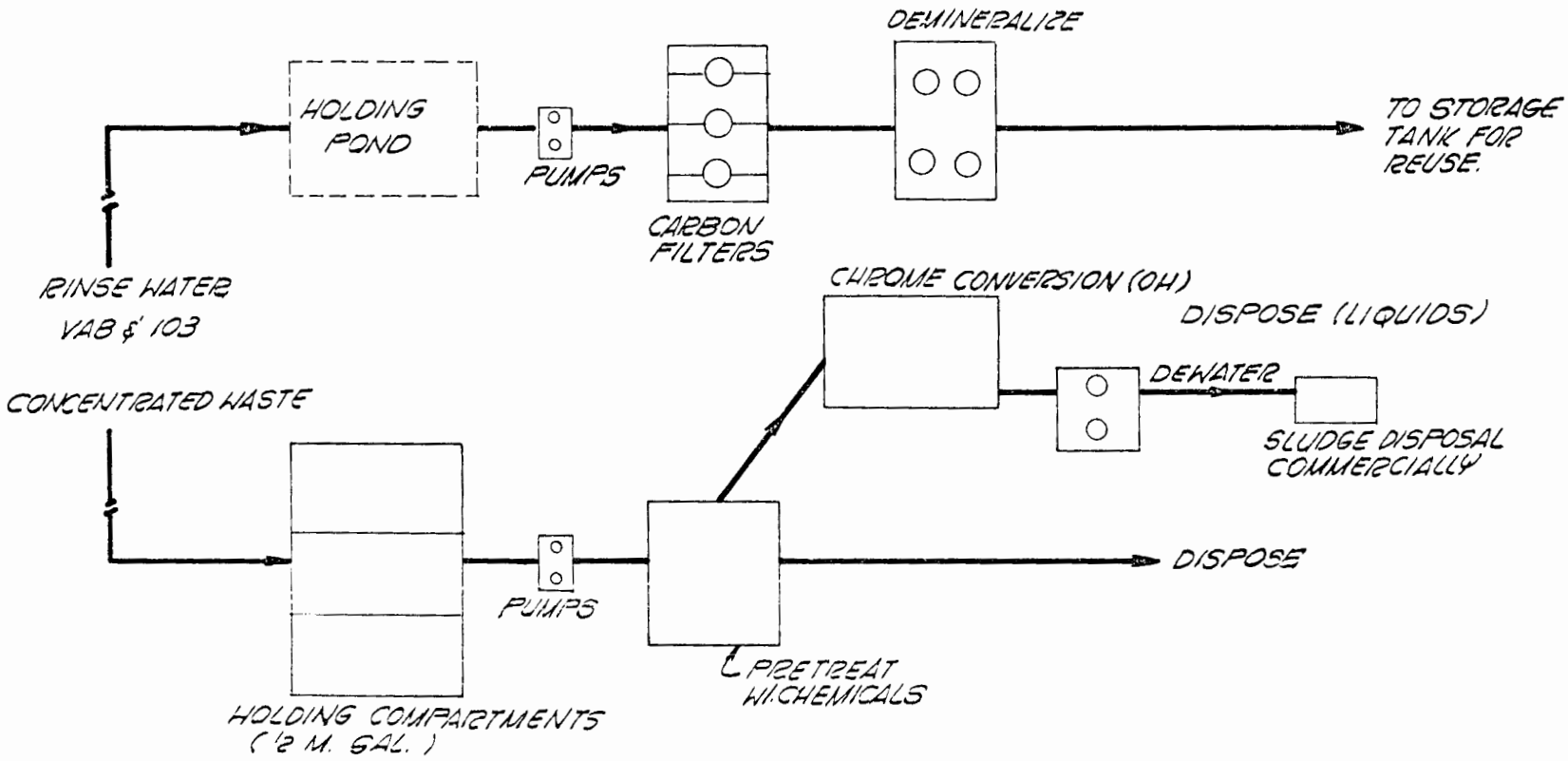


SITE PLAN

MICHOUD ASSEMBLY FACILITY

FISCAL YEAR 1978 ESTIMATES

MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES
FOR EXTERNAL TANKS



CHEMICAL WASTE TREATMENT FACILITY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

REHABILITATION AND MODIFICATION OF SHUTTLE FACILITIES, AT VARIOUS LOCATIONS

	Amount	Page No.
Office of Space Flight:		
Johnson Space Center	590,000	CF 11-45
Michoud Assembly Facility	465,000	CF 11-46
Kennedy Space Center	695,000	CF 11-48
Total	1,750,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Rehabilitation and Modification of Shuttle Facilities

INSTALLATION: Various Locations

FY 1978 CoF ESTIMATE: $1,750,000

LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to prior shuttle unique rehabilitation and modification projects:

	Planning and Design	Construction	Total
Specific CoF funding.....	296,000	2,900,000	3,196,000
Other affiliated funding.....	---	1,040,000	1,040,000
Total.....	296,000	3,940,000	4,236,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide for the minor rehabilitation and modification of facilities required to support the Space Shuttle Program at NASA field installations. Included in this project are facility rehabilitation and modification needs which are estimated to cost less than $500,000 per project and are uniquely required by the shuttle program to achieve initial operational capability or to meet program milestones.

PROJECT JUSTIFICATION:

The Space Shuttle development, assembly, and test requirements are being carried out to a large extent in existing Government facilities at the various NASA installations and industrial plants. The major modifications and new construction required at these various locations are presented as discrete line items within an integrated Space Shuttle facilities project. In many instances, shuttle support can be accommodated in existing facilities; or only limited rehabilitation or modifications are required to achieve the capability for the desired tests.

This project includes only shuttle-unique facility rehabilitation and modification work at various locations, each item having an estimated cost not in excess of $500,000. Each work item is necessary to support a specific shuttle requirement, ensure continued reliability, provide a safer environment, and/or improve the efficiency and economy in individual facilities supporting the Space Shuttle Program.

For clarity, full disclosure purposes, and better fiscal and technical control, all unique Space Shuttle facility requirements, both discrete individual line item projects as well as the smaller facility projects, are included within the integrated total Space Shuttle facility budget. The work covered in this project is of such a nature and magnitude that it is included under a single rehabilitation and modification shuttle project for various locations. The cost of this project and all such follow-on projects will be charged against the total Space Shuttle facility commitment.

PROJECT DESCRIPTION:

This project provides for necessary rehabilitation and modifications to existing facilities in support of the Space Shuttle Program. The justification, description, and cost estimate for each element are listed below:

A. Johnson Space Center 590,000

1. Modifications to Administration Wing, Building 30 480,000

The Shuttle Data Reduction Complex will be a large, integrated telemetry/computer complex designed to reduce engineering and performance data from shuttle missions to usable forms; and to catalog, store, retrieve and distribute data to users as tabulation, plots and strip charts. Output will be used for anomaly investigation, subsystem verification, design analysis, mission problem solving and mission evaluation in continuing support of the Space Shuttle Program. Because of the major increase in the volume of telemetry data and the complexity of the recorded data, the present Data Reduction Complex in Building 12 at JSC cannot accommodate all the processing requirements in either capability or capacity. This project, the second phase of a multi-year project, thus provides for modifying part of the third floor in the administration wing of Building 30 to

accommodate the Shuttle Data Reduction Complex Modifications include increasing the air conditioning system capacity; expanding the 60-Hertz, 120/208-volt electrical power system; relocating partitions and underfloor ducts; installing a signal grounding network; expanding the raised floor area as required; and installing telemetry and computer equipment. Certain existing subsystems of the existing Data Reduction Complex which can be used for the new shuttle system will be relocated to Building 30.

2. Modifications to Shuttle Avionics Integration Laboratory, Building 16 110,000

The Shuttle Avionics Integration Laboratory (SAIL), located in the high bay of Building 16, is a research and development complex designed to support verification of the Space Shuttle avionics system and other shuttle elements, including real or simulated payloads and the remote manipulator system. The configuration of the avionics system when it is integrated with other shuttle systems requires special ground support equipment and performance monitoring/control hardware for each orbiter/element combination. This project thus provides for modifications to the SAIL to accommodate selected orbiter payloads. To provide the necessary flexibility (including the possibility of having to accommodate a full-size payload or payload simulator), facility power, cooling, supports and interconnecting cables must be appreciably increased; and existing structures extensively modified. Specific work includes:

a. Removing and/or reworking existing structural supports and raised flooring in the payload bay area;

b. Providing additional supports to accommodate flight deck modifications and additions;

c. Relocating and/or modifying existing structures and cable trays to obtain the required clearances and satisfy additional or changed interface requirements; and

d. Providing additional electrical and hydraulic power, cooling and ground provisions to support the different types of payloads, the remote manipulator system and its associated ground support equipment, and performance monitoring/control hardware.

B. Michoud Assembly Facility 465,000

1. Installation of Backup Transformer for Substation No. 13 110,000

Substation 13 provides a major portion of the electrical power for the Michoud Assembly Facility (MAF) boiler plant, to the main cooling tower fans as well as to all of the boiler plant condenser water pumps. There is presently no backup transformer to ensure continuous operation of the boiler plant in the event the existing transformer should fail. If the boiler plant loses electricity, MAF would be without air conditioning

to maintain temperature and humidity control for external tank production. Buildings 101 and 102 would be completely without air conditioning. The dehumidification of Building 103 (the main manufacturing building) would result in unsatisfactory temperature and humidity conditions for welding external tanks. Substation 13 is the only MAF substation supplying power to facilities necessary for external tank production that does not have backup power. This project therefore provides for installing a new 1,500-kVA transformer and the associated buses, switches, cables, conduit, concrete slab, fenced enclosure and connections. Because of the lead time required to acquire and install such a transformer, this project should be implemented now to avoid adversely affecting the external tank production schedule.

2. Rehabilitation of Battery Charging and Storage Building 104 85,000

Building 104, which contains 24,700 square feet (2,295 m^2), is used to recharge the batteries in all electrically powered vehicles used in the main manufacturing building (103) at Michoud Assembly Facility to support external tank production. Hydrogen emissions produced by charging the batteries are a safety hazard to personnel and to the building itself. The building is not air conditioned and the lack of proper ventilation imposes a hardship on workers. In addition, cracks in the exterior load-bearing walls extend for the full height of the walls and through the walls to the extent that daylight is visible from inside. This project thus provides for the installation of a new mechanical ventilation system to remove fumes and gases, and for the repair of load-bearing walls to preserve the building's structural integrity and prevent its further deterioration. It also provides for cleaning walls, ceilings and floors; and for painting certain areas inside the building. These modifications will upgrade the facility to comply with applicable safety standards. The project should be undertaken now to avoid adverse effects on the external tank production schedule.

3. Rehabilitation of Asphalt Road 170,000

This project provides for repairing and resurfacing Saturn Boulevard from Venus Drive west to the marine dock, a road at Michoud Assembly Facility over which the external tank will be transported. The project includes applying 14,500 square yards (12,123 m^2) of asphalt emulsion slurry seal to Saturn Boulevard from Venus Drive to the incinerator road, and applying an asphalt overlay 4 to 8 inches (10.2 to 20.3 cm) thick to the remainder of the road. Failed roadway surfaces will be repaired and the cracks sealed; the asphalt overlay will be leveled to correct contours in the old pavement. Those surfaces not requiring major repairs will be seal-coated to prevent further deterioration. These repairs are necessary to eliminate the unevenness of the surface so that the external tank is not damaged during transport.

4. Rehabilitation of Gaseous Nitrogen Supply System 100,000

The existing gaseous nitrogen supply line from the bulk storage area to Building 420, where final checkout and acceptance of external tanks will be performed, is badly corroded. Because the line leaks and

controlled pressures required for pneumatic checkout of the external tank liquid hydrogen tank cannot be maintained, adequate reliable tests cannot be made. This project thus provides for a construction project to upgrade the liquid/gaseous nitrogen system at Michoud Assembly Facility. It includes approximately 1,900 feet (579.1 m) of 2 1/2 inch (6.4 cm) line for 5,000-psi (351.5 kg/cm^2) gaseous nitrogen distribution from the bulk storage area to Building 420; it also includes a tie-in to the new line that supplies the high pressure storage vessels in Area 404. The underground portion of the line will be buried at least 2 feet (0.6 m) deep in open areas and 3 feet (0.9 m) deep in steel casings under roads. This project should be implemented now to ensure that external tank testing can be performed satisfactorily and that the external tank production schedule will not be adversely affected.

C. Kennedy Space Center 695,000

1. Construction of High Purity Liquid Oxygen Facility, Launch Complex 39 220,000

This project provides for modifications to an existing liquid oxygen facility in the Launch Complex 39 area of Kennedy Space Center, needed to provide the capability to receive, store and transfer high purity oxygen (99.99% purity level) for support of fuel cell requirements of the Space Shuttle Orbiter. The liquid oxygen available for the Space Shuttle Main Engines is not sufficiently pure to satisfy the requirements of the Orbiter fuel cells which provide internal power to the Orbiter. The high purity liquid oxygen will be procured commercially but must be received, transferred and stored in special facilities in the launch complex area. The project includes necessary site work; installation of high pressure, vacuum-jacketed piping; construction of off loading and catch basin facilities; and upgrading electrical systems to include a 100-kVA transformer, with related wiring and lighting. Construction of this project must begin in early CY 1978 to support the first manned orbital flight of the Space Shuttle, currently scheduled for mid-CY 1979.

2. Modifications for SSME Storage and Servicing, Vehicle Assembly Building..... 40,000

This project provides for modifications to the Vehicle Assembly Building (VAB), Building K6-848 at Kennedy Space Center, to provide facilities for processing the Space Shuttle Main Engines (SSME). The Space Shuttle concept involves repeated flight of the same Orbiter vehicle. The SSME is contained in the Orbiter and is reused repeatedly. Some on-site engine servicing and replacement will be necessary during the period between flights. Facilities will be needed for receiving engines returned from the manufacturer, storing and testing, as well as minor on-site servicing. Checkout Cell 5 and Room 1M4 in the low bay of the VAB will be used for these functions. The project provides for modifications to existing utility systems to provide for improved lighting and electrical service to the storage and servicing areas. In addition, special supply systems will be modified and extended to provide nitrogen, helium, cooling water and hydraulic services needed to support the storage and servicing activities. The SSME and first Orbiter will be on dock at KSC late in the third quarter of CY 1978. This project is needed early in 1978 to accomplish engine servicing requirements related to that milestone.

3. Modifications for Hydraulic Power Unit Testing, Building M7-1412 30,000

This project provides for modifications to the Cryogenic I Unit in the Hypergolic Maintenance Facility in order to support hot-fire testing of the Solid Rocket Booster (SRB) Hydraulic Power Units. This testing is part of the post-manufacturing operations at KSC, and will extend for the period of the first six DDT&E flights and through a demonstration period on recycled SRB systems. The project includes necessary site work, installation of nitrogen supply lines, electrical power supply, and an operational intercom system. With delivery of the first flight set SRB's to KSC in the third quarter of CY 1978, this project must be started in early CY 1978. Thus, FY 1978 funds are required.

4. Rehabilitation of External Siding, Vehicle Assembly Building 225,000

This project provides for inspecting sheet metal screws and steel carriage bolts on two sides of the Vehicle Assembly Building (VAB), Building K6-848, high bay, tightening loose fasteners, and replacing missing and deteriorated fasteners. The VAB high bay, which is 437 feet long by 513 feet wide by 524 feet high (133.2 m by 156.4 m by 159.7 m), is covered by over 1 million square feet (92,900 m^2) of corrugated insulated aluminum siding. The building, which will continue to be used for the Space Shuttle Program, was completed in 1966; since then it has been exposed to weather and to acoustic vibration during launches. As a result, many of the fasteners have become loose or are missing, seriously affecting the integrity of the siding. This project involves the east and north sides of the high bay, or an estimated 412,000 square feet (38,275 m^2) and approximately 320,000 fasteners. All of the fasteners must be inspected; approximately one-third of them will require replacing or retightening. The project should be undertaken now so that these two sides will be structurally sound before shuttle launches begin and so that the construction schedule for the Space Shuttle Program will not be adversely affected. The siding on the south and west sides of the high bay will require similar rehabilitation later.

5. Rehabilitation of Chilled Water Lines, Vehicle Assembly Building 180,000

Insulation on existing chilled water lines in the Vehicle Assembly Building (VAB), Building K6-848, have deteriorated to the point where its thermal efficiency has been impaired, and corrosion of the lines and energy consumption increased. The insulating characteristics have changed because the combined weight of the pipe and the water has compressed and deformed the insulation. Additionally, water from pipe fittings and valves has leaked onto the lines and corroded them. All of these problems contribute to inefficient energy usage. Work to be performed includes removing the existing insulation, cleaning the pipe surface, repairing leaks as necessary, and reinsulating the lines.

Rehabilitating the insulation will decrease energy consumption and operations and maintenance costs, and increase the life of the pipe. If replacing the insulation is delayed, continued corrosion will

necessitate replacing the lines and fittings later, at a higher cost. This project costs will be paid off in less than 4 years by the savings in energy consumption. Since this building will be activity involved with shuttle activities, the project should be undertaken now to avoid an adverse impact during the shuttle operational activities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

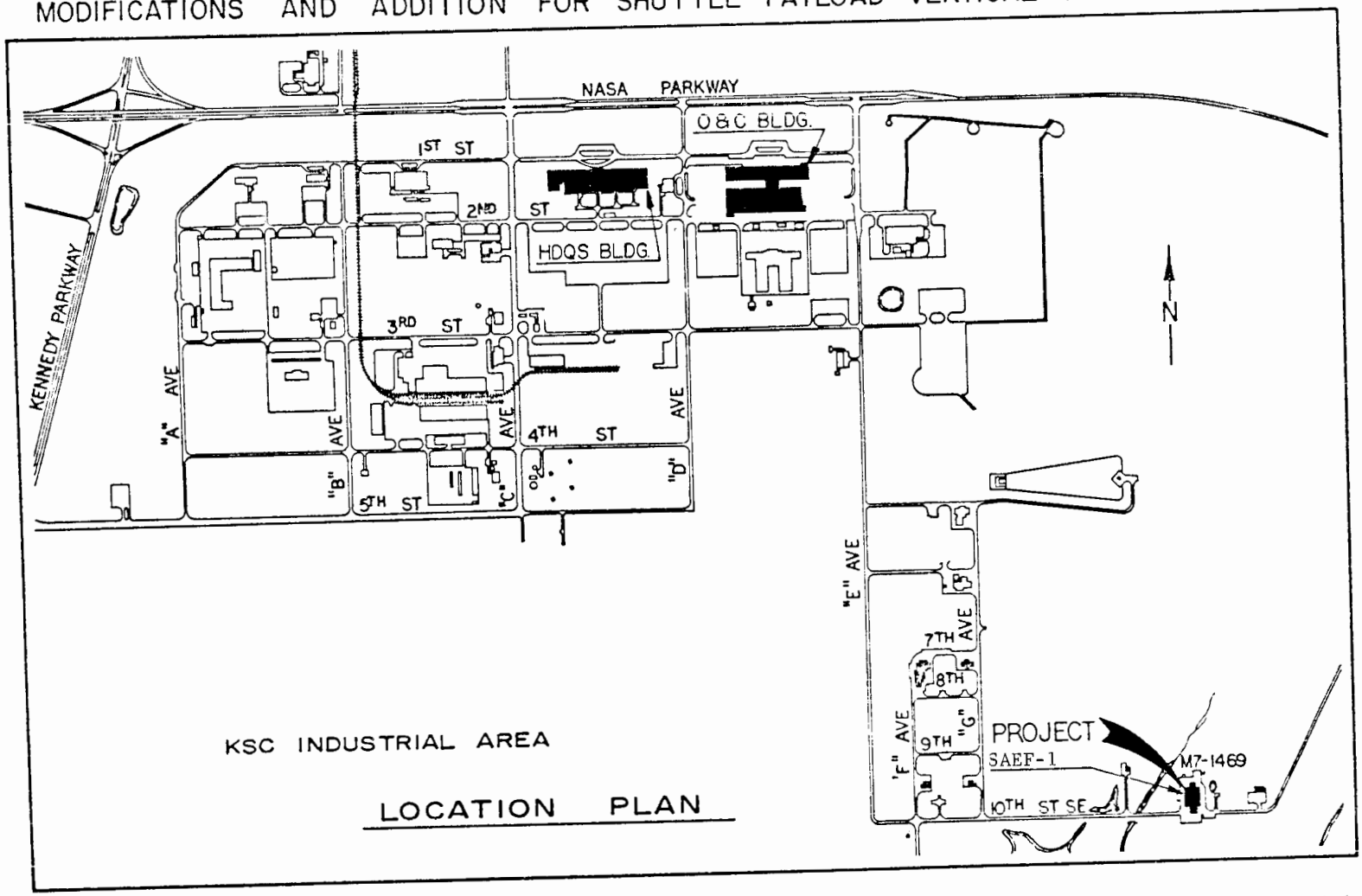
SUMMARY

SPACE SHUTTLE PAYLOAD FACILITIES

	Amount	Page No.
Office of Space Flight:		
Modifications and addition for shuttle payload vertical processing (KSC)..	6,410,000	CF 12-1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1978 ESTIMATES

MODIFICATIONS AND ADDITION FOR SHUTTLE PAYLOAD VERTICAL PROCESSING



LOCATION PLAN

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE:	Modifications and Addition for Shuttle Payload Vertical Processing
INSTALLATION:	John F. Kennedy Space Center
	FY 1978 CoF ESTIMATE: $6,410,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1977 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	564,000	---	564,000
Other affiliated funding	---	4,400,000	4,400,000
Total	564,000	4,400,000	4,964,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to modify the existing Spacecraft Assembly and Encapsulation Facility No. 1 (SAEF-1) at Kennedy Space Center (KSC) for processing upper stage vehicles, payloads, and cargoes to be processed vertically before they are moved to the launch pad for insertion in the orbiter. The project includes constructing and outfitting two assembly and test workstands; providing specialized pneumatic, fluid and electrical/electronic services; modifying one exterior and one interior door in the air lock to accommodate additional height; relocating the monorail hoist in the air lock; providing two segmented-boom mounted platforms in the air lock; general upgrading of the heating, ventilating and air conditioning system; and constructing a new 2-story, 8,840-square foot (821-m^2) addition to house operations support.

PROJECT JUSTIFICATION:

The SAEF-1 facility has been used in the past to support the expendable vehicle programs, such as the Helios, Viking and the Mariner-Jupiter-Saturn missions, and will require certain modifications to support the processing of the vertical shuttle cargoes. The anticipated manpower loading for this facility when the Shuttle Transportation System (STS) program becomes fully operational will vary from 60 to 75 people, with occasional two shift operations.

Some of the cargoes to be carried on the space shuttle orbiter will include a propulsion stage that is designed to be launched from the orbiter once the orbiter attains low earth orbit. The function of the upper stage is to extend the area of operation and exploration beyond what the shuttle by itself can achieve. NASA and the Department of Defense (DoD) have evaluated alternatives to provide this capability, and have determined that the best way to provide it is through the Interim Upper Stage (IUS), the Spinning Solid Upper Stage (SSUS) and, later, through a cryogenic propellant upper stage.

The IUS and SSUS are expendable systems using solid propellants; they will be operational beginning in CY 1980. The difference between the IUS and the SSUS is that the IUS contains its own avionics system and can be maneuvered after it has been placed in orbit while the SSUS does not have this capability. Both NASA and DoD will use them to deploy payloads during initial STS operations. The capability to retrieve payloads is not part of either system, however.

Specialized shuttle off-line facility capabilities are required to assemble and test IUS's and SSUS's for STS payloads. The projected frequency of launches and the IUS/SSUS test/operations concept dictate the need for a facility dedicated to the IUS/SSUS projects. This facility must also provide the capability to integrate the IUS's and SSUS's with their respective payloads into cargoes and place these cargoes into a transport canister for movement to the launch pad.

The capability to handle cargoes containing IUS's and SSUS's, ranging up to 60 feet (18.3 m) long, in a vertical orientation is necessary for three reasons: (1) most spacecraft/satellite designs require a constant vertical attitude during 1 "g" operations; (2) aligning the spacecraft and the IUS or SSUS is facilitated in the vertical mode; and (3) transporting IUS/SSUS cargoes horizontally would require an additional operational step to rotate the transport canisters to a vertical attitude before they are inserted into the Orbiter cargo bay from the payload changeout room. Workstands are needed to provide access to the IUS/SSUS so that the various stages can be assembled. Special systems--including pneumatic, fluid and electrical/electronic services--are necessary to service and test the IUS/SSUS and their respective payloads.

Only three buildings at KSC could begin to accommodate the height required for cargoes containing IUS/SSUS: the Vehicle Assembly Building, which is to be used for orbiter/external tank/solid rocket booster mating; the Operations and Checkout Building, which is to be used for horizontal payloads; and SAEF-1, which was used to support the Viking program. SAEF-1 requires a minimum number of modifications to provide the special facility needed to process cargoes containing IUS's and SSUS's.

The first IUS may arrive at KSC as early as mid-1979 and may be launched in March 1980, allowing approximately nine months for processing. Modifications to SAEF-1 will take 12 months for construction and six months for activation and checkout. The first SSUS with its payload is scheduled to fly on Orbiter Flight Test #4 in December 1979. Therefore, this project requires FY 1978 funding.

PROJECT DESCRIPTION:

This project provides for modifying existing SAEF-1 to accommodate vertical cargo processing, including IUS's and SSUS's.

Two assembly, test and checkout workstands will be erected in the SAEF-1 high bay. Each stand will include seven platforms approximately 35 feet long by 40 feet wide (10.7 m by 12.2 m); the platforms will be spaced approximately 10 feet (3.0 m) apart. Each workstand will accommodate cargo combinations up to 60 feet (18.3 m) long, 15 feet (4.6 m) in diameter and 65,000 pounds (29,483.5 kg). Incorporated in each stand will be a strongback for cargo support and accommodations to support cargo integration and verification equipment. The stands will include fluid, electrical/electronic and structural/mechanical support services. Fire protection, safety and communications devices will be provided. Hydrazine servicing and gaseous helium will be provided to the stands from sources located outside the building.

The entrance door at the south side of the air lock will be increased from 64 feet (19.5 m) to 71 feet-2 inches (21.7 m) to accommodate the transport canister in a vertical orientation. The door between the air lock and the high bay must have one additional (existing) panel activated to accommodate the height of the canister. The height of the canister will also necessitate raising the ceiling in the air lock from 64 feet (19.5 m) to 75 feet-2 inches (22.9 m) and relocating the monorail hoist. Two segmented-boom mounted platforms will be provided in the air lock so that operations personnel can clean the transport canister before it is moved into the high bay.

Additions to the electrical power and fluid mechanical systems for the air lock and high bay will be made. A new 750-kVA substation will be located outside the building, and control and distribution systems provided. Nitrogen purge will be incorporated in all nonexplosion-proof electrical cabinets and boxes. Remote control television to monitor hypergolic propellant operations will be provided, and the existing operational intercom system will be extended to support the workstands and control rooms.

A 2-story, 8,840-square foot (821-m^2) addition will be constructed adjacent to the west side of SAEF-1. The addition will be approximately 130 feet long by 34 feet wide (39.6 m by 10.4 m). It will house operational support areas, a mechanical equipment room and an elevator.

The existing marginal heating, ventilating and air conditioning system will be upgraded to provide the necessary environmental conditions, which includes the replacement of deteriorated components and a portion of the existing roof will also be rehabilitated.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				6,314,000
Site preparation	LS	---	---	144,000
Modify existing building				5,148,000
Architectural	LS	---	---	(286,000)
Structural	LS	---	---	(98,000)
Mechanical	LS	---	---	(1,331,000)
Electrical	LS	---	---	(1,010,000)
Communication/data	LS	---	---	(231,000)
Assembly, test and checkout stands	EA	2	680,500	(1,361,000)
Gases and fluids	LS	---	---	(684,000)
Door modifications	LS	---	---	(147,000)
Power distribution	LS	---	---	580,000
Support area addition	SF	8,840	50.00	442,000
Equipment				96,000
Service boom	EA	2	48,000	96,000
Fallout Shelter (not feasible)	---	---	---	---
Total				6,410,000

LIST OF RELATED GRAPHICS:

Location Plan
SAEF-1 Building Perspective

OTHER EQUIPMENT SUMMARY:

Certain noncollateral equipment, to be funded from R&D resources, will be required to support initial operation. The kind, size and cost estimate for such equipment are not yet fully defined.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Additional work area may be required to support additional processing tasks which may later be required to be performed at KSC. The requirement for and the scope of such work cannot be validated at this time. However, some such potential future need appears possible.

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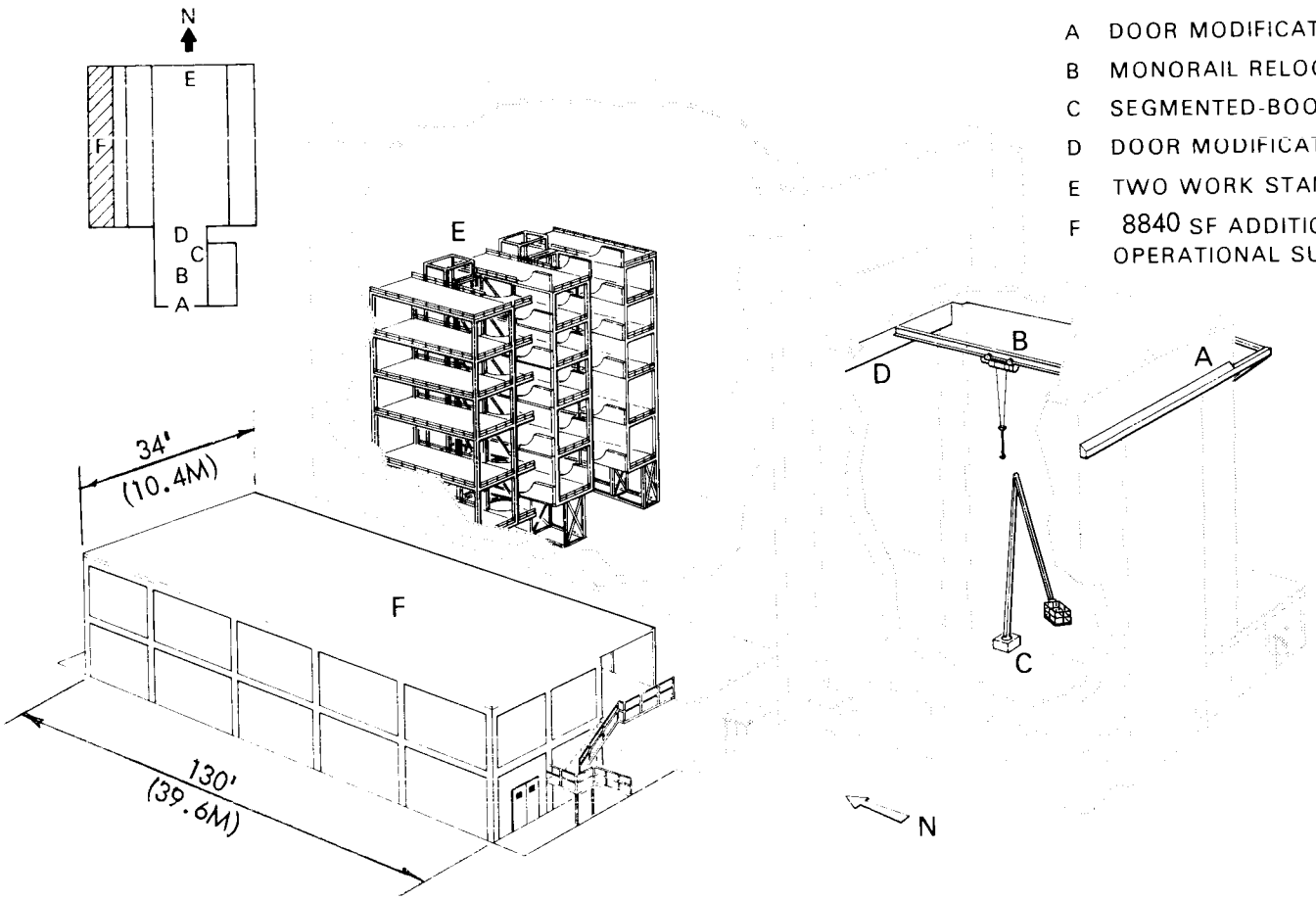

A DOOR MODIFICATION
B MONORAIL RELOCATION
C SEGMENTED-BOOM PLATFORM
D DOOR MODIFICATION
E TWO WORK STANDS
F 8840 SF ADDITION FOR OPERATIONAL SUPPORT

PERSPECTIVE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

REHABILITATION AND MODIFICATION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	1,315,000	CF 13-4
Dryden Flight Research Center	195,000	CF 13-5
Goddard Space Flight Center	1,760,000	CF 13-6
Jet Propulsion Laboratory	1,990,000	CF 13-8
Johnson Space Center	1,605,000	CF 13-9
Kennedy Space Center	1,185,000	CF 13-12
Langley Research Center	1,795,000	CF 13-14
Lewis Research Center	2,270,000	CF 13-17
Marshall Space Flight Center	1,550,000	CF 13-19
Michoud Assembly Facility	280,000	CF 13-21
National Space Technology Laboratories	160,000	CF 13-22
Wallops Flight Center	1,425,000	CF 13-22
Various Locations	1,270,000	CF 13-24
Miscellaneous Projects Less than $100,000 Each	2,100,000	CF 13-26
Total	18,900,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Rehabilitation and Modification of Facilities Not in Excess of $500,000 Per Project		
LOCATION: Various Locations		
	FY 1978 CoF ESTIMATE: $18,900,000	
FY 1976: $16,000,000	TQ: $7,000,000	FY 1977: $17,875,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECTS: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of the NASA Comptroller

SUMMARY PURPOSE AND SCOPE:

This program is intended to provide for the rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants engaged in NASA activities. Included in this project are those priority rehabilitation and modification facility needs for FY 1978 which can be foreseen at the time of the submission of these estimates, and which are estimated not to exceed $500,000 per project. The purpose of this program is to protect, preserve, and enhance the capabilities and usefulness of existing NASA facilities, and to ensure the continued safe, economical, and efficient use of the physical plants. Each of the individual items contained in this year's request for facility rehabilitation and modification work is in itself a proper facility project. Each represents the consistent application of the approved and accepted definition, and in this context each includes all of the facility work that needs to be done in the budget time frame, or all of the facility work that can be done in that time frame, as limited by constraints other than resources availability. Each individual item has been tested against applicable need dates, time lines and the ability to place the planned work under contract in the budget time frame.

In addition to the usual rehabilitation and modification requirements to the physical plant, the Agency continues to place emphasis on the identification of projects which relate directly to the conservation of

energy at the various field installations. In the past, this particular program was specifically directed toward the general nonprogrammatic segments of NASA facilities; however, increasing additional attention has been given to facility modification requirements generated by specific programs or projects.

PROJECT JUSTIFICATION:

At its initial cost, the existing NASA physical plant totals about $6.2 billion (September 30, 1976). A continuing program of rehabilitation and modification of these facilities is required to:

a. Protect the capital value represented by those facilities and to overcome the cumulative effects of wear and deterioration.

b. Ensure the continued and reliable availability of these facilities as well as their operational capabilities as applicable.

c. Improve the capabilities and usefulness of these facilities in terms of NASA mission accomplishment, and to overcome the aggregate effects of obsolescence.

d. Provide a better and safer environment for all personnel.

e. Provide for significant reductions in energy consumption through the initiation of energy conservation projects and the provision of updated and improved utility control systems.

This project includes only facility rehabilitation and modification work having an estimated cost not in excess of $500,000. The work covered in this project is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance and repair activities, or by related routine facility work efforts which are provided for in other than CoF estimates. Rehabilitation and modification work estimated to cost more than $500,000 is reflected as a separate major CoF line item project. Not included in this project are the minor construction of facilities projects (new and addition type) required in FY 1978. Provision for the major portion of this latter requirement is made under a separate project entitled "Minor Construction" which is included in the CoF estimates.

PROJECT DESCRIPTION:

Proposed rehabilitation and modification items for FY 1978 are outlined under "PROJECT COST ESTIMATE" and total $18,900,000. Of this total, $16,800,000 represents discrete work packages at designated NASA installations. The remaining $2,100,000 relates to those smaller rehabilitation and modification projects estimated to cost less than $100,000, the nature and purpose of which are the same as for that work

specifically delineated but which, because of their individual smaller size, are not listed by item. At this time these items are considered to be of the highest priority. They have been carefully selected from lists totaling about $45 million. This listing represents a modest increment in relation to the existing total "backlog" of this type of work, for which provisions must be made over the next several years.

The remainder of the rehabilitation and modification work should be undertaken over the next several years to place these installations on a more economical and efficient operating base. As indicated above, the projects in this request are considered to be of the highest priority on the basis of relative urgency and expected return on the investment involved. It is recognized, however, that during the course of the year some rearrangement of priorities may be necessary and it is also realistic to assume that a change in some of the items to be accomplished within the allocated resources may be required. For the purpose of justifying this estimated facilities rehabilitation and modification requirement, a tentative listing of projects is set forth under "PROJECT COST ESTIMATE". This work will be accomplished on a priority basis. The total of $16,800,000 of discrete projects relates to the following broad categories of facilities:

a.	Utility Systems	3,925,000
b.	Fire Detection/Protection Systems	1,445,000
c.	General Purpose Buildings	4,950,000
d.	Technical Buildings/Structures	5,255,000
e.	Pavements and Drainage	780,000
f.	Building Exteriors and Roofs	445,000

In addition, there is the "Lump Sum" estimate of $2,100,000 for smaller project work, thus making a total of $18,900,000. The FY 1978 requests for facility rehabilitation and modification work are directed toward the most urgent current needs for work of this type in the continuation of this program at NASA installations.

PROJECT COST ESTIMATE:

A. Ames Research Center..... 1,315,000

1. Rehabilitation and Modification of Technical Facilities for Fire Protection..... 260,000

This project provides for the rehabilitation and modification of the remaining technical facility support areas to include computers, machine shops, wind tunnel model development and preparation, and related research laboratories to obtain an adequate level of fire protection. This work will include the installation of automatic fire detection and sprinkler systems in thirteen buildings with a total floor area of approximately 300,000 sq ft (27,870 sq m) and two cooling towers. These protection systems will also be connected to the Center's emergency monitoring station and to the Moffett Field Fire Department. This project provides for the protection of those elements considered to be urgently essential for the protection of life, expensive resources, or continuity of significant research programs. These facilities have a replacement value in excess of $45 million and are vital for the operational continuity of ongoing aerospace programs.

2. Modifications to Vacuum Spheres and Ejector Systems for Seismic Protection Buildings N-229, N-234, N-234A, N-238..... 355,000

This project provides for the structural modifications to the 3.5-Ft. Hypersonic Wind Tunnel Facility, Building 229; Thermal Protection Laboratory, Building 234; Thermal Protection Laboratory Boiler, Building 234A; and the Arc Jet Laboratory, Building N-238 for improved seismic protection. The work will include the reinforcement of the steam ejector support structure. This work will also include the replacement and reinforcement of the structural framing system of the six 77-foot (23.5 m) diameter steel vacuum spheres. All modifications are to increase the stiffness of the structures beyond the predominant frequencies experienced in earthquake ground motions in conformance with present seismic design standards. The need for these modifications is the result of a recent earthquake risk analysis and will reduce hazards to these facilities in recognition of their location in an acknowledged earthquake area. These structures were constructed over fifteen years ago using engineering concepts which have now been outdated. These modifications are the result of an improved concept for seismic dynamic analysis developed specifically for Ames Research Center's geographical location.

3. Modifications for Utility Control System..... 360,000

This project provides for the installation of a central automated utility control system for controlling the mechanical system in 48 buildings. This work will include the installation of a computer and peripheral equipment in the control center now located in the Research Support Building N-213. The central control system will be connected to the buildings using the existing Center cable network. Also included in the work will be the installation of sensors, transducers, and data gathering panels for the automatic

control of the heating and air conditioning systems in these buildings. This project will add computer-based automated control to the existing building mechanical systems, and will tailor the operation of these systems to the weather conditions and occupancy requirements. The installation of this utility control system is expected to produce a 1 to 2 percent reduction in the electrical power requirements of the Center. In order for the Center to meet its energy conservation goal, and to further improve the operation of the mechanical systems of these facilities, these modifications are considered a primary requirement.

4. Rehabilitation and Modification of Space Technology Building, N-204..... 340,000

This project provides for the rehabilitation and modification of 10,000 square feet (930 sq m) of the Space Technology Building, N-204. This work will include the dismantling and removal of obsolete heat transfer equipment and low density wind tunnels and remodeling a major portion of the first floor into office space. The interior modifications will include the installation of new partitions, flooring, ceilings, electrical systems, lighting, and restroom facilities. The heating, ventilation, and air conditioning equipment will be rehabilitated including the addition of approximately 50 tons of air conditioning equipment. This work will also include a new entry way with a ramp for the handicapped, and walkways to provide better access to the building. The original single story building was built in 1955 and a second floor added in 1963. Due to its central location within the Center, this project will convert specialized but obsolete and unused building space into an efficient operations center for specific administrative functions now needed by the Center. These include the Technology Utilization Office, the Safety Office, and the Public Affairs Office. Present facilities for these functions are overcrowded, poorly suited to their function, and not readily accessible.

B. Dryden Flight Research Center..... 195,000

1. Rehabilitation and Modification of Fire Protection System..... 195,000

This project provides for the rehabilitation and modification of the existing obsolete fire annunciating system at DFRC. The existing annunciating system was installed in 1952 and is inadequate. A new class "A" fire annunciating system will be connected to the existing fire alarm and detection system in 16 additional buildings at the Center. These buildings are 4801, 4802, 4803, 4806, 4807, 4808, 4809, 4810, 4820, 4821, 4823, 4825, 4826, 4827, 4830, and 4982. The complete and operable fire alarm system will consist of alarm initiating devices (manual pull boxes, smoke detectors, water flow indicators), audible alarm sounding systems (bells, horns), supervisory signal systems (water level monitors, pressure monitors, valve supervision, fire pump status monitors) and a class A reporting system. These reporting systems will constantly monitor all systems, and immediately report any off-normal or change of status to selected locations. In addition, the new system will be connected to the Edwards Air Force Base Fire

Station Central System. The Air Force at Edwards provides the fire protection service for the Center. The existing system lacks the capability to report trouble or malfunction signals. In the event of a broken wire in the loop the existing system is totally inoperable until the problem is isolated and repair is accomplished. The installation of the proposed Class "A" System would eliminate these problems and provide an improved level of fire protection for this Center.

C. Goddard Space Flight Center..... 1,760,000

1. Modification of Fire Protection System in Various Buildings..... 200,000

This project provides for upgrading the Fire Protection System of certain areas of 13 Buildings necessary to protect life and equipment. One portion of the project provides for the upgrading of the fire protection systems in Buildings 1, 5, 11, 14, 16, 18, 19, 20, 21, 22, 25, the Propulsion Test Site and the Antenna Test Range. This work includes improvements to fire water distribution systems, fire detection systems and hose cabinets. This effort is necessary to retard the spread of a potential fire and increase the safety of building evacuation. The second portion is the separation of various areas within buildings 3/14, 22 and 25 in order to contain possible fires. The modification of structures, partitions, shafts and utility compartments are necessary to reduce the spread of any fire.

2. Modification for an Applications Support Facility, Building 16W..... 450,000

This project provides for the modification of approximately 11,900 square feet (1,105.9 sq m) of space in an existing area of the Development Operations Building, Building 16W. Approximately 5,500 square feet (511.2 sq m) of this space will be modified to accommodate the Applications Information Processing Systems and will include a raised floor area for computers. The remaining area of approximately 6,400 square feet (594.7 sq m) is required for contiguous office space. This project is necessary to support the Severe Storms Research Program through the provisions of on-line, interactive image analysis, real time image analysis, access to discipline oriented on-line data base, and a computer network, thereby providing an interface between outsiders and NASA Centers. This capability does not currently exist at GSFC and is required to carry out the Severe Storm Research Program.

3. Rehabilitation of Cooling Tower "B"..... 190,000

This project provides for the rehabilitation of Cooling Tower "B" and includes the refurbishment of steel framework supporting the condenser water pumps, hoist, and the associated sprinkler system. This rehabilitation is necessary to maintain the integrity of GSFC's central air conditioning system that provides environmental control to several data centers and related office areas. Cooling Tower "B" is approximately ten years old and has deteriorated excessively with a corresponding reduction of effectiveness.

4. Rehabilitation of Roofs on the Central Flight Control/Range Operations Building 3 and the Space Science Laboratory, Building 6..... 185,000

This project provides for the rehabilitation of approximately 80,000 square feet (7,434 sq m) of roof area on the Central Flight Control and Range Operations Building, Building 3 and the Space Sciences Laboratory, Building 6. This work includes the removal of the present gravel, resaturation of the felt and the application of new gravel. Also, the resealing of approximately 2,000 linear feet (613.5 m) of gravel stops and flashings will be accomplished. The age of the roofs (15 years old) and the effects of "ponding" after heavy rains have caused loosening of the gravel and cracking of the seal. Resaturation and gravel replacement are necessary to prevent accelerated deterioration of the roof and possible internal water damage to equipment and materials in these buildings.

5. Modifications for Utility Control System..... 180,000

This project modifies the existing computerized control of GSFC's Utility Control System by extending the system's coverage to three additional facilities. The proposed modifications will optimize the efficiency of operation of the central heating and cooling plant and includes an economizer cycle that will measure the energy added on the basis of free and return air enthalpies rather than temperature. Additionally, instruments will be added to three Laboratory Buildings, Nos. 27, 88, and 300, which will be connected to the system.

6. Modification Heating, Ventilating, and Air Conditioning Systems in Various Buildings..... 210,000

This project provides for the modification to the heating, ventilating and air conditioning systems in Buildings 1, 2, 3/14, 4, 5, 6, 7, 8, 10/15, 11, 12, 14, 16, 18, 19, 20, 21, 22, 23, and 26. The work includes the conversion of the air conditioning units to accept mixed air and the installation of variable volume dampers. These modifications will permit recirculation of the heated interior air, thereby minimizing the use of 100 percent outside air and the utilization of interior air for building ventilation when outside air temperature and humidity are not favorable. This would allow for the variance in the heating/cooling input to the conditioned air eliminating wasteful reheat and recool of air necessary to maintain proper interior temperature. The installation of the variable volume dampers will permit the regulation of air flow according to seasonal conditions as well as personnel occupancy of the building.

7. Modifications to the Central Power Plant, Building 24..... 345,000

This project provides for the installation of boiler feed water preheaters to five boilers and the installation of six blow down heat exchangers. The preheaters and heat exchangers will permit the utilization of energy contained in the boiler exhaust and blow down water to preheat boiler feed water, thus increasing the boiler efficiency.

D. Jet Propulsion Laboratory..... 1,990,000

1. Modification for a Central Cooling Tower System..... 460,000

This project provides for the replacement of seven existing cooling towers with a single cooling tower system. This work includes two cells and associated circulating pumps and a basin that will have provisions for one additional cell for future requirements. New underground piping, excavation work and water treatment controls also are necessary. The existing cooling tower systems serving 13 buildings are 25 years old and are badly deteriorated. Replacement of this system is cost effective and results in a cost reduction in energy consumption and maintenance.

2. Modification to Fire Protection Systems in Various Buildings..... 125,000

This project provides for the upgrading of those areas necessary to protect life and equipment. Specifically, this project proposes the installation of fire alarms, smoke detectors and automatic fire sprinklers in the Structural Test Laboratory, Building 18, and the installation of Automatic Fire Sprinklers in the Pump House, Building 159 and the Engineering Office Building 138. The building detection and alarm systems provide personnel warning for a timely evacuation. The sprinkler systems will be utilized to protect high value research equipment and spacecraft components.

3. Modifications of Electrical Feeders..... 250,000

This project provides for the modification of the existing overhead 17 kV distribution system, serving the eastern portion of the Laboratory with a new underground dual radial distribution system. The work consists of installing connecting services from Transformer Banks 11 and 63 to the Structural Test Laboratory, Building 18, and the Compressor Building, Building 58. Also included is the installation of a new substation in Building 111 and new switchgear, ductbanks, and conductors at Substations D and E. The existing overhead distribution system was installed approximately 30 years ago and has been modified, relocated and extended as JPL expanded. The overhead line has been a source of continuing interruption due to wind and/or lightning damage.

4. Modifications for Energy Conservation..... 270,000

This project proposes to modify the heating, ventilating and air conditioning (HVAC) systems in Buildings 125, 144, 168, 169, 202, 238, 251, and 264 for energy conservation purposes. In addition to modifying these systems, economizer systems will be installed. Demand oriented control systems will be provided for double duct or multizone air handling units in Buildings 125, 168, 169, 238, 251, and 264 where they are beneficial. Time clocks will also be used until the Utility Control System is installed and operating.

5. Modifications for Utility Control System..... 450,000

This project provides modifications to existing utility systems for remotely controlling, measuring values, and determining the status of temperatures, pressures, humidities and electrical energy consumption in various mechanical rooms. The work includes the installation of multiplex equipment, building control panels and system control and monitoring points for approximately 100 buildings. This project is required to provide the necessary interface for remotely controlling each respective heating, ventilating and air conditioning system. Presently, roving patrols are utilized to monitor and repair the individual building systems on the Laboratory. The modified control system will provide immediate notification of equipment malfunctions, thereby minimizing unscheduled shutdowns and preventing potential damage to equipment requiring close environmental control.

6. Modifications for Heating, Ventilating and Air Conditioning Systems in the Physical Science Laboratory, Building 183..... 435,000

This project provides for the rehabilitation of the existing heating, ventilating and air conditioning system. It includes the installation of return air ducts and outside air ducts to economize the air handling units on the second, third, eighth and ninth floors. It also provides for the installation of new steam and chilled water valves and controls, damper upgrading and controls on all air handling units. Replacement of one of the steam absorption air conditioning units with an electric motor driven chiller and installation of a new cooling tower are proposed. Electrical modifications will be made to accommodate the above work. A new pneumatic control system, hot and cold deck reset controls and zone thermostats will be installed. Time clocks will be installed together with connections for the Utility Control System provided under separate funding.

E. Johnson Space Center..... 1,605,000

1. Modification to Fire Protection Systems in Various Buildings..... 130,000

This project provides for the installation of automatic sprinkler protection in five storage areas at Johnson Space Center to comply with fire safety codes. NASA policy and various fire protection codes require fire suppression systems for areas used to store flammable and other hazardous materials. Buildings 380, (Hazardous Material Storage Facility), 381, (Gas Cylinder Storage Facility), and 382, (Drum Storage Facility), are used for this purpose. Room 106 in Building 420 (Support Shop and Warehouse) is used to store computer tapes in plastic canisters on open metal racks. They are highly combustible materials that would produce an intense fire if ignited. Building 421 (Mission Support Warehouse) is a warehouse which has a sprinkler system; however, protection is not provided under the mezzanine where combustible materials are stored. This project will thus provide necessary fire protection in these buildings. New automatic deluge sprinkler systems will be installed in Buildings 380, 381 and 382; the existing wet pipe sprinkler system in Building 420 will be extended to include Room 106; and an automatic wet pipe sprinkler will be installed under the mezzanine in Building 421.

2. Rehabilitation of Electrical Distribution System..... 155,000

This project consists of replacing deteriorated electrical cables at Johnson Space Center. It provides for replacing deteriorated 15-kV primary electrical underground feeder cable in three locations: (1) feeder cable 1-6 from the substation to the tunnel and from manhole 11 to Building 49, (2) feeder cable 1-9 from the substation to the tunnel, and (3) feeder cable 1-12 from the substation to Buildings 32 and 36. The existing underground electrical cable has been in continuous service for the past 11 years. The insulation has deteriorated during this time, and several failures have occurred. These faults have been corrected as they occurred with a large amount of unscheduled maintenance, but the repairs have not been sufficient to prevent extensive future failures. Replacing the cable with cable that has improved insulation will ensure an adequate, reliable source of power to these facilities; it will also reduce the likelihood of serious program impacts resulting from primary power losses. This project represents the amount of cable replacement which can be implemented this year.

3. Modifications of Mission Simulation/Training Facility, Building 5..... 300,000

This project provides for various modifications to Building 5 to accommodate the installation of the Spacelab Support Module Simulator (SSMS) and its associated computer complex and laboratory equipment. Modifications will also provide office space and a maintenance area. Work includes modifying partitions and computer floor panels; installing a fire suppression system; and modifying the lights, electrical power and air conditioning. The SSMS is a major simulator that will support crew and flight control personnel training for Spacelab payloads. Development of reliable operational and flight technique procedures depends on the proper installation of this simulator.

4. Rehabilitation of Aircraft Aprons, Ellington AFB..... 210,000

This project continues rehabilitation of aircraft aprons at Ellington AFB. It provides for replacing approximately 1,500 square yards (1,254 sq m) of concrete pavement and base material in the existing aircraft mooring apron east of Hangar 276, and installing 42,500 square feet (3,948 sq m) of asphaltic concrete surface overlay on the access apron between Hangars 135 and 276. These aprons, which were constructed in 1942, have cracked and settled in many places because of the failure of the base material. Moving aircraft across the cracks and sunken areas results in excessive strain on the aircraft and causes increased maintenance that would not be required if the aprons were repaired. Replacing the base material and pavement in the deteriorated areas, sealing the joints, and applying an asphaltic concrete overlay will ensure safer and more economical operations.

5. Rehabilitation of Various Facilities, WSTF..... 110,000

This project provides for rehabilitation of a water well control cable, a propellant neutralization pond, and the access road at the White Sands Test Facility. The water well control cable that runs from

the water control console in Building 112 to booster station no. 2, and from there approximately five miles (8.0 km) to water well "J", will be replaced. The existing cable, which has been in service for 11 years, is unreliable because of repeated circuit failures brought about by insulation faults and structural weaknesses. The second part of this project involves relining propellant neutralization pond 351A with 1,780 square yards (1,488 sq m) of reinforced concrete to a depth of 4 inches (10.2 cm). Approximately 1,500 feet (457 m) of propellant-inert construction joints are also required. The existing lining in the pond is spalled and cracked so badly that propellants can seep into the surrounding soil. Relining the pond is necessary for environmental protection. The third part of this project is to apply a double surface treatment to approximately 21,000 square yards (17,560 sq m) of the site access road from U.S. 70 to the "100" Project Control Area. The access road was constructed of 2-inch (5.1 cm) asphaltic concrete during 1964 and 1965; it was last sealed in early 1971. Normal use of the road has degraded the surface, with pot holes and spalling at the shoulders. A new seal coat is required on the road because of this deterioration and the development of many surface cracks, which allow water to penetrate and weaken the road bed. Restoring the surface will increase the life of the pavement and preclude extensive base course repairs in the future.

6. Modifications to Chilled Water Systems in Various Buildings..... 465,000

This project provides for various modifications to chilled water systems in and between several buildings at Johnson Space Center. The work includes: (1) modifying chilled water pumps, distribution piping and valves; (2) installing approximately 600 feet (182.9 m) of insulated chilled water lines and associated valves and components; (3) connecting various system components with the remote monitoring and control system in the central heating and cooling plant; (4) providing equipment to supply conditioned air to several relocated computer units in the Mission Control Center, Building 30; and (5) installing separate small chilled water pumps, water piping, valves, insulation controls and auxiliary equipment in six buildings. This project will achieve more efficient energy usage at JSC by using all of the cooling capacity available in the chilled water before returning it to the central chillers; by connecting chillers of varying capacities to provide the flexibility to match chiller capacity and chilled water demand more closely; by improving the monitoring and control of the chillers and distribution system; by using unblended chilled water more efficiently through the installation of new computer-controlled air conditioning equipment in Building 30; by installing additional chilled water pumps in key buildings so that the large central pumps can be turned off during low use periods; and by achieving greater efficiency in the configuration of the chilled water system. These modifications will be offset by the total energy and manpower savings realized.

7. Modifications to Clean Rooms, Various Buildings..... 235,000

This project will reduce the design air flow in clean rooms in eight buildings at Johnson Space Center by about 25 percent when the clean rooms are unoccupied (approximately 70 percent of the time).

This reduction will be accomplished by adjusting inlet vanes and fan speed, partially shutting down the filter module fans, modifying control systems, and adding timers and dampers to maintain proper system pressurization. Reducing the design flow during times when the clean rooms are unoccupied will reduce fan power, and the cooling and reheat energy required to maintain the required level of air conditioning. No sacrifice in cleanliness will result. Approximately 90 billion BTU's of energy can be saved. The modifications proposed by this project will achieve energy savings which will offset the cost of the project.

F. Kennedy Space Center..... 1,185,000

1. Rehabilitation of Air Conditioning Systems in Various Buildings, KSC and CCAFS..... 400,000

This project provides for rehabilitating or replacing air conditioning system components in two buildings at Kennedy Space Center (KSC) and four buildings at Cape Canaveral Air Force Station (CCAFS). The NASA buildings involved are as follows:

Building	Function	Location
M6-138	Communication Distribution Switching Center	KSC
M6-486	Base Support Building	KSC
1726	Hangar S	CCAFS
55005	Laboratory and Engineering Building	CCAFS
67900	Spin Test Building	CCAFS
21900H	Operational Support Building	CCAFS

Work includes replacing air-cooled condensers and condensing units, pumps, air-handling units and chillers; and modifying associated supports, piping, insulation and electrical connections. The facilities at CCAFS are currently used to process payloads for expendable vehicle launches; when the shuttle begins regular service, they will be used for off-line shuttle payload processing. Facilities at KSC support day-to-day operations for all programs; one of the buildings where air conditioning system modifications are proposed, the Communications Distribution Switching Center, Building M6-138, is the main communications facility for the entire Center. Accrued maintenance, year-round operation and the high salt content of the air have resulted in the deterioration of the air conditioning systems in these facilities, which are an average of 15 years old. Rehabilitating the systems will decrease the amount of electrical energy required to operate them and increase compressor life and efficiency.

2. Rehabilitation of Roofs on Various Buildings, KSC and CCAFS..... 260,000

This project provides for repairing or replacing roofs on six buildings at Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS) as follows:

Building	Function	Location	Area Involved, $Ft^2 (M^2)$
M6-688	Auto Maintenance Facility	KSC	12,700 (1,180)
M6-695	Fire Station	KSC	10,000 (930)
M7-351	Auditorium and Training Facility	KSC	9,700 (900)
60505	Storage Building L	CCAFS	5,500 (510)
1726	Hangar S	CCAFS	10,800 (1,000)
3-49635	Dispensary	CCAFS	17,600 (1,640)

The project includes: (1) removing loose gravel and preparing it for reuse; (2) examining damaged felts, bare or soft spots, and blisters, and removing or replacing them as needed; (3) patching, repairing or replacing insulation board, flashings, gravel stops and gutters as needed; (4) applying a continuous waterproof membrane; and (5) replacing the gravel. These buildings are all scheduled to be used for continued support of present and future KSC programs. No major roof rehabilitation has been undertaken in the past 10 years. The existing roofs have deteriorated to the extent that rehabilitation is necessary to protect equipment and material from leakage and possible water damage. Spot repairs have proved costly and unsuccessful. Rehabilitating the roofs should extend the service life approximately 10 years.

3. Rehabilitation of Fire Water System, Launch Complex 36..... 190,000

This project provides for the cleaning and relining with cement approximately 3,600 feet (1,097.3 m) of 20-inch-diameter (50.8 cm) process water pipe from the auxiliary valve pit to launch pads 36A and 36B at Cape Canaveral Air Force Station. The water system, which is 15 years old and is expected to remain in use through 1981, supplies fire water to the launch pads for emergency use and during Atlas/Centaur launches. During the past 2 years, several system failures have occurred as the result of corrosive and erosive action of the water inside and outside the pipe. The project involves cleaning the interior to remove loose scale, chemical deposits, and accumulated dirt and debris; completely inspecting the interior of the pipe and spot-checking the exterior to determine weak areas and whether a cathodic protection system is necessary; and providing the interior with a new cement mortar lining. Rehabilitating the pipe will enhance launch safety by enhancing reliability in support of launch activities.

4. Rehabilitation of Water Systems in Operations and Checkout Building M7-355..... 110,000

Insulation on existing high temperature hot water, secondary hot water and chilled water lines in the Operations and Checkout (O&C) Building M7-355, have deteriorated to the point where its thermal efficiency has been impaired, and corrosion of the lines and energy consumption increased. The insulating characteristics have changed because the combined weight of the pipe and the water has compressed and

deformed the insulation. Additionally, water from pipe fittings and valves has leaked onto the lines and corroded them. All of these problems contribute to inefficient energy usage. Work to be performed includes removing the existing insulation, cleaning the pipe surface, repairing leaks as necessary, and reinsulating the lines.

Rehabilitating the insulation will decrease energy consumption and operations and maintenance costs, and increase the life of the pipe. If replacing the insulation is delayed, continued corrosion will necessitate replacing the lines and fittings later, at a higher cost. Since this building will be actively involved with the processing of shuttle payloads, the project should be undertaken now to avoid an adverse impact during the operational activities.

5. Rehabilitation of High Temperature Hot Water System, KSC Industrial Area..... 225,000

This project provides for replacing 1,480 feet (451 m) of underground high temperature hot water lines ranging from 1 to 6 inches (2.5 cm to 15.2 cm) in diameter located in the main distribution system and secondary feeder lines to three buildings located in the industrial area. The insulation on the existing lines has deteriorated to the point where its thermal efficiency has been impaired, and corrosion of the lines and energy consumption increased. It is necessary to repair these lines at this time to prevent further deterioration and corrosion which will cause failure of systems and serious interruptions to critical operations in the industrial area.

G. Langley Research Center..... 1,795,000

1. Modification to the 0.3-Meter Transonic Tunnel, Building 1242..... 485,000

This project will provide for the modification to the 0.3-Meter (13.1 inches) Transonic Tunnel, Building 1242. This work will include the installation of a new 13-inch (33 cm) square two-dimensional test section consisting of a computer driven self streamlining wall system. The computer will use static wall surface pressure measurements obtained from pressure sensors, wall position measurements from displacement transducers, and a unique "pressure matching" scheme to determine "free air streamlines" shapes. The test section floor and ceiling will be driven to these shapes by use of a computer controlled jack system. A "free air streamline" is the path a particle of air would take around an airfoil in the absence of tunnel walls. The computer will be a general purpose minicomputer suitable for process control. This project is an integral step towards fulfilling the objective of developing systems and methods that minimize or eliminate tunnel wall interference. The new two-dimensional test section will allow testing of models approximately twice as large as those for the present facility and thereby doubling the present Reynolds number capability as well as providing "free air" conditions. This project will provide an important tool for the Airfoil Research Program.

2. Rehabilitation of 2.3kV Electrical Power Distribution System..... 310,000

This project provides for the rehabilitation of certain elements of the Center's electrical power distribution system at the 2,300-volt level to nine research facilities. This work will include the replacement of approximately 1,000 feet (305 m) of aerial line with direct buried cable. In addition, approximately 3,500 feet (1,070 m) of primary feeder cables will be installed in the existing underground duct system network. All cable will be lead sheath jacketed with an overall neoprene protective cover to counteract electrolytic corrosion. Three obsolete station services will be replaced with unitized metal-clad substations to be properly coordinated with the increased available primary bus short-circuit system values to permit safe interruption of faults. The electrical distribution system at the Center provides utilization services at 208/120 volts for lighting and small power loads and at 480 volts for medium power loads at the various facilities. These services are obtained by feeder cables from primary substations delivering power at 2,300 volts to the facility located building substations where it is further stepped down to the above utilization voltages. Many of these services have been in use for more than thirty years. The present equipment is obsolete and maintenance and repairs are difficult as replacement parts are no longer available from the original manufacturers. The deterioration is such that rehabilitation is now necessary to restore the equipment to a safe level of operation.

3. Modifications to Aircraft Noise Reduction Laboratory, Building 1208..... 340,000

This project provides for modifications to expand the research capability and improve the operational efficiency of the Aircraft Noise Reduction Laboratory, Building 1208. This work will include: (1) installation of approximately 3,500 sq ft (325 sq m) of acoustical paneling to the ceiling and walls of the Exterior Effects Room and adjacent areas, (2) modifications to the Physics Area to provide an acoustic wedge lined room approximately 14 ft by 10 ft by 10 ft (4.26 m x 3.05 m x 3.05 m), and (3) installation of remote monitoring and control systems to analyze the operating conditions of the Research Air Supply Systems. The acoustic paneling is required to reduce the reverberation time and standing waves within the test room for the low noise frequencies associated with some of the advanced aircraft and helicopter configurations. Additionally, it will minimize the interference from unwanted outside noises during demonstrations, subjective testing, and assessments of sub- and supersonic aircraft noises. The wedged lined room is needed to provide a free field environment for such human factors research as speech interference and the annoyance aspects of impulsive noise sources (helicopter blade slap). This room is also required for the precision calibration of acoustical instrumentation for which no such facility presently exists at LaRC. The research air supply monitoring and control system is needed to improve the efficiency of operation of the system and will provide for rapid failure analysis. When operational, this system is expected to reduce the need of facility operating manpower by an equivalent of 1.5 manyears annually.

4. Rehabilitation of Low Turbulence Pressure Tunnel, Building 582-A..... 410,000

This project provides for the rehabilitation of the Low Turbulence Pressure Tunnel, Building 582-A. This will include the rehabilitation by replacement of the existing deteriorated 20 by 20-foot (6.1 by 6.1 m) tunnel heat exchanger and the associated piping, controls and antiturbulence screens. The tunnel heat exchanger consists of 11 finned tube elements 22 inches (.56 m) wide and 20 feet (6.1 m) high. This work also includes the installation of a small package steam heat exchanger which will be connected to the tunnel heat exchanger system to provide a constant temperature and Reynolds number during periods of aerodynamic testing under a given set of operating parameters. In addition, a turning motor will be installed to rotate the main drive fan to circulate warm, low velocity air to warm the tunnel shell metal. The recently completed facility recertification program has limited the tunnel's cold weather operations to maximum conditions only when the tunnel shell metal temperature is 60°F (15°C) or higher. To maintain most favorable operating conditions in cold weather the package heat exchanger will supply hot water to the tunnel heat exchanger. Energy savings for the tunnel shell temperature control by this method will provide a cost payback for this equipment in about five years. Rehabilitation of this facility is essential to restore the tunnel to its full operational low turbulence capacity as well as removing cold weather operating limitations imposed by the recertification program.

5. Modification of H.V.A.C. System in Flight Instrument Laboratory Building 1202, and Structural Materials Research Laboratory Building 1293..... 250,000

This project provides for the modification of the heating, ventilating and air conditioning (HVAC) system in two buildings for a more cost effective energy installation. These modifications will include correcting systems that simultaneously heat and cool the same space at the same time (minimize reheat), retrofit the ones now using large quantities of outside makeup air by effectively blending outside air with return air, and improving operation of the controls. Facility 1202 requires special treatment to permit a weekend shut-down since it houses the Visitor Center of 8,000 sq ft (743 sq m) of the total 78,300 sq ft (7,274 sq m). To permit the two existing units to be shut down during periods of non-utilization a new direct expansion air handling unit with remote condensing unit will be provided. Facility 1293 will also require a package single zone unit to provide for the chemical laboratories of approximately 1,000 sq ft (93 sq m). The existing HVAC systems of these buildings were installed at minimum initial cost, and now operate in an inefficient energy mode. An assessment of the improvements to these systems have been made in order to realize improved energy conservation and to provide better working conditions. These modifications are cost effective and will save over 900,000 KWH of electrical power and over 130,000 gallons (492 kl) of fuel oil a year.

H. Lewis Research Center 2,270,000

1. Rehabilitation and Modification of Data Cabling System 285,000

This project provides for the rehabilitation and modification of the data cabling system to improve the transmission of research data. This work will include the installation of dedicated data cables between 37 test facilities in 17 buildings and the central minicomputer facility in the Computer Center, Building 86. This project will provide for the installation of 300 pair of cables in each of three different areas of the Center, utilizing existing pole lines, manholes and ducts where possible. Some realignment of existing cables will be required to optimize the utilization of existing ducts. Some additional cable ducts will be installed where realignment is not possible. The installation will include a central patch board to allow selection of cable pairs for more efficient and versatile use of wire and computer equipment. The installation of dedicated data cable is necessary to create a central minicomputer facility which will provide on-line service to test facilities in all parts of the center. This facility will be capable of receiving and transmitting data at ten times the present rate with this installation. This will improve the speed with which experiments can be conducted, improve the quality of the data, and reduce the manpower needed to conduct an experiment by centralizing the programming and support of on-line minicomputer service. This dedicated data cabling system will provide a direct hard wired link between the various research facilities and a central minicomputer facility. The installation of this cabling system is necessary for the LeRC to improve the data analysis communications system to exploit the capabilities of the computer tool for the development of advanced aeronautical propulsion systems.

2. Modification of Central Steam Plant, Building 12 465,000

This project provides for the modification of the steam generating system in the Central Steam Plant, Building 12, to improve the overall operating efficiency. The Central Steam Plant generates steam for heating systems and research process systems. The plant includes four operating boilers, two are fired by coal and two are fired by natural gas which has a fuel oil backup. The work will include: (1) the installation of induced draft fans and oxygen analyzers and, (2) the upgrading of the existing combustion control system of the two coal fired boilers to improve operating efficiency. The existing mechanical fly ash systems of these boilers will also be improved to reduce the amount of particulate emissions to the atmosphere. An economizer will be installed in the stack of one of the gas/oil boilers to preheat boiler feedwater and thereby improve the thermal efficiency. This work will include some related modifications to the electrical power system in the building. These improvements to the Central Steam Plant are necessary to provide adequate emission standards. In addition, with all boilers operating to their optimum efficiency these modifications will result in fuel savings of approximately $30,000 a year. These modifications to the Central Steam Plant are needed at this time to reduce the particulate emissions, improve the operational efficiency to conserve energy in order to provide improved level of steam service.

3. Modification to the Altitude Exhaust System in Engine Research Complex, Buildings 5, 23, 37, and 38..... 325,000

This project will provide for the modification to the altitude exhaust system for the Engine Research Buildings No. 5, 23, 37 and 38 to protect the system from over pressurization. The work will consist of the installation of twelve additional pressure relief devices varying from 12 inches (30.5 cm) to 30 inches (76 cm) diameter in the existing altitude exhaust piping. The altitude exhaust system is used to simulate low pressure conditions that would be encountered at high altitudes. Combustion air and products of combustion from research tests of aircraft engines flow from the test cells through the system to exhausters where it is discharged to the atmosphere. Included in this work is the installation of approximately 60 feet (18.3 m) of piping from each relief device to a safe point of discharge to the atmosphere. In addition, electrical signal equipment will be installed at each new pressure relief device to transmit a signal to the Central Control Room in the ERB to shutdown the combustion air compressors and sound an alarm. A recent hazard analysis conducted on the altitude exhaust piping distribution system has identified the need for this positive means of overpressure protection. Existing portions of the system can be overpressurized by combustion air from the test cells if the research equipment or valves malfunction or are not operated correctly. This modification to the altitude exhaust pressure system is needed at this time to eliminate a potentially hazardous condition.

4. Rehabilitation of Liquid Nitrogen Distribution Piping, Electric Propulsion Research Building 16..... 275,000

This project provides for the rehabilitation of the liquid nitrogen distribution piping of the Electric Propulsion Research Building 16. This work includes the replacement of the existing pipe with the installation of approximately 1,670 feet (544 m) of vacuum jacketed stainless steel pipe ranging in size from one inch (2.5 cm) to three inches (7.6 cm). The existing system routing valves will be replaced with vacuum jacketed valves. This liquid nitrogen distribution system is used to support research in fusion related and ion beam research and development projects for spacecraft propulsion. The requirement for liquid nitrogen is dictated by the need to simulate the temperature of outer space where ion engines will function.

Liquid nitrogen is also required to reduce the temperature of the electrical conductors for fusion research projects. The insulation of the existing copper pipe is cracked and in poor condition and is in need of replacement. The new vacuum jacketed piping will drastically reduce evaporation losses of liquid nitrogen in the existing distribution system. Based on the present cost of liquid nitrogen, the savings due to the greater insulating value of the vacuum jacketed piping are estimated to be about $170,000 per year.

5. Rehabilitation and Modification of Technical Support Building 15..... 470,000

This project provides for the rehabilitation and modification of 15,000 square feet (1,393.5 sq m) of the northeast wing of the Technical Support Building 15. The northeast wing of Building 15 was built in three stages between 1945 and 1963 and has been the main cafeteria for the Center most of this period. LeRC is remote from public eating facilities and requires an efficient cafeteria for essential feeding of the 3,000 people located at the Center. This work includes the replacing of roofing, ceilings, flooring, and interior wall finishes in the cafeteria. The existing heating, ventilating, and air conditioning systems will be replaced with the installation of three new air handling units with chilled water cooling and steam heating coils. The work also includes installation of adequate fire protection equipment and new rest room, plumbing, electrical, lighting, and food processing equipment. The main cafeteria has been in service over 24 years and the facility is obsolete and is in need of repair. The food processing equipment has exceeded its life expectancy and needs to be replaced. The rehabilitation of the northeast wing of Building 15 will improve the existing inadequate conditions and provide a modern food preparation and service area for the Center.

6. Modification of Monitoring Systems for PSL Equipment Building No. 64..... 450,000

This project provides for the modification of the 20-year-old manual monitoring system for the combustion air system in the Propulsion System Laboratory Equipment Building 64. This work will include the installation of about 400 instrumentation channels to monitor the combustion air system parameters such as flows, temperatures, and pressures. Instrumentation sensors and related equipment will be installed on the air system motors, heaters, dryers and other auxiliary mechanical and electrical subsystems. The complete instrumentation system will be controlled by a new dedicated minicomputer to be installed in Building 64.

These improvements will give the Lewis Research Center a diagnostic and status monitoring control of the air system that will greatly improve the operating and operator efficiency, and provide equipment protection against malfunctions in the PSL Equipment Building. The instrumentation included with this project will reduce the loss and leakage of combustion air by supplying only the needed pressure and quantity as required for the research load demand. By eliminating these losses it is estimated that an annual savings of electrical energy of over 2,300,000 KWH will be achieved. These modifications will improve operating efficiency and safety, provide energy and manpower savings, and will include the basic equipment for a complete and modernized monitoring system.

I. Marshall Space Flight Center..... 1,550,000

1. Rehabilitation of Office and Engineering Building 4610 East..... 325,000

This project, which includes all of the work which can be done this year in the total rehabilitation of Building 4610 East, provides for converting the air conditioning systems to variable air volume systems, modifying seven air handling units, changing the air conditioning control system, balancing the air distribution system, and reducing the lighting level in 90,000 square feet (8,361 sq m) in the east wing of the building. These changes are all designed to conserve energy. The building consists primarily of office space used to directly support continuing and future NASA programs, including space shuttle and spacelab. The existing heating, ventilating and air conditioning systems in the east wing of Building 4610 use more energy than required because they are designed to maintain constant conditions during all cooling load changes. The proposed variable air volume systems will use a varying amount of supply air to prevent overcooling, thus minimizing the use of steam for reheat. The existing air handling units can be modified to accommodate the new systems, thus realizing another 6 to 7 years of service life. By modifying the lighting system to reduce lighting levels (conforming with new NASA illumination standards), significant amounts of energy can be saved.

2. Rehabilitation of Structures and Mechanics Laboratory, Building 4619 West..... 435,000

This project provides for interior and exterior rehabilitation of approximately 64,000 square feet (5,945 sq m) in the west wing of Building 4619. The work includes restoring badly deteriorated steam systems, replacing the existing air conditioning systems with variable air volume systems, replacing pendant-type lighting fixtures and providing localized switching, insulating exterior walls in the high bay, and installing double glazed windows. This 17-year-old building was heavily used during the Apollo and Skylab programs. As a result, building systems have deteriorated at a faster than average rate. Systems frequently fail, damaging installed equipment and placing a heavy burden on the limited maintenance force. The existing heating, ventilating and air conditioning systems waste energy; the more efficient variable air volume systems proposed to replace them use economizer cycles to save energy. The lighting system design does not meet the latest NASA illumination standards. Modifying the lighting system, replacing lights as needed and providing localized switching will permit optimum lighting at reduced energy consumption. Insulating the corrugated cement asbestos siding in the high bay and installing double glazed windows will also result in energy savings. Rehabilitating the building now is essential to continue dependable support of test operations for continuing NASA programs; delaying the rehabilitation will result in increased energy consumption, and maintenance and repair costs.

3. Rehabilitation of Laboratory and Office Building 4487, "B" Wing West and "C" Wing West..... 445,000

This project provides for rehabilitating approximately 45,000 square feet (4,180 sq m) in "B" wing west and "C" wing west in Building 4487; which represents the building rehabilitation work attainable this year. The work includes replacing obsolete or overloaded air conditioning units, air handlers and chillers;

upgrading electrical distribution systems to provide adequate circuits and circuit breakers; correcting lighting levels; providing individual room lighting control; and repairing interior and exterior surfaces as necessary. Building 4487 was originally constructed in the 1950's. Normal deterioration over the past 20 years has increased energy consumption, maintenance costs and downtime on obsolete building systems. Laboratories housed in the facility are essential to Marshall's mission for the design, development, test and evaluation of electronic devices; and for the packaging of flight electronic equipment. Additionally, they support applied research for the Space Shuttle program and for advanced development for the Spacelab, Interim Upper Stage and Space Tug projects. Rehabilitating the building will preserve and enhance its capabilities, extend its useful life, and ensure building system reliability. It will reduce maintenance costs and energy consumption, and provide better laboratory support for NASA programs. Delaying the project will result in continued high energy use and maintenance costs, and increased rehabilitation costs.

4. Modifications of Engineering and Development Laboratory, Building 4708..... 345,000

This project provides automatic sprinkler systems to protect computers, development simulators, electronic research equipment and highly specialized test equipment in 118,000 square feet (10,962 sq m) of Building 4708. Equipment to be protected includes one-of-a-kind, long lead items which, if damaged by fire, would cause unacceptable delays in vital program missions. The equipment for which fire protection is proposed and the facility in which it is housed are valued at $47,000,000. At the time this equipment was installed, agreement on the use of water as a fire extinguishing medium had not been reached. Use of Halon systems is prohibitively expensive. However, there is now agreement between users and safety personnel that the loss by water damage would be less severe than damage as a result from fire. This project will provide reasonable fire prevention and protection safeguards to meet the minimum requirements of Federal Fire Manual RP-1, National Fire Protection Association codes, OSHA standards or NASA recommendations for the protection of life and essential electronic equipment.

J. Michoud Assembly Facility..... 280,000

1. Modifications to Manufacturing Building 103..... 110,000

This project provides for installing platforms, walkways, handrails and ladders to provide access to the main stop valves and control valves in the roof trusses of Building 103 so that operations and maintenance personnel will have a safer working environment. It also provides for reworking or replacing fume abatement equipment to control stack emissions. Presently, there are no permanent platforms, walkways with handrails or caged ladders providing access to the main stop valves or control valves in the steam, condensate, chilled water and plant air systems in Building 103. Access to these valves, which are located 35 to 40 feet (10.7 to 12.2 m) above floor level, is provided by temporary scaffolds. Permanent structures, properly designed, must be installed to provide a safe working environment for personnel. Fume

abatement equipment over cleaning facilities, where toxic chemicals are used, must be modified or replaced so that stack emissions will be controlled within acceptable environmental limits. The Manufacturing Building 103 houses several contractors performing activities in support of the Army tank development, Navy surface effect ship, and NASA space shuttle external tank development programs.

2. Rehabilitation and Modifications of Maintenance Shops, Building 301..... 170,000

The maintenance shops, Building 301 houses all craft shops and in support of all tenant activities at MAF. Building 301, which consists of 60,022 square feet (5,576 sq m), contains maintenance shops used for general support of operations at Michoud Assembly Facility. Current working conditions do not comply with applicable safety standards. This project provides for rehabilitation of the ventilation system, modification of work areas for asbestos and fiberglass insulation workers, providing safety cages around ladders, rehabilitating the heating system, restoring three sliding doors, installing new roof gutters and downspouts, modifying the monorail system over the shops to handle heavy equipment and materials, rehabilitating deteriorated restrooms, and rearranging the shop area to improve the working layout. These modifications will upgrade the facility to comply with applicable safety standards and provide an improved working environment.

K. National Space Technology Laboratories..... 160,000

1. Rehabilitation of North Access Road..... 160,000

This project provides for the rehabilitation of approximately two miles (3.2 km) of the 24-foot-wide (7.3 m) north access road to NSTL. Both lateral and longitudinal cracks have developed in the surface. These cracks permit water to penetrate the base, which weakens the base and results in subsequent extensive damage. The project includes removing and replacing sections of deteriorated pavement, spot patching as necessary, applying a seal coat and a wear coat, and restripping the finished pavement. Implementing this project now will preclude more costly repairs at a later date.

L. Wallops Flight Center..... 1,425,000

1. Rehabilitation of Airfield Facilities..... 410,000

This project provides for the replacement of a six-inch course and a four-inch asphaltic concrete wearing surface on the center 50 feet (15.33 m) of the south portion of Taxiway 4/22, 2,100 feet (640 m). Other provisions include repairing the rigid pavement of the north end of Taxiway 4/22, painting and markings on Runway 4/22 and construction of three fueling pits in the D-1 area with connection fuel lines from fuel storage area. The flexible portion of this taxiway is currently beyond economic maintenance capability

and must be upgraded to provide access to Hangar N-159. The rigid pavement of the north end of Taxiway 4/22 requires repairs to prevent further deterioration. The fueling pits will improve fueling operations and will reduce the need for mobile fueling units. Increased airfield programs, such as Terminal Configured Vehicle, Radar Systems Research Aircraft, Remotely Operated Multiple Array Acoustics Range, and Vertical Take-Off and Landing Automatic Landing Technique and the activation of Hangar N-159 require the upgrading of Taxiway 4/22.

2. Rehabilitation of Electrical Distribution System..... 315,000

This project provides for the rehabilitation of the 2,400-volt power distribution system on the Main Base to include: replacement of approximately 10,000 ft (3,050 m) of overhead lines, hardware, and poles; abandoning approximately 3,600 ft (1,100 m) of overhead lines and hardware; construction of approximately 2,000 ft (600 m) of new service; providing switching capability for load balancing and sectionalization of the system; and replacement of various distribution transformers. The existing system is approximately 30 years old and operates in an overloaded condition in some areas. The poles, hardware, and lines have deteriorated with age thereby developing into an unreliable system. The rehabilitation is required to provide reliable service and allow switching of the system to balance loads and minimize outage time.

3. Rehabilitation of Utilities System..... 290,000

This project provides for the rehabilitation of sewage collection and treatment systems, modification to domestic water collection and treatment systems and upgrading the airfield storm drainage system. This work is required to replace obsolete, worn, and marginal capacity equipment and to modify systems to provide more efficient and reliable operation.

4. Rehabilitation of Aircraft Maintenance Hangar Building D-1..... 300,000

This project provides for the rehabilitation of the Aircraft Maintenance Hangar to include the installation of 8,000 sq ft (740 sq m) of lay-in suspended ceiling with recessed flourescent lighting; removal and replacement of 8,000 sq ft (740 sq m) of flooring; replacement of the domestic water system; rehabilitation of the rest rooms in the south wing, and painting the offices, shops and hallways throughout the building. In the north wing, replace 8,000 sq ft (740 sq m) of flooring and paint the offices and hallways. The existing incandescent lighting fixtures and asbestos flooring are of the original installation of 1944. The lighting is very obsolete for an office environment and the flooring is worn and has deteriorated from past exposure and excessive water. This work is required to provide acceptable office space for the research, maintenance, and operations personnel involved in the aircraft and airfield programs conducted at WFC.

5. Modification and Rehabilitation of Scout Launch Facilities at WFC/WTR..... 110,000

At WFC: Modifications to the interior and heating, ventilating and air conditioning systems of the blockhouse, W-20, addition of a sandblasting and painting shelter to Assembly Shop Number 3 Building W-65, and increase the number of electrical conductors to the Scout Launcher. The malfunctioning environmental control system causes the trip-off of electronic power supplies from excessive heat which could result in a checkout or launch delay. Bay 6 of W-65 is presently utilized for sandblasting and painting but will become a Spacecraft Facility and must be vacated by FY 1978. This work will provide improved environmental control for the blockhouse instrumentation, an area for sandblasting and painting of Government supplied equipment and meet the requirement of future payloads for increased conductors to the blockhouse.

At WTF: Rehabilitation of the Scout Logistics Spares Building, B-988, including new environmental control, replacement of sliding and personnel access doors, replacement of plywood partitions with partitions with fire resistant material, and general refurbishment of the total interior; and the addition to the Mechanical Shop Building of a shelter for sandblasting and painting Scout Government supplied equipment; and the installation of an anchor in the floor of the Ordinance Assembly Building, B-960, for load testing Scout-handling fixtures. The existing doors and partitions of B-988 are of the original Navy construction and have deteriorated over the years. General refurbishment is needed to make B-988 habitable with replacement of the fire-hazardous plywood partitions being the most important item; sandblasting and painting shelter is necessary for the local refurbishment of motor containers, a requirement of the new operational contract.

M. Various Locations..... 1,270,000

1. Modification of 26 Meter Antenna (DSS-62), Madrid, Spain..... 450,000

This project provides for the modification of the existing 26 meter (85-ft) antenna at Madrid, Spain, to operate at both S- and X-band frequencies. It will include primarily the structural modification necessary to support a new S- and X-band microwave subsystem. This work consists of backup structure modifications and strengthening, bolted joint replacements by welding, extended foundation, air conditioning and servo line line replacement, associated installation and improved safety modifications to ladders and platforms.

These modifications are required to provide a new X-band capability as an adjunct to the existing S-band capability. The primary data mode for future planetary spacecraft commencing with the MJS missions will be X-band to achieve higher data rates and precision navigation at greater distances.

2. Modification of 26 Meter Antenna (DSS-44), Canberra, Australia..... 465,000

This project provides for the modification of the existing 26 meter (85-ft) antenna at Canberra, Australia, to operate at both S- and X-band frequencies. It will include primarily the structural modification necessary to support a new S- and X-band microwave subsystem. This work consists of backup structure modifications and strengthening, bolted joint replacement by welding, extended foundation, air conditioning and servo line replacement, associated installation and improved safety modifications to ladders and platforms.

3. Modification of Power Distribution System (DSS-62), Madrid, Spain..... 180,000

This project provides for the replacement of 480 volt distribution switchgear, increasing installed transformer capacity for Operations and Power Plant Buildings, increasing underground distribution cable capacity with applicable underground duct banks, rehabilitation of ground fault protection system, modification of distribution switchgear and modification of engine-generator control switchgear. Two existing 400 cycle motor-generated sets are to be relocated to provide space for installation of larger type switchgear.

Areas in the old power distribution system should be upgraded to meet the higher power plant generating capacity and the power distribution upgrade is required to eliminate the potential for fires which could result from inadequately rated circuit breaker short circuit interrupting capacity and ground faults, and to minimize the safety hazard to operational personnel.

4. Modification of Internal Lighting System, Madrid, Spain..... 175,000

This modification will replace incandescent lighting fixtures with radio (noise) clean fluorescent light fixtures in the Operations and Control Buildings. Fixture replacements will be made at the Madrid Deep Space Network (DSN) and Spaceflight Tracking and Data Network (STDN) stations. The work will include furnishing and installation of fluorescent light fixtures and rearrangement of wiring with ceiling modifications to suit the area of lighting.

Replacement of existing incandescent light fixtures will result in a moderate savings of electrical energy presently used with incandescent light fixtures. Fluorescent fixtures have a ten times longer life resulting in less spare parting and a decrease in labor lamp replacement. Air conditioning requirements will also be reduced due to less heat dissipation from fluorescent fixtures resulting in additional energy savings.

MISCELLANEOUS PROJECT LESS THAN $100,000 EACH	2,100,000
TOTAL	18,900,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that between $18 and $20 million per year will be required for the continuation of this facility rehabilitation and modification program.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

MINOR CONSTRUCTION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	245,000	CF 14-2
Dryden Flight Research Center	245,000	CF 14-3
Goddard Space Flight Center	250,000	CF 14-3
Jet Propulsion Laboratory	255,000	CF 14-4
Johnson Space Center	55,000	CF 14-5
Langley Research Center	470,000	CF 14-5
Lewis Research Center	660,000	CF 14-6
Marshall Space Flight Center	235,000	CF 14-8
National Space Technology Laboratories	100,000	CF 14-8
Wallops Flight Center	405,000	CF 14-9
Various Locations	2,480,000	CF 14-9
Miscellaneous Projects Less than $50,000 Each	550,000	CF 14-12
Total	5,950,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Minor Construction of New Facilities and Additions to Existing Facilities Not in Excess of $250,000 Per Project		
LOCATION: Various Locations		
		FY 1978 CoF ESTIMATE: $5,950,000
FY 1976: $5,000,000	TQ: $1,250,000	FY 1977: $2,925,000*

COGNIZANT INSTALLATIONS/LOCATION OF PROJECTS: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of the NASA Comptroller

SUMMARY PURPOSE AND SCOPE:

To provide for minor facility construction at NASA field installations and at Government-owned industrial plants engaged in NASA activities. This provides for minor facility projects involving the construction of new facilities or additions to existing facilities, each project of which is estimated not to exceed $250,000. Such minor construction is necessary in FY 1978 to improve the usefulness of NASA's physical plant by making it possible to accomplish needed adjustments in the utilization and augmentation of its capabilities.

*In FY 1977 the Minor Construction Program totaled $5,125,000. Within the amount authorized by PL 94-307 and subsequently permitted by Appropriation Conference Report No. 94-1362, dated July 22, 1976, $2,200,000 of the $5,125,000 was redirected to the Lunar Sample Curatorial Facility at the Johnson Space Center. Priority minor construction work resulting from this redirection has been incorporated in the FY 1978 request.

PROJECT JUSTIFICATION:

The existing NASA physical plant is necessarily impacted by changing utilization and adaptions required by changing technology and mission needs, as well as by new facility requirements generated by research, development, test, and like activities. Items included in this project reflect work which must be accomplished in FY 1978 to meet general NASA installation requirements or technical facilities needs.

This work is not solely or primarily required to support specific research or development programs. However, included are those items which are required in FY 1978 to meet the particular needs of one or more specific research or development programs and which could be adequately identified at the time of submission of this budget estimate. Of the $5,950,000 project total, $4,250,000 has been carefully selected from a list totaling about $8 million. This selection has been made on the basis of the relative urgency of each item and the expected return for its accomplishment in relation to the investment involved. An additional $1,700,000 of prior year projects are also included as explained in item K. 5., on page CF 14-11. It is recognized, however, that during the course of the year some rearrangement of priorities may be necessary and that changes may be required in some of the items to be accomplished within the resources allocated.

PROJECT DESCRIPTION:

Tentative subprojects of work to be considered for accomplishment under this estimate are outlined under "PROJECT COST ESTIMATE" and total $5,950,000. Of the $5,950,000 total, $5,400,000 represents specific discrete items of work and $550,000 is indicated as a "lump sum" amount to provide for facilities work of these types (new construction and additions) estimated to cost not in excess of $50,000 for each such project. This amount in turn is based on a listing of specific project tasks of the new construction type which must be accomplished in this time frame.

PROJECT COST ESTIMATE:

A. Ames Research Center..... 245,000

1. Construction of Addition to Aircraft Service Facility, Building N-248..... 245,000

This project provides for the construction of a two-story addition of approximately 6,000 square feet (560 sq m) to the northeast corner of the Aircraft Service Facility, Building N-248. This addition will be a structural steel frame building and metal siding similar to that of the existing building. This work also includes interior partitions, flooring, ceilings, an electrical distribution system, lighting system, and acoustical insulation. In addition, heating, ventilation, and air conditioning systems will be provided. This project will provide office and laboratory work space for 12 engineering personnel, nine experimenters, and flight crews. This addition is required to support the C-141A Aircraft Infrared Observatory and other space science investigations. The existing building and office areas are overcrowded and inadequate. Additional space will also permit surplusing four existing trailers in which the working environment is

unacceptably noisy. This construction project supports space science investigations and infrared astronomy research, and will permit better utilization of important and unique research facilities by improving the efficiency of the necessary ground and support activities.

B. Dryden Flight Research Center..... 245,000

1. Construction of Addition to Servicing Dock, Building 4823..... 245,000

This project provides for the construction of an addition of approximately 9,800 square feet (910 sq m) to the Servicing Dock, Building 4823. The addition will be a pre-engineered metal building 70 feet (21.3 m) wide with an eave height of 20 feet (6.1 m) on a 8 inch (20.3 cm) concrete slab. The building will be insulated and equipped with lighting, electric heating, rest room facilities, and a wet pipe sprinkler system. The addition will be utilized for shop support of the Servicing Dock activities. Five F-104 airplanes are maintained in this building. The F-104's are used as chase aircraft in support of all DFRC research projects. This construction is urgently needed at this time to provide shop space to relieve the crowded conditions in the existing Building 4823 and will eliminate the need for a trailer which provides space for three people.

C. Goddard Space Flight Center..... 250,000

1. Construction of an Addition to the Magnetic Test Building, Building 303..... 185,000

This project proposes the construction of a two-story addition totaling 1,200 square feet (111.5 sq m) for magnetic component testing. The existing temporary building used for magnetic component testing is deficient because it is not "drift free" and receives interference from the 40-foot coil building. This addition is necessary to support the Magsat Program (Applications Explorer Mission) with an anticipated launch date in the first quarter of 1979. Critical humidity and temperature controls are required to support the Magsat Program. Utility services for this facility will be obtained from Magnetic Control/Test Monitor Building 302. Nonferrous materials (wood and wood products) are used throughout the building's construction to maintain the magnetic characteristic necessary for the functioning of this facility. The first floor of this facility will be used as a staging area for associated hardware while control consoles and cabling will be installed on the second floor.

2. Construction of Geophysical Instrumentation Facility at the Goddard Optical Research Facility..... 65,000

This project provides for the construction of an underground or earth covered enclosure, approximately 15 feet by 8 feet (4.6 m by 2.4 m) to house seismometers, tiltmeters, and gravimeters at the Goddard Optical

Research Facility. Vehicle access, power, and a security fence to prevent vandalism are included. To fully interpret the range measurements from the Laser Tracking Network, measurements at many of the sites are required from very sensitive instruments: seismometers, tiltmeters, and gravimeters. Therefore, a special underground concrete enclosure is needed to provide this environmental stability for the instruments.

D. Jet Propulsion Laboratory..... 255,000

1. Construction of Addition to Visitor's Control Center, Building 249..... 60,000

This project will provide a 750-square-foot (69.7 sq m) addition to the Visitor's Control Center, Building 249. The addition will contain restroom facilities for men and women as well as a conference room to service procurement and contractor functions. The present Visitor's Control Center is used for incoming visitors as well as for preconstruction conferences and bid openings with contractors. Approximately 250 people pass through this area each day and during times when conferences are in session, overcrowded conditions occur. The present restroom facilities are inadequate to handle the large crowds that are a daily occurrence.

2. Construction of an Addition to the Spectroscopy Laboratory for Infrared Interferometry, Building 245..... 95,000

This project proposes the construction of a 760-square-foot (70.7 sq m) addition to the Spectroscopy Laboratory, Building 245. Heating, air conditioning, lighting and utilities will be installed, as well as a paved access road to the new addition. This addition is required to accommodate a third Infrared Interferometry Laboratory that utilizes a High Speed Interferometer to support the Stratospheric Research Program in measuring and determining trends of pollutants in the stratosphere. The instrument is currently flying on a balloon and will be retired to the proposed Laboratory when the second instrument is ready to fly in CY 1977. Known gases will be utilized to calibrate the instrument waveform to provide comparisons of signals received from the instrument in flight.

3. Construction of Addition to Communication's Network Service Facility, Building 186..... 100,000

This project proposes the construction of a repair and storage addition of 1,200 square feet (111.5 sq. m.) to the T.V. Terminal Room at the Communication Network Service Facility, Building 186. This facility will centralize the maintenance function and equipment storage requirements for the laboratory-wide closed circuit television system. The Closed Circuit T.V. System functions as a primary information distribution and dispersing system for many laboratory functions and conferences as well as to the mass media in support of flight project activities. The closed circuit system originally covered a nine building network; six more have been included with eleven more scheduled. This facility is necessary to maintain, store, and repair this equipment as a result of the increased capacity.

E. Johnson Space Center 55,000

1. Construction of Addition to Domestic Water System 55,000

This project provides for installing approximately 1,200 feet (365.8 m) of new 6-inch (15.2 cm) water line in the JSC support facilities area, four new 6-inch (15.2 cm) valves, a new fire hydrant, and cathodic protection on approximately 10,500 feet (3,200 m) of existing cast iron pipe. Extending the water line to the support facilities area and installing a new fire hydrant will improve fire protection in the area by ensuring an available water supply. The system's reliability will be improved by providing looped service to the facilities in the area. The existing water system is deteriorating as the result of age, soil conditions, and chemical composition of the water. Installing cathodic protection will prevent the pipe's corrosion, thus enhancing system reliability and decreasing maintenance costs.

F. Langley Research Center 470,000

1. Construction of Addition to Visitor Center, Building 1202 240,000

This project provides for the construction of a 5,000-square-foot (465 sq m) one-story addition on the north side of the present Visitor Center, Building 1202. The exterior of this masonry addition will match the existing building. The interior will be concrete floors with carpet. This work will also include the electrical, lighting, heating, ventilating and air conditioning systems. A multipurpose permanent theater seating approximately 125 people will be provided and the remaining interior walls will be primarily movable partitions to provide flexibility for the main exhibit area. The present Visitor Center was planned for approximately 100,000 visitors per year. Over 150,000 people came to the Visitor Center last year, and from all indications, depart with a better understanding of NASA's current work and past accomplishments. With this increase in the number of visitors, and the number of additional exhibits that are planned for display, the existing facility is inadequate for effective public relations. The proposed addition will address future plans for LaRC's and NASA's space and aeronautics programs, and thus complete the triad of "what we have done", "what we are doing", and "what we plan to do".

2. Construction of Addition to Service Area, Building 1265 Complex 230,000

This project will provide a 3,240-square-foot (301 sq m) service area addition and modification of 455 square feet (42 sq m) in existing building. The new addition will include a service area and storage mezzanine. The modification work will provide a new men's lavatory and locker room and a storage mezzanine. The following areas will be included in the new addition: (1) model preparation area, (2) "clean room" for oxygen equipment, (3) electrical engineering technicians' work and equipment storage room, (4) shop supervisor's office, (5) general equipment storage areas, and (6) an equipment delivery area. The addition will

include a 2-ton (1,814 kg.) overhead crane to serve the entire addition and a 20-foot (6.1 m) metal door. The restrooms will be expanded to provide adequate facilities for the 42 people in this facility. The complex of facilities directed and supported from Building 1265 now includes the 8-Foot High Temperature Structures Tunnel, the 7-inch Mach 7 Pilot Tunnel, the Thermal Protection Systems Test Facility, and the Radiant Heating Static Test Stand. The model area is quite inadequate since it was originally sized for only the 8-Foot High Temperature Structures Tunnel. The existing space is adequate for the preparation of a single model with limited shop and storage space. The additional space will allow the most efficient work schedule by simultaneously accommodating preparation of several models, work on oxygen equipment, construction of systems control electronics equipment, and general shop activities. The construction of this addition will permit more effective utilization of the tunnel, relieve crowded working conditions and eliminate the need for two trailers.

G. Lewis Research Center..... 660,000

1. Construction of an Addition to Electric Power System in 10 x 10-Foot Supersonic Wind Tunnel, Building 86..... 195,000

This project will provide for the installation of an uninterruptible power system for the IBM 360/67 computer in the 10 x 10-Foot Supersonic Wind Tunnel, Building 86. This work will include the construction of approximately 420 square feet (39 sq.m) of area within the basement of Building 86 to house the electric batteries and the installation of a ventilation system and safety equipment. The new system will include a battery charger/rectifier and an inverter package with a battery which will provide 225 kilowatts of electrical power to the existing computer distribution panels.

The new uninterruptible power system will provide a reliable power source for computer operation at such time as unscheduled power outages occur and will eliminate power line transients to the computer. The existing IBM 360/67 computer is required for on-line, real-time analysis of data from approximately 45 research facilities around the Center. This computer is integrated with the experimental test facilities to closely monitor the test, to analyze some elements quickly and to compare then with previous results in order to better utilize the test facility. The annual costs directly attributable to unscheduled computer power service outages which now average six per year for the 360/67 system exceed $50,000 (a year) without including any replacement costs for research data lost during such outages. This addition to the electric power system is required at this time to eliminate these unscheduled power interruptions which present a serious problem in the operation of the computer.

2. Construction of an Addition to Equipment Utilization Building 34..... 110,000

This project provides for the construction of a 1,500 square foot (139 sq m) masonry one-story addition to the Equipment Utilization Building 34. The addition will be built on the northeast corner of

Building 34 and will match the architecture of the existing building. Included in the addition are aluminum windows, three personnel doors, and one 10-foot by 10-foot (3.05 m by 3.05 m) roll up door. Also included in the project is the construction of a 400-square-foot (37 sq m) pre-engineered metal building for the storage of solvent. The existing Utilization Building 34 is used to provide space for the Control Utilization of Research Equipment (CURE) program to ensure that the available equipment is used most effectively throughout the Center.

The new addition will provide space for relocation of an office, thus allowing the existing shop area to be expanded to accommodate additional manpower. Part of the shop area will be isolated as a "safe area" for high pressure component testing. This additional area will result in more efficient management by consolidating stores. It will also provide a central area where receiving, repairing and issuing functions are integrated with the existing testing and repair facilities. This consolidation will greatly decrease handling and increase efficiency of the CURE program.

3. Construction of Plant Maintenance Materials Storage Building..... 115,000

This project provides for construction of a 2,880-square-foot (268 sq m) pre-engineered metal building erected on a reinforced concrete slab in the south area of the Center. The building will be 40 feet (12.2 m) wide and 72 feet (21.3 m) long with a 14-foot (4.3 m) eave height. This work will also include insulation, electrical lighting, windows, and ventilators.

The building will be used for the storage of plant maintenance materials which are now stored in two 100-year-old dilapidated wooden structures, storage barn, Building 304 and storage basement, Building 305. These buildings which are of questionable structural integrity, are not economical to maintain and will be demolished as a part of the proposed work. Construction of this building will provide for more effective storage of these materials at a site which is more accessible to the Center's needs.

4. Construction of Alternate Power Source for "West Area" Facilities..... 240,000

This project provides for the construction of an additional electric power source to provide improved service for four major research facilities: Electric Propulsion Laboratory, Building 301; Energy Conversion Laboratory, Building 302; Space Power Research Laboratory, Building 309; and the Photovoltaic Test Laboratory, Building 311, in the West Area of the Center. These facilities are utilized for such energy related research and development projects as the storage of electric power, photovoltaic demonstration, test, and calibration, and endurance testing of ion propulsion engines for spacecraft. This work will include the installation of 920 feet (280 m.) of an 34.5 kV electrical transmission lines on existing steel towers from substation "A" to a new substation "N" to be located on West Area Road. The proposed transformer will be an outdoor, oil filled rated 3750/5000 kVA 34.5 kV primary, 2.4 kV secondary mounted on a concrete slab. The 5 kV electrical cables

will be extended in buried conduit from the transformer to 4.76 kV switchgear in a new 300-square-foot (27.9 sq m) masonry control house. A new 2.4 kV tie circuit will be installed on existing poles connecting the substation "M" and "N" to permit parallel operation. The existing tie circuit to substation "K" will be reconnected and used as an emergency feeder to Building 415. The project also includes essential protective relaying and controls.

The West Area is presently being served by a radial power system with a 2,400-volt emergency tie circuit of limited capacity. Power outages averaging four per year due to planned maintenance and one half per year due to system malfunction have been experienced. These power outages are very costly in time and loss of research data. The construction of this additional electric power source will improve the reliability of the electric power system to these vital research facilities.

H. Marshall Space Flight Center 235,000

1. Construction of Addition to Communications Building 4207 235,000

This project provides for a 5,000-square-foot (465 sq m) addition to the Communications Building 4207 at Marshall Space Flight Center. Demands on the telecommunications systems at MSFC have been growing steadily as new testing techniques, additional applications and equipment advances have been developed. Emphasis on manpower reductions, energy conservation, early warning of disasters and pollution control require a remote system to monitor and control plant conditions. The ability to meet these demands is becoming increasingly difficult because the space in Building 4207 is too limited to accommodate installation of new automatic switching and other equipment necessary for high quality signal transmission and remote monitoring and control. The additional space made available by this project will allow installation of equipment to increase automation of the existing system, thereby enhancing capacity, response and reliability in continuing support of all programs at MSFC.

I. National Space Technology Laboratories 100,000

1. Construction of Sewage Disposal System, River Complex 100,000

This project provides for the installation of a sewage disposal package treatment plant to serve five buildings and a trailer in the River Complex area, which houses offices and laboratories. All facilities in the area are now served by two septic tanks. Because of soil percolation and the River Complex's proximity to the East Pearl River, a designated recreational area, it is necessary to provide a new sewage treatment facility to remove the potential health hazard created by the existing septic tanks. The project includes removing the old septic tanks and drain fields; installing the package treatment unit, 6-inch (15.2 cm) vitrified clay lines, and manholes; and providing for pretreatment of a limited amount of acids and chemicals.

J. Wallops Flight Center 405,000

1. Construction of Addition to the Flight Information Control and Analysis Laboratory, Building N-161 165,000

This project provides for 3,400 square feet (315.9 sq m) of additional office space on the second floor and an additional 3,400 square feet (315.9 sq m) for supplies, and parts storage, and repair facility on the first floor. The project includes the necessary air conditioning, electrical, communication, and fire protection for the expansion. This project will allow for consolidating of all computer personnel in the one location and provide for more efficient and time saving operations.

2. Construction of a Public Information Building 240,000

This project provides for the construction of a public information facility with display area, office, and rest rooms for the Visitor's Information Center. The facility will contain approximately 7,500 square feet (696.8 sq m) of floor space, including rest rooms and mechanical equipment room. The facility will in clude a solar heating and air conditioning system with approximately 2,000 square feet (185.8 sq m) of solar array.

The Wallops Flight Center (WFC) has been utilizing temporary and substandard facilities for their public information display facility. The present location is being reconverted into an aircraft maintenance hangar to handle increasing aeronautical programs and existing facilities are not adequate to house this function. The new facility with solar heat and air conditioning will accommodate the increasing number of visitors to WFC and demonstrate the application of solar technology to the public.

K. Various Locations 2,480,000

1. Construction of Airstrip Extension, Goldstone, California 150,000

This project will provide for extending the present airstrip at Goldstone, California from 4,760 feet (1,450 m) to 6,000 feet (1,829 m) and widening from 60 feet (18.3 m) to 100 feet (30.5 m). Improvements will include paving turnarounds and provision for a short taxi way at the northeast end of the runway.

The extension and widening of the airstrip are required to meet new Federal Aviation Administration (FAA) minimum requirements and will provide greater safety during frequent severe climate conditions.

Goldstone is located 175 road miles from the Jet Propulsion Laboratory (JPL) in Pasadena. There is a constant requirement for JPL technical personnel to travel to Goldstone on routine or emergency projects for short periods of time. Consequently from 25 to 100 people are flown to and from Goldstone daily.

2. Construction of Logistics Support Area, Merritt Island (MILA), Florida..... 170,000

This project will provide for the construction of a 2,000-square-foot (185.8 sq. m.) logistics-storage addition to the operations building at the MILA Spaceflight Tracking and Data Network (STDN) station. The building will be concrete-masonry constructed on a slab-on-grade to match existing construction. Existing utilities, fire detection/protection systems will be extended as necessary.

The recent consolidation of the Deep Space Network (DSN) station into the MILA STDN station was accomplished at no building expansion by reducing existing logistics and office space below minimum standards. In addition, storage space now utilized off the station must be relinquished in the near future. Therefore, the addition is necessary to provide lost storage space and to provide the station with the logistics storage space for functional operation of the station.

3. Installation of Central Air Conditioning System, STDN Station, Goldstone, California..... 215,000

This project will provide for the construction of a central chilled water air conditioning system to support the operations and administration buildings at the Goldstone STDN Station. The central chilled water system will be fabricated from exterior type units and will be installed on a concrete pad at the south end of the operations building. The existing system is composed of old, multiple, direct expansion, single units which are difficult to maintain and costly to operate. The existing facilities were incrementally constructed to meet the needs of the station as they developed.

The new central system will provide better balance and control under fluctuating electronic loads. This will permit quick reaction to increases and decreases in load, thereby allowing the system to operate at less cost. In addition, a large portion of the redundancy of the existing multiple single units can be eliminated.

4. Construction of Geophysical Instrumentation Facilities, Various Locations..... 245,000

This project will provide for the construction of an underground or earth covered enclosure, approximately 15 feet (4.6 m) by 8 feet (2.4 m) to house seismometers, tiltmeters, and gravimeters at the following three laser tracking facilities: Otay Mt. and Quincy, California, and Bear Lake, Utah. Vehicle access, power, and a security fence to prevent vandalism are included.

To fully interpret the range measurements from the Laser Tracking Network, measurements at many of the sites are required from very sensitive instruments: seismometers, tiltmeters, and gravimeters. Therefore, a special underground concrete enclosure is needed to provide this environmental stability for the instruments.

Each site will be managed as a separate project with other laser sites included in future year programs as required.

5. To provide for the accomplishment of project work which had previously been scheduled but which could not be undertaken due to the need to revise the listing of work in favor of the Johnson Space Center Lunar Sample Curatorial Facility as provided for by Fiscal Year 1977 Construction of Facilities Appropriation Conference Report (Report No. 94-1362), dated July 22, 1976, page 9..... 1,700,000

a. Construction of Support Facilities for Mobile Lasers, Various Locations..... (1,455,000)

This project will provide facilities for the periodic location of mobile, precise laser tracking stations to support the Laser Earth Dynamics Program (LED). This project is designed to define the global tectonic plates, plate motion (earthquakes), plate stress, and information about fault structures. The construction will consist of site clearing/grading, road construction, erection of temporary shelters, trailer hardstands, boresight towers, wind holddowns, connection of commercial power, grounding and sanitary facilities. Higher costs are estimated at the remote sites due to their distances from supporting centers and area locations. All costs have been tailored to the proposed sites. These facilities will be constructed for the mobile laser facilities at eight various locations including Alaska, and range in estimated cost from $125,000 to $245,000.

Each of the eight sites will be managed as a separate project because of the different locations involved.

b. Construction of a 30-Foot Antenna at the Network Test and Training Facility (NTTF), Goddard Space Flight Center..... (245,000)

This project will relocate an existing 30-foot (9 m) antenna to the Network Test and Training Facility (NTTF). The construction includes antenna foundation, boresight tower foundation and guy anchors a hydro-mechanical building, power and signal cable trenching, necessary road accesses, and antenna service apron. This project originally was to be sited at Rosman, North Carolina. This relocation is necessary to meet changes in programmatic requirements. The station's grounding, fire detection/protection and electrical systems will be extended as necessary.

The requirement exists to provide the NTTF station with a full Unified S-Band capability and a simultaneous S/Ku-band operational capability. This support is required for all synchronous and elliptical orbiting spacecraft.

MISCELLANEOUS PROJECTS LESS THAN $50,000 EACH	550,000
TOTAL	5,950,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that between $4 million and $6 million per year will be required for the continuation of this essential minor construction work at NASA field installations and Government-owned industrial plants engaged in NASA activities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

	Amount	Page No.
Regular Requirements:	6,100,000	
Master planning	240,000	CF 15-2
Sustaining engineering support	1,255,000	CF 15-3
Preliminary engineering reports and related special engineering support	1,655,000	CF 15-4
Final design	2,950,000	CF 15-5
Other Requirements:	5,680,000	
Shuttle facility planning and design	2,680,000	CF 15-6
Spacelab/payloads planning and design	630,000	CF 15-7
Large aeronautical facilities planning and design	2,370,000	CF 15-7
Total	11,780,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1978 ESTIMATES

PROJECT TITLE: Facility Planning and Design		
		FY 1978 CoF ESTIMATE: $11,780,000
FY 1976: $9,275,000	TQ: $2,500,000	FY 1977: $12,655,000

The funds requested in this estimate are required to provide for the following advance planning and design activities related to facilities activities and projects:

a. The accomplishment of necessary development and master planning for field installations and, where not otherwise provided for, the provision of continuing engineering support and special engineering management and other services.

b. The preparation of preliminary engineering reports, cost estimates, and design and construction schedules.

c. The preparation of final construction contract plans, specifications, and associated cost estimates and schedules that are required to implement construction projects.

d. The accomplishment of facilities siting and other investigations, as well as the accomplishment of special facilities studies and reports.

The $11,780,000 requested for facility planning and design for FY 1978 is composed of two major segments:

a. Regular requirements - $6,100,000

b. Other requirements - $5,680,000

Regular requirements encompass the basic purposes outlined above. The "other requirements", while also in support of these purposes, cover those special needs which are related to large, complex projects or specific programs which are considered to represent high potential future construction requirements and for which early definition is essential.

These large projects require significantly more planning and longer lead time than is normally involved. Much of this planning must be completed prior to inclusion of the project in a budget request; consequently, most of these projects represent a continuing effort from previous years rather than new work.

1. REGULAR REQUIREMENTS 6,100,000

A. Master Planning 240,000

This segment of the requirement includes the necessary provisions to update and further develop existing master plans for the field installations, including facility studies and site investigations. Documentation will define facility parameters within which subsequent engineering efforts will be based for future development. This also provides for documentation on existing plans where actions or deviations from previous plans have not been recorded for the various field installations.

Master plans at the various field installations are generally updated at cyclic 3-year intervals. Approximately one-third of the field installations are involved in any one fiscal year, keeping the level of effort relatively constant. These plans provide for the orderly consideration of the allocation, proper arrangement and efficient correlation of land areas and structures to serve the purpose of the various installations. Representative master planning activity candidates for FY 1978 are:

(1) Goddard Space Flight Center

A major update to incorporate the land-use interfaces with latest Agricultural Research Center planning, remote test site data and proposed construction plans.

(2) White Sands Test Facility

A scheduled update to reflect the existing facilities inventory and use.

(3) Langley Research Center

A major update to incorporate current and planned West Area development and master plan inventory.

(4) Marshall Space Flight Center

A major update to involve facilities consolidation planning, land utilization and general updating of the existing plan.

B. Sustaining Engineering Support..... 1,255,000

Provisions for facility studies and specific engineering support continue to take on an added importance which has been evidenced in recent years, and must be given further high priority throughout FY 1978. These efforts are of upmost importance due to the more unpredictable cost situation which currently exists, and cost trends in construction materials, fuels, the continuing importance of energy conservation and efficiency, and the operation and maintenance cost for the physical plant. This also includes provisions for maintaining a current engineering data base and updated construction specifications for utilization by the various field installations. The following items are included in the FY 1978 requirements:

(1) Building Research and Advisory Board Support

This covers annual support to the Federal Construction Council (FCC) operations and provides for special studies that this Council will perform throughout FY 1978 to help advance the science and technology of Federal Government building and construction. The FCC is a committee of the Building Research Advisory Board, National Academy of Sciences, and its activities are supported by several Federal agencies including NASA.

(2) Utilities Services/Rates Analysis

This provides for the continued services of utility rate analysis support, to include counseling, surveillance, and Agency-wide recommendations with regard to utility rates, contract negotiations and systems operations. This has become of increasing importance in light of the rapid increases in utility costs and utility supply problems.

(3) Design Specifications Update and Support

This provides for the continuation of engineering services for the updating and refining of the Agency-wide construction specification systems which combines a catalog of preapproved standard construction specifications, and a program for selective retrieval and printout of bid specifications.

(4) Facility Operation and Maintenance Analysis

This provides for continued engineering support in implementing, at field installations, improvements relative to manpower utilization, work control systems, preventive maintenance, and facilities management and reporting. This also includes some facility operation and maintenance management surveys to be conducted on a priority basis at selected NASA field installations.

(5) Energy Reduction Analysis and Support

Since early 1976 progressively intensified efforts have been undertaken to identify, study and develop new initiatives which will assist in reducing NASA's future energy consumption. Most of these initiatives thus far have or will need some capital investment in facilities to provide capabilities either direct or indirect to reduce energy demands. This is within the continuing total effort to reduce NASA's energy consumption progressively with a level-off envisioned in the 1980-85 time frame. It is anticipated that this FY 1978 phase of this total endeavor will complete this identification phase and that future requirements will relate to the preparation of PER's and final design.

(a) This provides for the continuation of engineering services to establish both immediate and long-range energy conservation criteria for the operational management and design of buildings. Involved is the validation of an energy computer modeling program together with the simplification and application guidelines. This is an extension of an existing program to develop substantive energy conservation design criteria and operational procedures for existing standard-type buildings at NASA installations as well as the contracted examination of potential energy reduction initiatives.

(b) This also provides for engineering support, analyses and reports relative to facility impacts, feasibility interfaces and cost effectiveness of proposed modification to NASA facilities which will incorporate solar technology. This work will be in response to any agreements between NASA and ERDA, FEA or others under which they will provide solar collectors and process components for incorporation into an operating NASA facility. NASA would install such solar equipment and integrate it to the maximum extent in its overall efforts to reduce reliance on fossil fuels.

(6) Value Engineering, Cost Validation and Analysis

This will provide for the procurement of engineering services to improve, whenever possible, cost effectiveness of facility projects by subjecting project design criteria, specifications and working drawings for specific material components and systems to a detailed independent review by engineering specialists in the particular area of involvement. It will also provide services necessary to more accurately predict facility costs which will aid in resources planning for the various field installations.

C. Preliminary Engineering Reports and Related Special Engineering Support..... 1,655,000

(1) Preliminary Engineering Reports (PER's)..... (1,180,000)

Preparation of PER's, investigations, and project studies related to proposed facility projects to be included in the FY 1980 Construction of Facilities program are provided for by this estimate. These

reports are required to permit the early and timely development of the best project required to meet the stated functional need and to provide the related basic data, cost estimates and schedules related to any such future budgetary proposals. This request will provide for PER work associated with proposed subsequent construction, except for Space Shuttle, payloads and larger aeronautical requirements, involving an estimated cost of $20 million to $30 million of construction for which updated PER's will be needed, and with new projects estimated to cost $35 million to $45 million for which completed new PER's will be required. In addition, this estimate includes $285,000 for a unique PER tailored to confirming the predicted performance of a large advanced antenna system and its ability to meet rigid specifications, and evaluating special and unique components and their proposed functional design. This work will also weigh specification and performance against cost to achieve an optimum large, low cost, advanced antenna system.

(2) Related Special Engineering Support..... (475,000)

Investigations and project studies related to proposed facility projects to be included in the subsequent Construction of Facilities programs are provided for by this estimate. Such studies have taken on an increased importance in recent years and involve chemical waste disposal, utility control systems improvements, and miscellaneous energy and like studies. These studies are required to allow for the timely development of projects to meet the stated functional needs and to provide basic data, cost estimates, and schedules for related future budgetary proposals.

D. Final Design..... 2,950,000

The amount requested will provide for the preparation of designs, plans, drawings and specifications necessary for the accomplishment of projects other than Space Shuttle, Spacelab and Large Aeronautical facility projects, primarily those which are planned for inclusion in the FY 1979 Construction of Facilities program. This request will provide for final design work associated with such proposed subsequent construction of this nature estimated to cost $45 million to $50 million. It will also provide for residual requirements of this nature which have accumulated from prior years' final design activities.

2. OTHER REQUIREMENTS..... 5,680,000

These other facilities planning and design requirements are generated by potential future projects, large in size and of a complex nature. Those in this particular request are primarily associated with future space programs which require a long planning cycle. Early and progressive design work is essential to ensure the ultimate best design, cost estimates and schedules. These projects then require added planning effort and associated design lead time well beyond that normally associated with preliminary engineering reports and general type facility projects. For this reason, these requirements must be provided for over and above the regular and the more recurrent facility planning and design needs covered above.

A. Shuttle Facility Planning and Design..... 2,680,000

(1) Shuttle Facilities Studies and Preliminary Design..... (580,000)

This portion of the total Space Shuttle Facility requirements is associated with the preparation of preliminary engineering reports (PER's), the conduct of facilities investigations, and studies for facilities projects which in most cases will be included in the FY 1980 Construction of Facilities program. This preliminary work is associated with future construction for that year, now estimated to cost approximately $40 million to $45 million, and with anticipated requirements to study facility problems relating to program implementation. Studies and PER's will be undertaken to examine the facilities needed to support the long-term logistics requirements connected with sustained high flight rates. These facilities relate to launching and landing as well as those needed to support production of the external tank and solid rocket boosters, which must be capable of sustained operations at the rate of up to 60 flights per year. Such facilities as a crawler transporter maintenance facility and helium and hydrogen recovery facilities are candidates for inclusion at Kennedy Space Center in the FY 1980 budget, and studies and PER's will continue to be needed to aid in decision making regarding modification of existing facilities, or providing added capabilities for solid rocket booster production facilities and external tank production facilities. Other reports and studies are expected to be required to support improvements to first generation Shuttle facilities to increase operational efficiency or to accommodate flight hardware changes. In addition, the forthcoming implementation stage of the Shuttle program will create requirements for quick response, value engineering, cost analysis and trade-off studies to resolve problems expected to emerge in both ongoing and completed Space Shuttle facilities projects. The cost of these studies is estimated at $200,000 and the estimated cost of preparing preliminary engineering reports (PER's) is $380,000.

(2) Shuttle Facilities Final Design..... (2,100,000)

This portion of the total facility planning and design required for Space Shuttle facilities is associated with the preparation of final design, drawings and specifications required for future construction of Space Shuttle facilities, now estimated to cost approximately $50 million to $60 million and which may be included in an FY 1979 Construction of Facilities request. The final design costs relating to the proposed FY 1979 projects will be somewhat reduced from that ordinarily expected since some of the projected construction is similar to facilities already designed and under construction. This design effort is mainly related to the potential requirement for solid rocket motor production facilities at a site to be determined, and to the second phase of the launch and landing facilities at Kennedy Space Center required to support the higher launch rates of the operational phase. Projects which are forecast during FY 1979 include continued modification of Launch Pad 39B and initiation of support facilities such as the hypergolic storage area, industrial waste treatment facility, and a Space Shuttle main engine maintenance facility. In addition, some facility modifications will be required to support higher production rates of the external tank at the Michoud Assembly

Facility. If the selected solid rocket motor production contractor elects to use Government facilities for production of the solid rocket motors, the required facility work would be accomplished mainly in FY 1979.

B. Spacelab Payloads Planning and Design..... 630,000

This planning requirement is related to the study, preliminary engineering and final design of facilities to support the Spacelab and Payloads programs. These programs are essential to provide the capability for developing, integrating and checking out scientific application, technology and upper stage payloads as well as the capability to launch these payloads in the Space Shuttle vehicle. As flight rates increase, special payloads requirements may require additional facilities to support individual payload operations. In addition, requirements for facilities to support incremental integration of multiple components, as well as ground control of in-flight payloads missions must be assessed. The facilities considered for construction are now estimated to cost $8 million to $10 million in each of the FY 1979 and FY 1980 Construction of Facilities programs. The cost of these studies and preliminary engineering effort required in FY 1978 is estimated at $150,000 and the final design is estimated at $480,000.

C. Large Aeronautical Facilities Planning and Design..... 2,370,000

(1) Final Design for National Transonic Facility..... (600,000)

This planning is required for obtaining the final facility design relating to the construction of a National Transonic Facility (NTF) which will have a high Reynolds number capability. The Aeronautics and Astronautics Coordinating Board has recommended that a single facility be built at the Langley Research Center to satisfy both the research requirements of NASA and the development needs of the U.S. Air Force. The proposed facility will provide for aerodynamic research and development on aircraft over a Mach range from 0.2 to 1.2 and at Reynolds numbers up to about 120 million. The proposed facility will be capable of cryogenic operation which permits major reductions in model loads and in tunnel power requirements. It will also permit separation of Reynolds number from aeroelastic effects, a capability unattainable in any known existing wind tunnels.

An amount of $5,500,000 has been provided for in previous fiscal years for engineering studies to fully define operating conditions and cost parameters and to initiate final design. Included in NASA's Construction of Facilities program is $25 million to initiate construction of the NTF. In the FY 1978 Construction of Facilities budget, $23.5 million is requested as a second construction increment for this major facility. It is planned that NASA will request some $15-20 million in the future to complete the construction of this National Transonic Facility.

It was anticipated that the FY 1977 allocation of planning and design resources would have completed all the facility planning and design work for the NTF. However, subsequent concerns arose during the steel

tunnel pressure shell design phase, necessitating additional special studies. These concerns related to efforts to insure greater competition in procurement and fabrication of the shell. The additional studies pertained to tunnel insulation, fan drive system, noise attenuation, improved vent stack (GN_2) testing and design, related modeling studies, model positioning studies, and validation of materials for the fan blades were also required. As a consequence, this FY 1978 request for an additional $600,000 is now necessary in order to accommodate the requirements outlined and to complete the NTF final design and related studies.

(2) Final Design for Modification of 40-by 80-Foot Subsonic Wind Tunnel..... (1,770,000)

The status of this project may be considered on the basis of these following elements:

(a) Repowering
(b) Provisions for the vanes/louvers and the substation relocation
(c) Addition of new 80 x 120-Foot Test Section

The completion of the final design for the repowering element was impacted by the emergence of design problems relative to the variable pitch mechanism, fan blades and hub. These have been successfully overcome with the major portion of the final design being completed. Final completion of this design for the repowering was realized in December 1976. The design for the vanes and louvers which are a separate element to provide for the interface of the new leg and existing 40 x 80-Foot Subsonic Wind Tunnel is well along. Negotiations with the Pacific Gas and Electric Company have begun for the design of the substation relocation. The final design of the 80 x 120-foot new test section is about one-third completed.

The total planning and design requirement for this facility is currently estimated at $3,978,000; $2,208,000 of this has been provided for through FY 1977 for engineering studies, special analyses and final design to the extent outlined above. The FY 1978 request for $1,770,000 will provide for the completion of final design of the new test section, related engineering studies and special design support.

The FY 1978 Construction of Facilities request for the Modification of the 40 x 80-Foot Subsonic Wind Tunnel at Ames is for $13.5 million which provides for the second increment of funding for long-lead procurement items for both the repowering and new test section. The remaining $60 million to $65 million required to complete this facility work is planned for the following two fiscal years, leading to an operational completion date of mid-1981. The attainment of this operational date is now considered to be the most cost effective and mission responsible schedule on which to proceed. This operational date requires that final design be accelerated somewhat from the schedule envisioned when our FY 1977 FP&D estimates were prepared. The new schedule provides for a single tunnel shutdown permitting the completion of the repowering and the vanes/louvers interface at one time, which provides greater support of the R&D test schedules. The FP&D

resources required to accomplish the design efforts outlined for FY 1978 supports the completion of the final design by mid-CY 1978. This request includes all presently known FP&D requirements of the 40 x 80-Foot Subsonic Wind Tunnel modifications. The FY 1978 request exceeds the $1.2 million future estimate provided in the FY 1977 budget submittal by $570 thousand. The requirement for these additional design funds was generated by the variable pitch mechanism, fan blades, and hub "design problems" cited above and as a consequence of an improved appraisal of the residual FP&D cost for this total project.

TOTAL..... 11,780,000