National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1977

Volume II

CONSTRUCTION OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

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VOLUME II

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 1977 provide for the continuation of prior years' endeavors in meeting the facilities requirements for the space shuttle program; rehabilitation, modification and minor construction of facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; and facility planning and design activities.

Space shuttle facility requirements in FY 1977 are less than amounts requested and approved in the last few years. 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 1977 also includes initial funding for a large aeronautical facility, the construction of a National Transonic Facility at the Langley Research Center. Requirements for this and other aeronautical research and technology facilities are outlined in detail in the enclosed justifications.

Other projects included in the FY 1977 program are in support of scientific investigations in space, 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 1977 is $124,020,000, an increase of $41,890,000 over the amount appropriated for FY 1976. Outlays are estimated to be $125,700,000 in FY 1977, an increase of $10,900,000 over the estimate for FY 1976.

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, [$82,130,000] *$124,020,000*, to remain available for obligation until September 30, [1978] *1979*: *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.

[For "Construction of facilities," to be available July 1, 1976, $10,750,000, to remain available for obligation until September 30, 1979.] (*42 U.S.C. 2451, et seq.; Department of Housing and Urban Development—Independent Agencies Appropriation Act, 1976; additional authorizing legislation to be proposed.*)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars)

Identification code 27-00-0107-0-1-999	Budget plan (amounts for construction of facilities actions programed)				Costs and obligations			
	1975 actual	1976 estimate	TQ estimate	1977 estimate	1975 actual	1976 estimate	TQ estimate	1977 estimate
Program by activities:								
Direct program:								
1. Space flight	77,185	47,220		39,825	35,945	67,500	20,000	64,000
2. Scientific investigations in space	18,770			8,720	8,043	10,451	1,200	6,900
3. Space applications					17	34		
4. Space research and technology	660			680	1,089	515	200	100
5. Aeronautical research and technology	9,745	4,635		28,950	5,496	9,500	3,000	18,400
6. Supporting activities	36,295	30,275	10,750	45,845	35,923	38,000	9,600	43,300
Total direct program costs, funded	142,655	82,130	10,750	124,020	86,514	126,000	34,000	132,700
Reimbursable program:								
6. Supporting activities	400	3,000				3,400		
Total reimbursable program costs, funded	400	3,000				3,400		
Total program costs, funded	143,055				86,514	129,400	34,000	132,700
Change in selected resources (undelivered orders)					16,370	22,600	−24,200	−10,200
10 Total	143,055	85,130	10,750	124,020	102,884	152,000	9,800	122,500
Financing:								
11 Receipts and reimbursements from: Federal funds	−400	−3,000			−400	−3,000		
21 Unobligated balance available, start of period: For completion of prior period budget plans:								
Direct					−76,734	−116,429	−49,959	−50,909
Reimbursable						−400		
24 Unobligated balance available, end of period: For completion of prior period budget plans:								
Direct					116,429	49,959	50,909	52,429
Reimbursable					400			
25 Unobligated balance lapsing					76			
Budget authority	142,655	82,130	10,750	124,020	142,655	82,130	10,750	124,020
Budget authority:								
40 Appropriation	140,155	82,130	10,750	124,020	140,155	82,130	10,750	124,020
42 Transferred from other accounts	2,500				2,500			
43 Appropriation (adjusted)	142,655	82,130	10,750	124,020	142,655	82,130	10,750	124,020
Relation of obligations to outlays:								
71 Obligations incurred, net					102,484	149,000	9,800	122,500
72 Obligated balance, start of period					91,432	108,609	142,809	121,409
74 Obligated balance, end of period					−108,609	−142,809	−121,409	−118,209
90 Outlays					85,307	114,800	31,200	125,700

Note.—Reconciliation of budget plan to obligations:

	1975 actual	1976 estimate	TQ estimate	1977 estimate
Total budget plan	143,055	85,130	10,750	124,020
Deduct portion of budget plan to be obligated in subsequent periods	26,659	25,430	7,450	30,020
Add obligations of prior period budget plans	46,487	92,300	6,500	28,500
Total obligations	102,884	152,000	9,800	122,500

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

SUMMARY OF THE BUDGET PLAN BY LOCATION
(In Dollars)

Location	FY 1975	FY 1976	Transition Quarter	FY 1977
Ames Research Center	3,660,000	2,695,000	---	4,490,000
Flight Research Center	---	---	---	750,000
Goddard Space Flight Center	2,110,000	---	---	---
Jet Propulsion Laboratory	8,820,000	---	---	---
Johnson Space Center	935,000	---	---	2,800,000
Kennedy Space Center	---	---	---	2,805,000
Langley Research Center	3,505,000	1,940,000	---	6,185,000
Lewis Research Center	3,240,000	---	---	2,170,000
Marshall Space Flight Center	4,060,000	---	---	---
Wallops Flight Center	1,370,000	---	---	---
Large Aeronautical Facility	---	---	---	25,000,000
Various Locations	7,470,000	---	---	---
Space Shuttle Facilities	77,185,000	47,220,000	---	39,825,000
Space Shuttle Payload Facilities	---	---	---	4,340,000
Rehabilitation and Modification	14,900,000	16,000,000	7,000,000	17,875,000
Minor Construction	4,500,000	5,000,000	1,250,000	5,125,000
Facility Planning and Design	10,900,000	9,275,000	2,500,000	12,655,000
Total Plan	142,655,000	82,130,000	10,750,000	124,020,000

SUMMARY OF THE BUDGET PLAN BY COGNIZANT OFFICE

	FY 1975	FY 1976	Transition Quarter	FY 1977
Office of Space Flight	78,120,000	47,220,000	---	43,755,000
Office of Space Science	22,400,000	---	---	3,570,000
Office of Aeronautics and Space Technology	10,405,000	4,635,000	---	30,850,000
Office of Tracking and Data Acquisition	1,430,000	---	---	750,000
Office of Center Operations	---	---	---	9,440,000
NASA Comptroller	30,300,000	30,275,000	10,750,000	35,655,000
Total Plan	142,655,000	82,130,000	10,750,000	124,020,000

SUMMARY OF BUDGET PLAN BY SUBFUNCTION

Code No.	Title				
253	Space Flight	77,185	47,220	---	39,825
254	Space Science, Applications and Technology	19,430	---	---	9,400
255	Supporting Space Activities	36,295	30,275	10,750	45,845
(250)	Subtotal, General Science, Space and Technology	132,910	77,495	10,750	95,070
405	Air Transportation	9,745	4,635	---	28,950
	Total	142,655	82,130	10,750	124,020

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

BUDGET PLAN BY LOCATION AND PROJECT

Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	Page No.
			(In Thousands of Dollars)				
		Ames Research Center	3,660	2,695	---	4,490	
AST	254	Modification for high enthalpy entry facility.	---	---	---	1,220	CF 1-1
AST	405	Modification of flight simulator for advanced aircraft.....	---	---	---	1,730	CF 1-8
Cntr Ops	255	Construction of supply support facility.....	---	---	---	1,540	CF 1-14
AST	405	Modification of 11 by 11-foot transonic wind tunnel.....	---	2,695	---	---	
AST	405	Addition to flight and guidance simulation laboratory.....	3,660	---	---	---	
		Flight Research Center	---	---	---	750	
TDA	255	Construction of addition to flight control facility.....	---	---	---	750	CF 2-1
		Goddard Space Flight Center	2,110	---	---	---	
SS	255	Rehabilitation and modification of science and applications laboratories.....	890	---	---	---	
SS	255	Modifications for fire protection and safety..	1,220	---	---	---	

Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	Page No.
			(In Thousands of Dollars)				
		Jet Propulsion Laboratory	8,820	---	---	---	
SS	255	Acquisition of land	150	---	---	---	
SS	254	Addition to systems development laboratory (SDL)	4,880	---	---	---	
SS	254	Addition for integrated systems testing facility	3,790	---	---	---	
		Lyndon B. Johnson Space Center	935	---	---	2,800	
SS	254	Construction of addition to lunar sample curatorial facility	---	---	---	2,800	CF 3-1
SF	255	Modification of water supply system	935	---	---	---	
		John F. Kennedy Space Center	---	---	---	2,805	
SF	254	Construction of airlock to spin test facility.	---	---	---	360	CF 4-1
Cntr Ops	255	Modifications for utility control system	---	---	---	2,445	CF 4-8
		Langley Research Center	3,505	1,940	---	6,185	
AST	405	Construction of addition for aeroelastic model laboratory	---	---	---	730	CF 5-1
Cntr Ops	255	Construction of data reduction center annex	---	---	---	2,970	CF 5-6
Cntr Ops	255	Construction of refuse-fired steam generating facility	---	---	---	2,485	CF 5-12
AST	405	Addition for composite model and metal finishing shops	---	1,940	---	---	

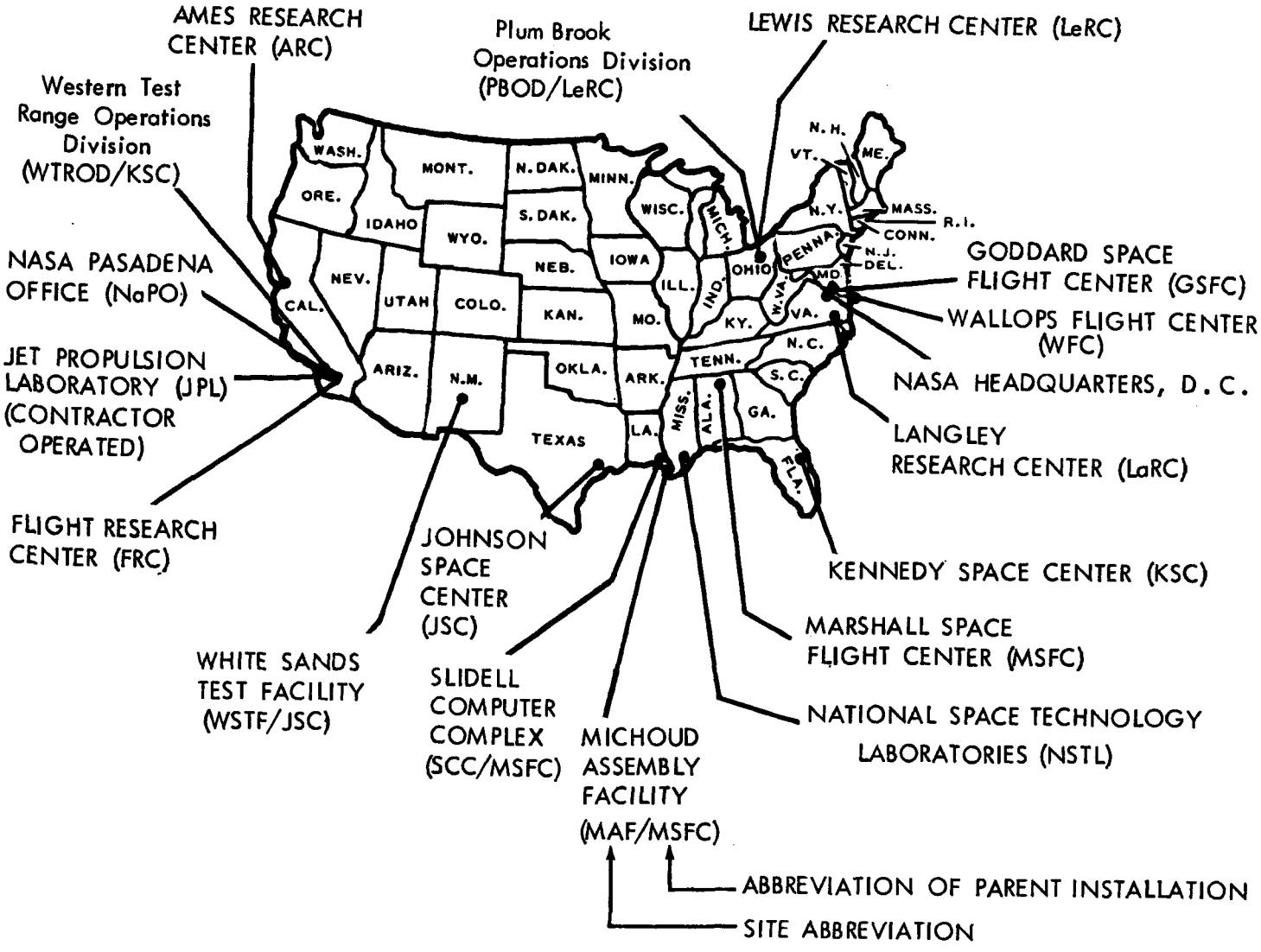
Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	Page No.
			(In Thousands of Dollars)				
AST	405	Modification of 6,000 p.s.i. air storage system	515	---	---	---	
AST	405	Rehabilitation of 16-foot transonic wind tunnel	2,990	---	---	---	
		Lewis Research Center	3,240	---	---	2,170	
AST	254	Modification of refrigeration system, electric propulsion laboratory	---	---	---	680	CF 6-1
AST	405	Rehabilitation of combustion air drying system, engine research building	---	---	---	1,490	CF 6-6
AST	405	Modification of propulsion systems laboratory.	2,580	---	---	---	
AST	254	Modification of rocket engine test facility...	660	---	---	---	
		Marshall Space Flight Center	4,060	---	---	---	
SS	254	Construction of X-ray telescope facility.....	4,060	---	---	---	
		Wallops Flight Center	1,370	---	---	---	
SS	255	Modification of beach protection system.....	1,370	---	---	---	
		Large Aeronautical Facility as Follows:	---	---	---	25,000	
AST	405	Construction of national transonic facility (LaRC)	---	---	---	25,000	CF 7-1

Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	Page No.
			(In Thousands of Dollars)				
		Various Locations	7,470	---	---	---	
SS	254	Construction of infrared telescope facility, Mauna Kea, Hawaii.....	6,040	---	---	---	
TDA	255	Modifications for fire protection and safety at various tracking stations.....	1,430	---	---	---	
		Space Shuttle Facilities at Various Locations as Follows:	77,185	47,220	---	39,825	
SF	253	Construction of orbiter processing facility (KSC).....	13,380	8,160	---	3,750	CF 8-4
SF	253	Modifications to launch complex 39 (KSC).....	35,355	13,110	---	19,855	CF 8-12
SF	253	Modifications for solid rocket booster processing facilities (KSC).....	---	5,240	---	9,700	CF 8-20
SF	253	Construction of shuttle/carrier aircraft mating facilities (FRC, Palmdale, Calif., and KSC).....	1,500	3,890	---	2,050	CF 8-31
SF	253	Construction of orbiter approach and landing test facilities (FRC, Calif. and Palmdale, Calif.).....	2,940	1,680	---	---	
SF	253	Modifications for crew training facilities (JSC).....	420	830	---	780	CF 8-36
SF	253	Rehabilitation and modification of shuttle facilities, at various locations.....	---	---	---	1,760	CF 8-43
SF	253	Modification of manufacturing and final assembly facilities for external tanks, (MAF).....	---	---	---	1,930	CF 8-48

Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	Page No.
			(In Thousands of Dollars)				
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	Modification of the vibration and acoustic test facility (JSC).....	410	2,410	---	---	
SF	253	Modifications for solid rocket booster component manufacturing and assembly facilities (location to be designated).....	---	3,000	---	---	
SF	253	Construction of orbiter landing facilities (KSC).....	15,880	---	---	---	
SF	253	Modifications for dynamic test facilities (MSFC; Downey, Calif.).....	3,920	---	---	---	
SF	253	Construction of materials test facility (WSTF).....	790	---	---	---	
SF	253	Modifications for solid rocket booster structural test facilities (MSFC).....	2,590	---	---	---	
		Space Shuttle Payload Facilities at Various Locations as Follows:	---	---	---	4,340	
SF	254	Modifications to operations and checkout building for spacelab (KSC).....	---	---	---	3,570	CF 9-1
SS	254	Modifications and addition for shuttle payload development (GSFC).....	---	---	---	770	CF 9-7
COMPT	255	Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of $500,000 Per Project.....	14,900	16,000	7,000	17,875	CF 10-1

Cognizant Office	Subfunction Code	Installation and Project	FY 1975	FY 1976	Transition Quarter	FY 1977	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.....	4,500	5,000	1,250	5,125	CF 11-1
COMPT	255	Facility Planning and Design.....	10,900	9,275	2,500	12,655	CF 12-1
		TOTAL PLAN.....	142,655	82,130	10,750	124,020	

LOCATION OF NASA MAJOR AND COMPONENT INSTALLATIONS



RECORDED VALUE OF CAPITAL-TYPE PROPERTY
IN-HOUSE AND CONTRACTOR HELD
AS OF JUNE 30, 1975
(Thousands of Dollars)

Reporting Installation	Real Property							
	Land	Buildings	Other Structures and Facilities	Leasehold Improvements	Total	Equipment(a)	Fixed Assets in Progress	Grand Total
Ames Research Center	2,928	196,541	6,166	---	205,635	114,810	16,938	337,383
ARC-Moffett Field, CA	2,928	196,541	6,166	---	205,635	108,824	16,938	331,397
Various Locations(b)	---	---	---	---	---	5,986	---	5,986
Flight Research Center	---	9,853	3,037	---	12,890	63,823	1,459	78,172
FRC-Edwards, CA	---	9,853	3,037	---	12,890	60,031	1,459	74,380
Various Locations(b)	---	---	---	---	---	3,792	---	3,792
Goddard Space Flight Center	1,661	91,830	58,670	172	152,333	549,170	14,647	716,150
GSFC-Greenbelt, MD	1,308	75,869	16,065	172	93,414	197,928	8,920	300,262
Tracking Stations (Networks)	353	15,960	42,560	---	58,873	279,283	5,727	343,883
Various Locations(b)	---	1	45	---	46	71,959	---	72,005
Jet Propulsion Laboratory	1,067	71,754	66,999	530	140,350	218,625	14,938	373,913
JPL-Pasadena, CA	1,067	59,636	7,756	385	68,844	132,138	14,938	215,920
Deep Space Network	---	12,118	59,243	145	71,506	86,487	---	157,993
Johnson Space Center	9,036	189,215	57,854	151	256,256	612,243	30,664	899,163
JSC-Houston, TX	5,466	155,470	32,540	63	193,539	324,473	30,664	548,676
White Sands Test Facility, WSTF-Las Cruces, NM	---	8,767	20,289	---	29,056	33,718	---	62,774
Various Locations(b)	3,570	24,978	5,025	88	33,661	254,052	---	287,713
Kennedy Space Center	71,345	297,723	310,931	---	679,999	589,556	23,622	1,293,177
KSC-FL	71,345	297,723	310,931	---	679,999	229,893	23,052	932,944
Western Test Range Operations Division, WTROD-Lompoc, CA	---	---	---	---	---	4,543	570	5,113
Various Locations(b)	---	---	---	---	---	355,120	---	355,120
Langley Research Center	116	132,810	155,400	---	288,326	169,343	45,694	503,363
LaRC-Hampton, VA	110	117,406	155,375	---	272,891	131,531	45,694	450,116
Various Locations(b)	6	15,404	25	---	15,435	37,812	---	53,247
Lewis Research Center	3,661	206,375	74,588	178	284,802	123,300	12,064	420,166
LeRC-Cleveland, OH	316	121,158	55,642	139	177,255	84,747	11,587	273,589
Plum Brook Operations Division, PBOD-Sandusky, OH	3,345	85,217	18,946	---	107,508	9,492	477	117,477
Various Locations(b)	---	---	---	39	39	29,061	---	29,100
Marshall Space Flight Center	7,568	197,558	109,156	---	314,282	476,560	24,570	815,412
MSFC-Huntsville, AL	---	118,769	54,541	---	173,310	245,716	9,775	428,801
Michoud Assembly Facility, MAF-New Orleans, LA	7,505	66,294	27,068	---	100,867	45,409	---	146,276
Slidell Computer Complex, SCC-Slidell, LA	63	4,518	879	---	5,460	22,345	723	28,528
Various Locations(b)	---	7,977	26,668	---	34,645	163,090	14,072	211,807
National Space Technology Laboratories	18,703	69,902	190,515	---	279,120	40,901	---	320,021
NSTL-Bay St. Louis, MS								
Wallops Flight Center	1,161	24,029	48,999	---	74,189	50,045	2,577	126,811
WFC-Wallops Island, VA	1,161	24,029	48,999	---	74,189	48,434	2,577	125,200
Various Locations(b)	---	---	---	---	---	1,611	---	1,611
NASA Headquarters	---	---	---	---	---	32,155	---	32,155
Washington, DC	---	---	---	---	---	1,760	---	1,760
Various Locations(b)	---	---	---	---	---	30,395	---	30,395
GRAND TOTAL	117,246	1,487,590	1,082,315	1,031	2,688,182	3,040,531	187,173	5,915,886

(a) Includes Contractor-Held Special Test Equipment (569,445).
(b) Includes Capital Type Property in Possession of Contractors at Various Locations.

NOTES CONCERNING THE JUSTIFICATION FORMAT

The Construction of Facilities budget estimate format for individual projects is much the same as it has been in the past several years. However, certain modifications have been incorporated in an effort to improve the clarity and usefulness of the data presented. These are:

a. FY 1976 AND PRIOR YEARS FUNDING - Under this entry, for both planning and design, and construction, two lines are shown:

(1) Specific CoF funding - to reflect the specific application to this project of any CoF resources during the last five budget years.

(2) Other affiliated funding - to reflect any other prior year funding (CoF or other) applied to the facility with which this project is associated.

It is believed that this approach is more meaningful because the great bulk of the CoF projects involve modifications or additions to existing facilities. The distinction made in the data as now presented permits a ready appraisal of the resources more specifically related to the present considerations as distinguished from those involved in earlier work for other purposes. This data has been rounded to the nearest $1,000.

b. LIST OF RELATED GRAPHICS - This heading has been added to identify additional material accompanying each project justification.

c. OTHER EQUIPMENT SUMMARY - This heading has been added to isolate and clearly set out this important facet of each project. In the past this material has been provided within the body of the documentation and its segregation will serve to facilitate its identify.

JUSTIFICATION
BY LOCATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

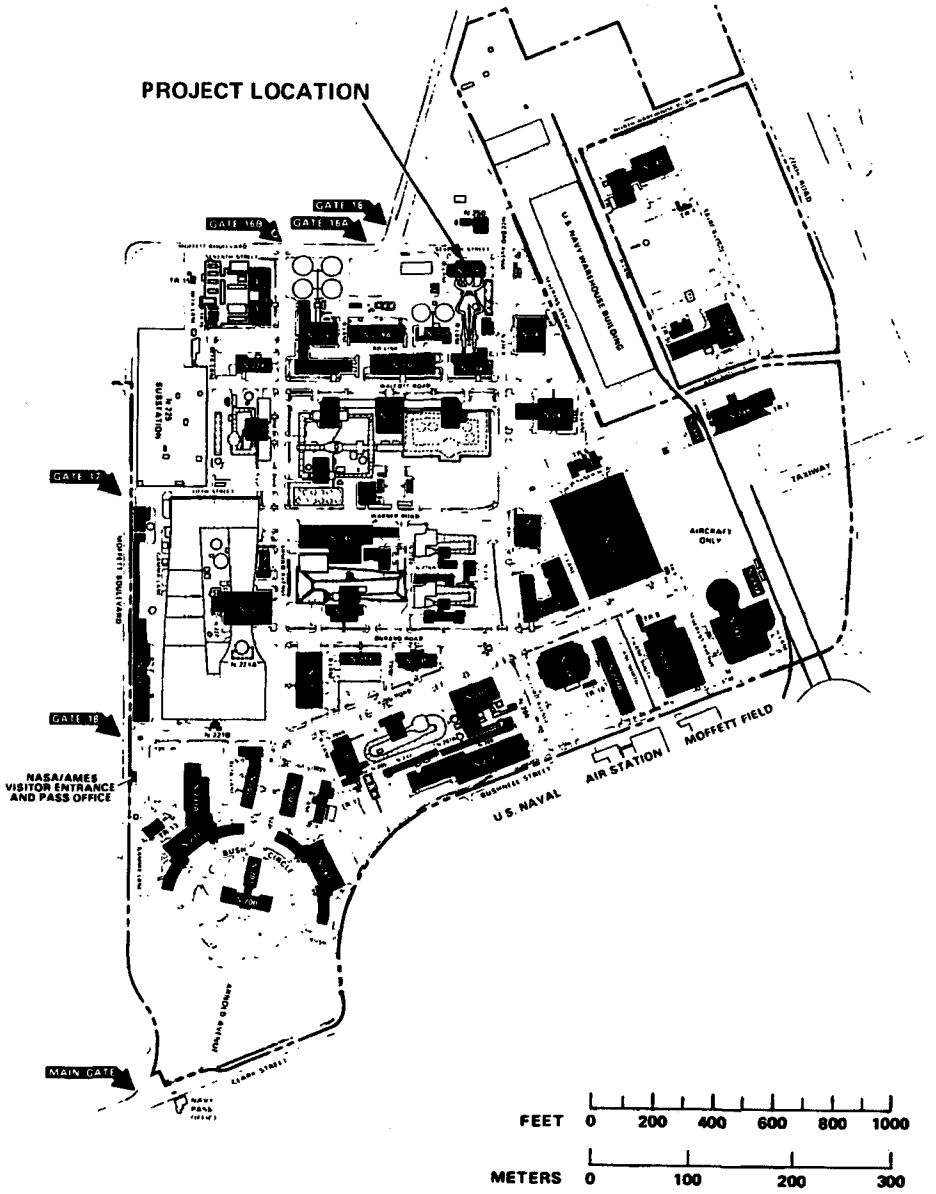
SUMMARY

AMES RESEARCH CENTER

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Modification for high enthalpy entry facility.....	1,220,000	CF 1-1
Modification of flight simulator for advanced aircraft.....	1,730,000	CF 1-8
Office of Center Operations:		
Construction of supply support facility.....	1,540,000	CF 1-14
Total.....	4,490,000	

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

LOCATION PLAN: MODIFICATION FOR HIGH ENTHALPY ENTRY FACILITY



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modification for High Enthalpy Entry Facility
INSTALLATION:	Ames Research Center
	FY 1977 CoF ESTIMATE: $1,220,000

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

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	134,000	3,575,000	3,709,000
Other affiliated funding	---	2,026,000	2,026,000
Total	134,000	5,601,000	5,735,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a 160 megawatt (MW) constricted arc facility in an existing test bay of Building N-238 at the Ames Research Center. The facility will perform the tests required to design and qualify the heat shield thermal protection systems of probes for entry into planetary atmospheres. Also included in the project are the fabrication and installation of the constricted arc heater and modification of the existing power supply, gas, water and vacuum systems.

PROJECT JUSTIFICATION:

Although the "state-of-the-art" of thermal protection during atmospheric entry has matured considerably over the last several years since the Apollo missions, new missions requiring survival for even more hos-

tile entry environments are currently being considered for the 1980-1990 time period. These missions include the entry of probes into the atmospheres of the outer planets, advanced maneuverable missile systems of high accuracy, the return of surface samples from Mars, and possibly of the disposal of toxic wastes in space and the attendant problem of safety in event of a mission abort. Each of these missions can be designed to involve a low thermal protection system risk provided that an appropriate factor of safety is used to account for uncertainties in the understanding of the fundamental phenomena that have as yet not been adequately explored by experiments. With an appropriate high enthalpy entry simulation facility, these prudent factors of safety can be reduced thereby increasing the efficiency of the mission or reducing the risk associated with the thermal protection system.

At the very high enthalpy entry conditions for the missions mentioned above, the mechanisms of thermal protection are considerably different than experienced for Apollo or current Intercontinental Ballistics Missiles (ICBM) reentries. For the outer planet probe mission, the heating is largely radiative from the hot gas shock layer surrounding the vehicle. The critical heat protection mechanisms of ablation-product absorption and ablating-surface reflection cannot currently be verified experimentally because no facility exists capable of simulating this heating environment. For the same reason, the potentially destructive phenomena of particulate removal and thermal stress inducted spallation caused by the high heating and high surface shear cannot be experimentally tested at present.

There are no known ablation facilities existing, either in the U.S. or abroad, that can achieve the required enthalpy simulation for probe entry into the atmospheres of the outer planets. The successful exploration of the atmosphere of any one of the outer planets (Jupiter, Saturn, or Uranus) by probe will require that new heat shield technology be developed prior to the design of the probe. At present, due to lack of experimental testing capability, the prudent factor of safety for a shallow entry (i.e., 7.5^{o} entry angle) into the atmosphere of Jupiter is currently about 35% in consideration of all present uncertainties. The thermal protection system under these conditions will amount to about one-half of the total probe system weight. The ratio between the thermal protection system weight and the science payload weight is then about 4. Thus, it is obviously important to have a firm determination of the required heat shield weight and not to use any larger factor of safety than necessary. With a full ground-based verification of the ablation mechanisms, it is felt that the factor of safety could be reduced to about 20% thereby permitting the potential of a 50% increase in science payload weight. Alternatively, the risk associated with a steeper entry (i.e., 15^{o} entry angle) could be reduced allowing greater mission flexibility in the selection of entry conditions (e.g., permitting a daylight entry at high solar elevation angles which is not possible with a shallow entry angle).

Therefore, the construction of the high enthalpy entry simulation facility at Ames Research Center, together with the existing lower energy facilities, will permit the evaluation of thermal protection system materials for advanced missions of the next decade in a timely manner, thereby allowing an increase in the efficiency of those missions and a reduction in technology risk.

PROJECT DESCRIPTION:

This project will provide for the fabrication and installation of a 160 MW constricted arc heater and nozzle in an existing test bay in Building N-238. The arc heater will be water-cooled and consist of components such as an anode, cathode, gas inlet, constrictor, and nozzle. The arc heater will be capable of producing the conditions required for simulating entry into planetary environment.

The existing 110 MW DC power supply will be increased to 160 MW by the addition of six power modules. Additional cooling and distribution shall be added to provide the power densities for the longer durations (10 to 15 seconds) required by the 160 MW arc heater.

This project will also include the modification of the existing gas, water, and vacuum systems of Building N-238 to meet the start up and operating needs of the arc heater. Necessary structures for the arc heater and the support systems and a safety enclosure will be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction.....				905,000
Electrical (inside 5' line).....	LS	---	---	100,000
Support systems.....	LS	---	---	225,000
Utilities (outside 5' line).....	LS	---	---	580,000
Equipment.....				315,000
Provision of arc heater and nozzle.....	LS	---	---	315,000
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				1,220,000

LIST OF RELATED GRAPHICS:

Location Plan
Single Line Drawing
Sketch of Constricted Arc Heater

OTHER EQUIPMENT SUMMARY:

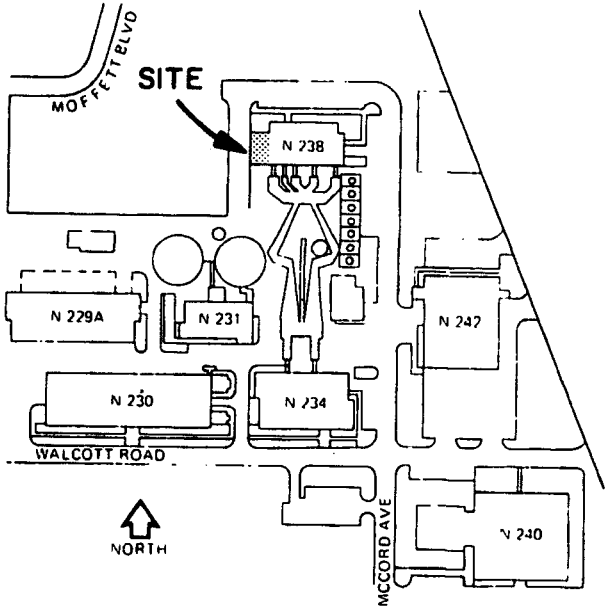
No other collateral or noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

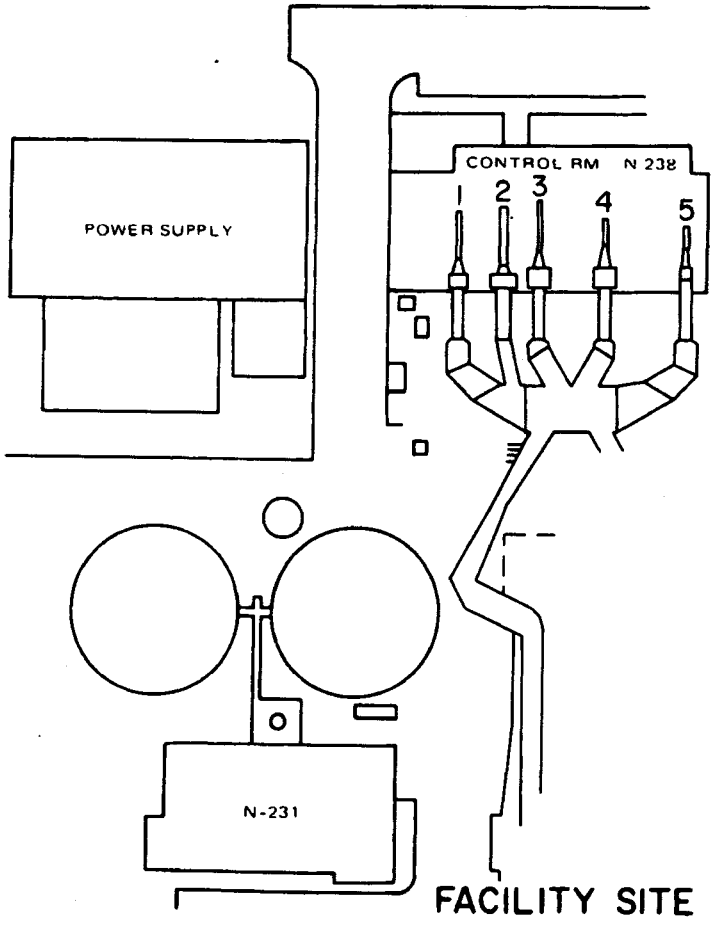
AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATION FOR HIGH ENTHALPY ENTRY FACILITY



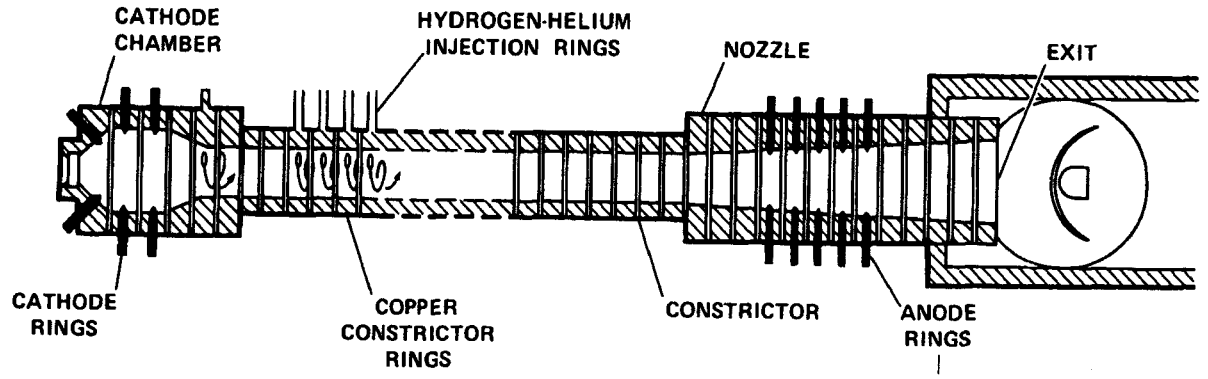
PLOT PLAN

1. 110 MW PILOT FACILITY
2. PROPOSED HIGH ENTHALPY ENTRY FACILITY
3. HIGH PRESSURE TURBULENT FLOW FACILITY
4. INTERACTION HEATING FACILITY
5. 20 MW ARC HEATER



AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

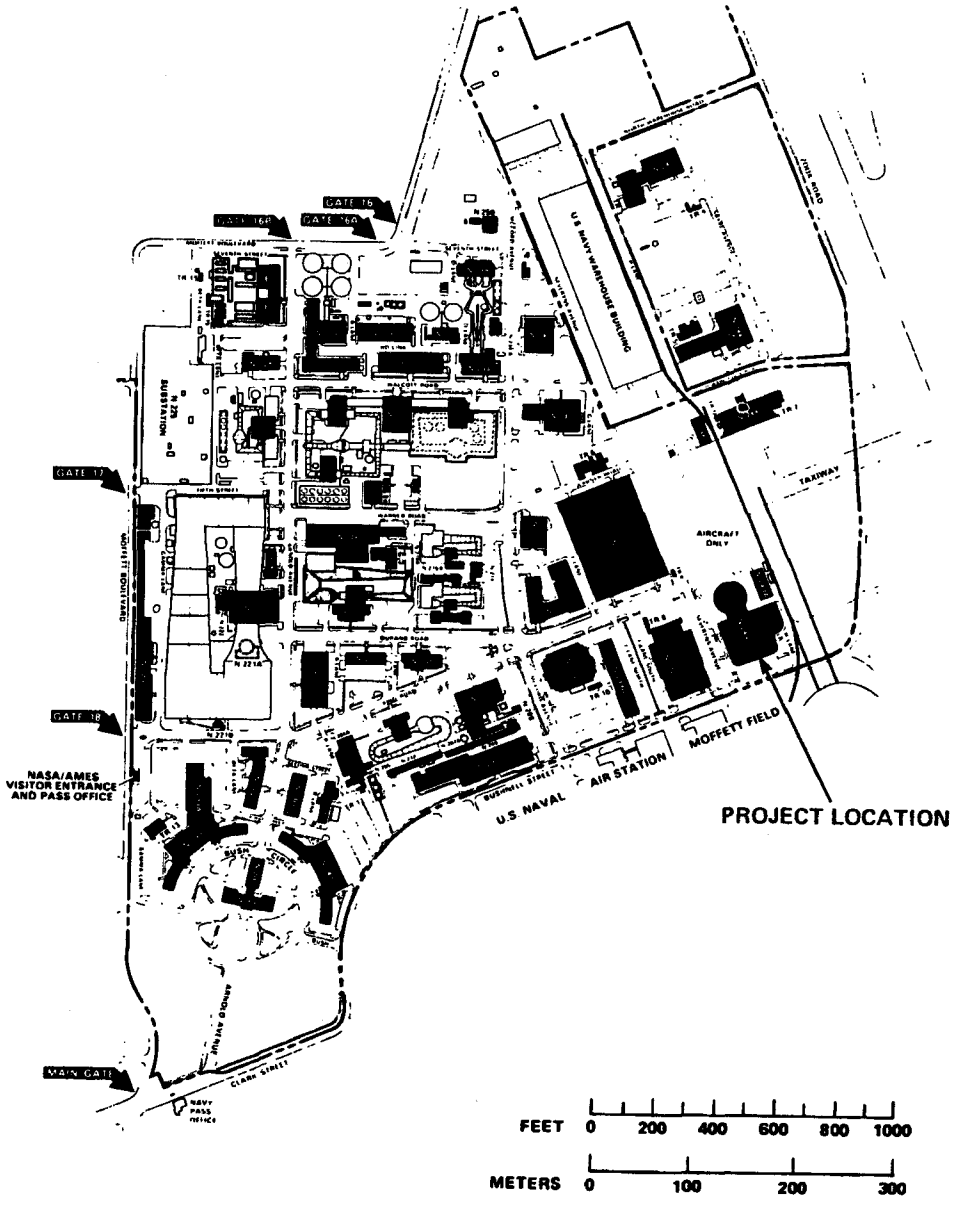
MODIFICATION FOR HIGH ENTHALPY ENTRY FACILITY



CONSTRICTED ARC HEATER DETAIL

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

LOCATION PLAN: MODIFICATION OF FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modification of Flight Simulator for Advanced Aircraft
INSTALLATION:	Ames Research Center
FY 1977 CoF ESTIMATE:	$1,730,000

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

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	333,000	3,860,000	4,193,000
Other affiliated funding	204,000	16,916,000	17,120,000
Total	537,000	20,776,000	21,313,000

SUMMARY PURPOSE AND SCOPE:

This project will increase the operational efficiency of the Flight Simulator for Advanced Aircraft by making more simulator time available for the investigators. It will allow a complete check-out of a simulation before the project occupies the simulator itself, and thus will increase the efficiency of both the use of the facility and the time of the investigators.

The proposed interchangeable module/platform system will allow "off-board" alterations to be made to the simulator cockpit, thereby reducing the time required for cockpit changeover between tests. Additionally, the cockpit module can be initially operated in the "test stand", allowing a complete check-out of the computer program and computer cockpit inter-ties before the project occupies the motion generator of the Flight Simulator for Advanced Aircraft.

PROJECT JUSTIFICATION:

The Flight Simulator for Advanced Aircraft (FSAA) is the most advanced simulator in existence. It is presently scheduled two shifts per day for the foreseeable future on "man-in-the-loop" simulation projects. These projects include certification criteria investigations in cooperation with the Federal Aviation Administration, and support of military aircraft programs for the Department of Defense. A most important use is the support of NASA research aircraft projects. The FSAA has been used in this manner to support the "Augmentor Wing Jet STOL Research Aircraft" and is still in current use in design support of the "Tilt Rotor Research Aircraft" and will continue to be used on this project through its flight test program. Scheduled projects in support of NASA research aircraft include the "Rotor Systems Research Aircraft". The work to be performed includes investigation of concept simulations, through design support simulations, to flight test support. It has also been used to support a space flight project, simulation of Space Shuttle landing.

The FSAA system is designed to accommodate frequent changes in the simulated vehicle. All cockpit hardware is connected by plugs and, for example, a control stick can conveniently be exchanged for a "column wheel" control. Entire instrument panels can be built up "off-board" and made ready to install between projects. As a further illustration of flexibility, a ceiling mounted throttle lever system can be interchanged for a conventional floor mounted throttle.

Ability to make these cockpit change overs was designed into the original FSAA simulator. The success of the simulator has produced an unanticipated heavy demand. In the past year, 27 different simulation projects have used the FSAA. Thus, the change-over time between projects becomes even more significant than originally estimated. The time required for cockpit change-over and the time spent in completion of the simulation computer cockpit check-out is not available for data taking.

It is anticipated that the proposed interchangeable module platform system will increase the FSAA data-taking time by 20 "shift-weeks" per year. This will allow an average of an additional five simulation projects to be conducted on the FSAA each year. The inherent flexibility of these changes will also permit new simulation equipment to be readily installed as it becomes available.

Because the FSAA facility is currently fully utilized, prospective programs are carefully screened to insure that the problems being investigated require its unique capabilities. As a consequence, most of the scheduled programs are ones in which the high fidelity lateral motion cues are critical to the piloted assessment. Deferment of such programs can leave unanswered questions which cannot be fully resolved in other facilities. In the case of hardware development programs, these unknowns can be extremely costly and time consuming to correct, and potentially hazardous if left until initial flight evaluations are made.

PROJECT DESCRIPTION:

The Flight Simulator for Advanced Aircraft (FSAA) located in Bldg. N-243 will be modified to provide a quick module change and/or readily changeable platform system. Included with this modification will be a new frame mounting technique for improved vibration isolation. Three new platforms will be provided. These platforms can be interchangeable for major changes but normal or minor modifications can be made by exchanging modules. Each of the platforms will be able to accommodate a pilot, co-pilot, flight engineer and observer. The platform will be fabricated aluminum with a number of hard points to accommodate almost any cab/module configuration. A ground check-out station and modification fixture will be included. One of the platforms not in use on the simulator will be mounted on this fixture for module change and computer program check-out. The last platform will be used for long term configurations and advanced visual display studies. Equipment modules to outfit two cabs (instrumentation, consoles, seats and control loaders) will be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction.....				50,000
Building and structure modifications....	LS	---	---	50,000
Equipment.....				1,680,000
Platform and shell.....	EA	3	185,000	555,000
Modifications to gimbal system.....	LS	---	---	205,000
Platform-handling equipment.....	LS	---	---	70,000
Cockpit equipment.....	LS	---	---	595,000
Computer communications equipment.....	LS	---	---	255,000
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				1,730,000

LIST OF RELATED GRAPHICS

Location Plan
Perspective and platform and module views

OTHER EQUIPMENT SUMMARY

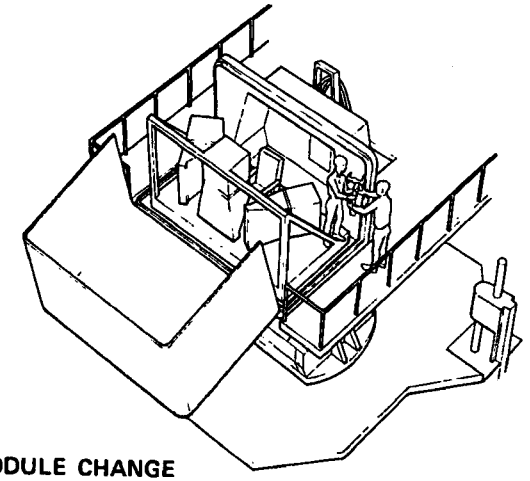
The existing noncollateral computer equipment and instrumentation valued at $3.9 million will be used with this facility. The existing collateral equipment to be used with this facility is approximately $2.7 million and includes an existing simulator, and the dedicated test equipment, communications equipment, data acquisition system, and control equipment.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

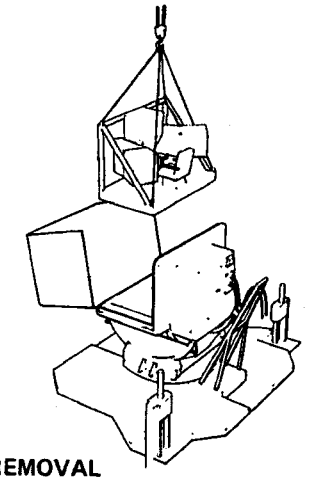
There are no presently known future requirements to complete this project.

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

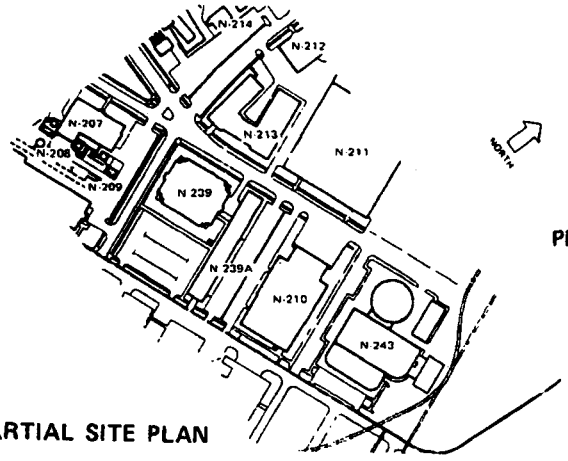
MODIFICATION OF FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT



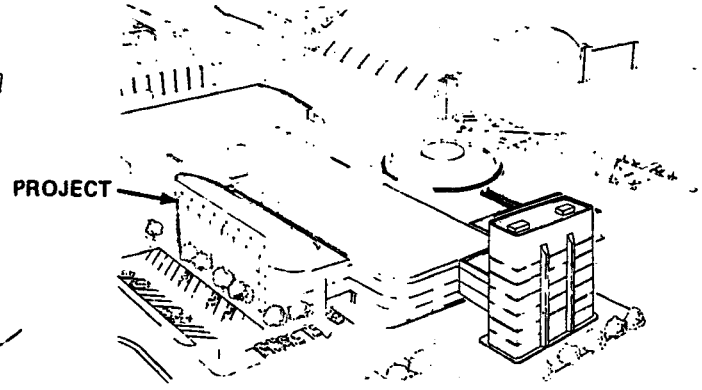
MODULE CHANGE



PLATFORM REMOVAL



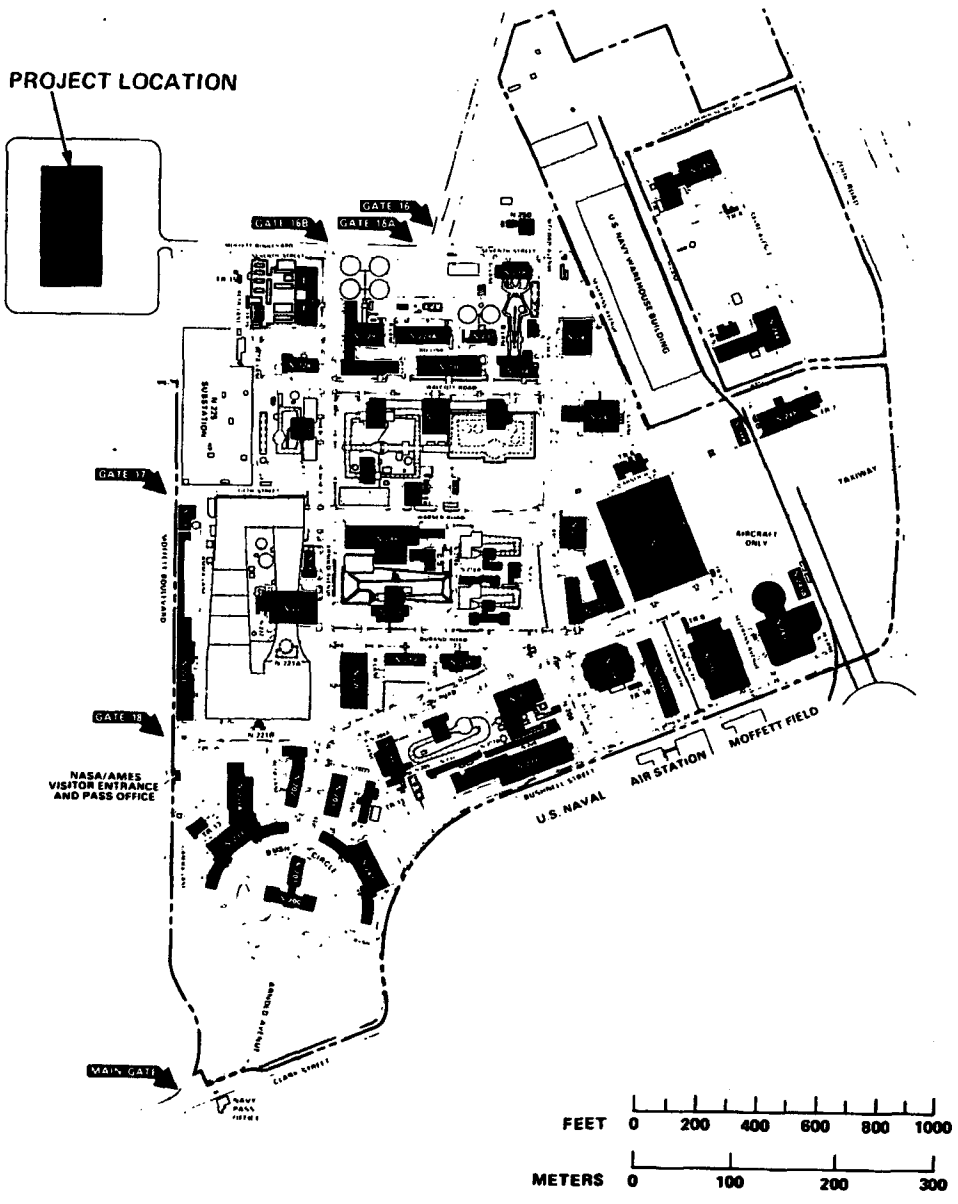
PARTIAL SITE PLAN



PERSPECTIVE

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

LOCATION PLAN: CONSTRUCTION OF SUPPLY SUPPORT FACILITY



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Supply Support Facility
INSTALLATION:	Ames Research Center
	FY 1977 CoF ESTIMATE: $1,540,000

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

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	95,000	---	95,000
Other affiliated funding	---	---	---
Total	95,000	---	95,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a separate "warehouse" type facility in an undeveloped area of Ames Research Center. The facility is intended to support the warehousing, shipping and receiving functions. The project will include special storage spaces for items such as flammable goods, hazardous chemicals, goods which require refrigeration, etc. Overhead hoists, loading docks and office space are also to be included.

Due to the proposed facility being sited in an underdeveloped area at the Center, it will be necessary to provide supporting utilities and access roads as part of the project. The area selected for the siting of the project is in accordance with the ARC master plan.

PROJECT JUSTIFICATION:

Successful performance of the mission of the Ames Research Center, or any major research center, is dependent in a large way on responsive support of the needs, both institutional and technical, of the research complement. Adequate storage and supply support is an essential element of this responsiveness. Since 1940, Ames Research Center has grown from a few buildings to a present replacement value of over $660,000,000, consisting largely of research equipment and facilities. In 1952, it was necessary to move the increased warehousing, shipping, and receiving functions from the Electrical Services Building to a 45,000-square foot (4,180 sq. m.) area under the 40-by 80-Foot Wind Tunnel, which currently provides 26,000 square feet (2,415 sq. m.) for stores issue, 7,000 square feet (650 sq. m.) for receiving, and 12,000 square feet (1,115 sq. m.) of miscellaneous storage. It was realized that the working environment under this wind tunnel was marginal at best, but then there was the possibility that the amount of testing in the wind tunnel would decrease. The tunnel use has increased, in fact, multiple shifts are forecast indefinitely. In addition the noise levels under this existing wind tunnel have increased to the range of 90 to 120 decibels depending on the tunnel test conditions. Studies have shown that this noise not only interferes with communications, but is also potentially detrimental to the health of the personnel involved (e.g., loss of hearing, nervous problems, etc.). At the present time, the Center is also using 80,000 square feet (7,432 sq. m.) of closed storage space located at Camp Parks, Pleasanton, California, 37 miles from Ames; 60,000 square feet (5,574 sq. m.) of open, fenced, hard standing storage at Camp Parks; 17,000 square feet (1,579 sq. m.) of open, fenced, hard standing storage area at the Ames Research Center; and 12,000 square feet (1,115 sq. m.) of closed temporary storage. The off-site locations required added manpower and funds to function at an acceptable level, the open storage has limited use especially in winter, and other temporary covered storage arrangements at the Center are unsatisfactory. This project will permit reducing the existing closed storage space at Camp Parks in half for use as long term storage, and remove it from day to day logistics operations. The U.S. Navy at Moffett Field cannot provide storage area for Ames' use.

It is not possible to provide efficient and responsive supply and storage support for the Center's operations with the present "patchwork" arrangement. For example, research missions aboard Center airborne science aircraft have been delayed because of the need to call in off-duty warehousing support personnel to make the 74 mile round trip to Camp Parks for aircraft repair parts. Frequently, it may also be necessary to send an aircraft mechanic to Camp Parks to provide the technical judgment as to the suitability of substitute parts. While this kind of problem is not necessarily typical or an everyday occurence, it represents the potential for adversely affecting research programs, e.g., the ability of airborne science researchers to make their observations within ideal time windows.

As a more general matter, it is not possible to respond adequately to the research needs of the Center under the present arrangement. For example, Services and Supply Division personnel estimate that Center usage justifies at least 1,000 additional items of stock inventory, but the lack of sufficient space in

the issue room precludes the stocking of these items. Thus, such items must be purchased on an individual basis, with resultant additional procurement workload and loss of quantity purchase advantages. Incoming shipments of bulk purchases which must be consigned to other storage locations (local or Camp Parks) many times requiring handling twice on receipt; usually this is repeated when the stored material is used, and this second handling is often piece-by-piece instead of in bulk. Also, the present facility will not accommodate necessary expansion of the existing refrigerated storage space, thus incurring similar problems for phototechnology supplies and other materials that must be stored under refrigeration.

The existing receiving facility has a single entry door, thus shippers with incoming materials have to "queue up" to unload. This frequently forces outgoing vehicles for on-Center deliveries to wait until the situation has cleared. Under these circumstances, it is impossible to conduct a routine and orderly receipt and dispatch of materials. There is no other realistic alternative to the present unsuitable arrangement than to provide for this facility.

PROJECT DESCRIPTION:

The proposed facility will consist of a new one-story, high bay structure containing a gross area of 80,000 square feet (7,432 sq. m.) with about 48,600 square feet (4,515 sq. m.) of warehousing functions, 15,000 square feet (1,394 sq. m.) of shipping and receiving functions and 12,000 square feet (1,115 sq. m.) of stock issuing functions. The net office space included in the project is 4,400 square feet (409 sq. m.) for Property Management Supply Branch and contract employees. Construction is a steel frame and roof system with prefinished sheet metal exterior walls and heavy duty concrete floor on grade. Shops and storage areas will be heated. Offices will be heated and air-conditioned. Also included will be ramps, loading docks, and cranes for shipping and receiving.

The proposed site is presently undeveloped. Extension of all necessary utilities and roadways are included and sized to serve presently proposed construction and future expansion. Parking facilities and minimal site improvements to the structure are to be included.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction				1,540,000
Utilities outside 5' line.....	LS	---	185,000	185,000
Site work.....	LS	---	180,000	180,000
Architectural/structural.....	SF	80,000	10.50	840,000
Mechanical/plumbing.....	SF	80,000	2.87	230,000
Electrical.....	SF	80,000	1.31	105,000
Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				1,540,000

LIST OF RELATED GRAPHICS:

Location Plan
Perspective
Single Line Drawing

OTHER EQUIPMENT SUMMARY:

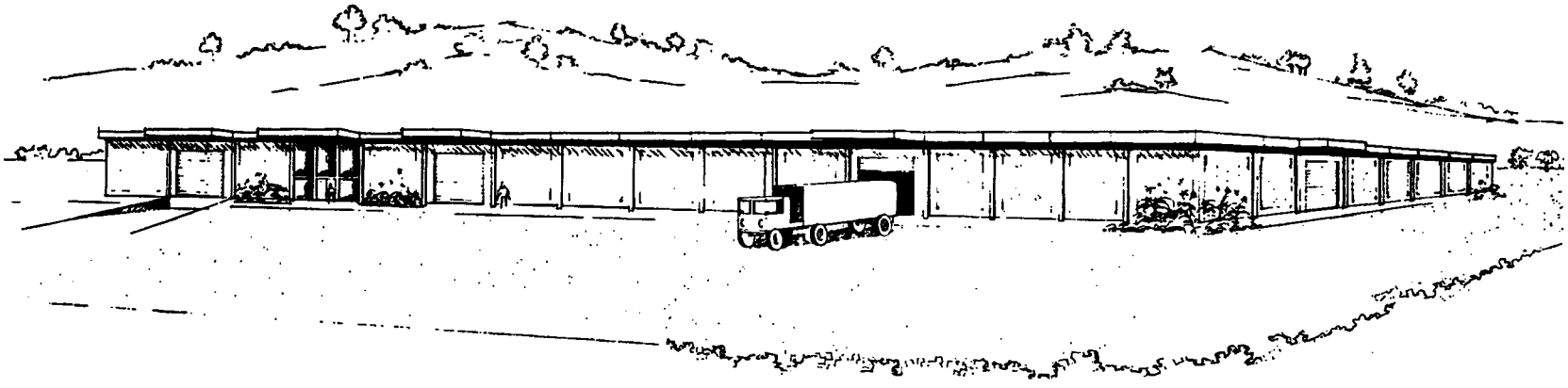
There are no additional known collateral or noncollateral equipment required to make this facility operational.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

As presently planned, there are no foreseen future funding requirements necessary to complete this project.

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

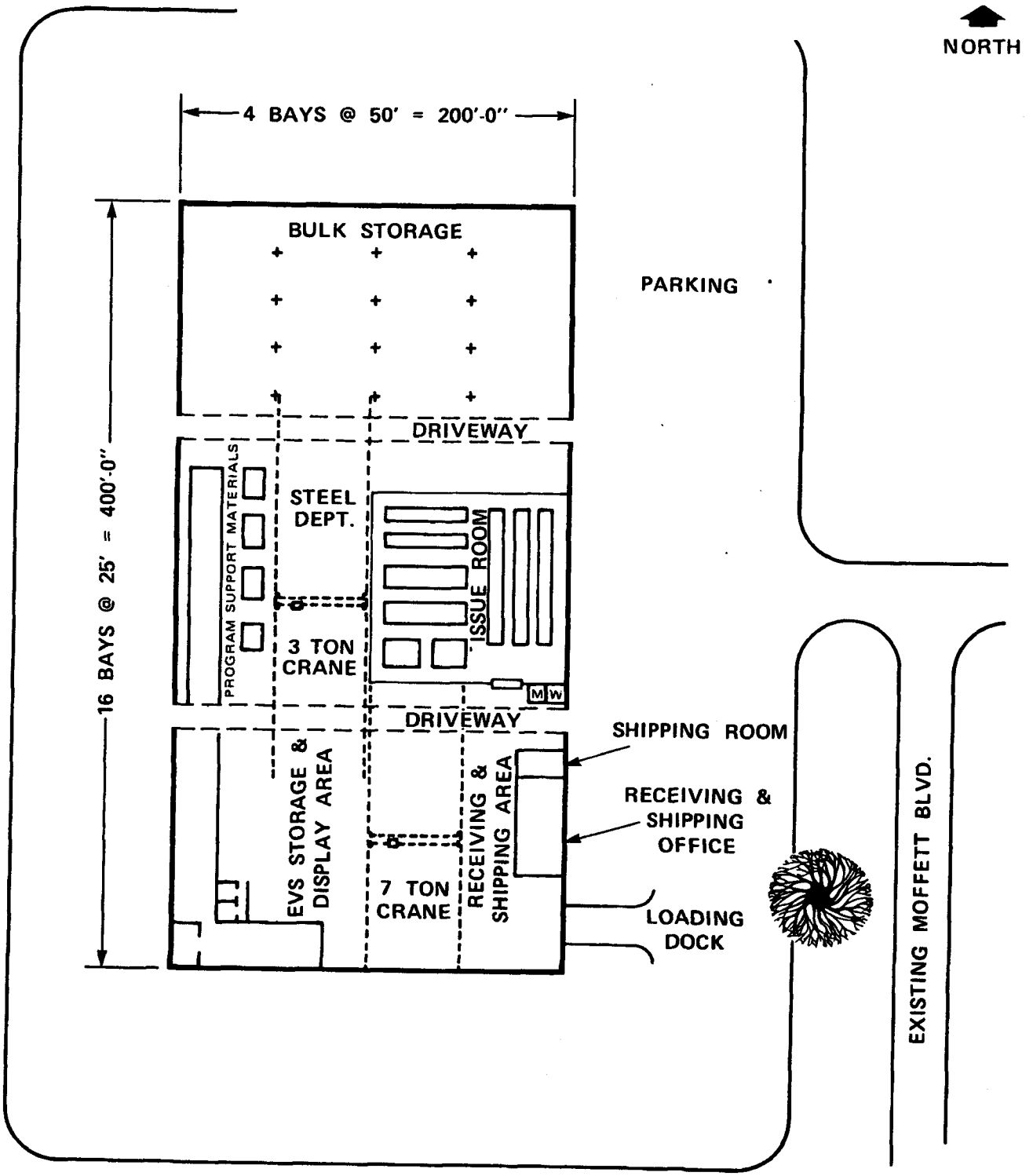
CONSTRUCTION OF
SUPPLY SUPPORT FACILITY



PERSPECTIVE

AMES RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF SUPPLY SUPPORT FACILITY



FLOOR PLAN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

SUMMARY

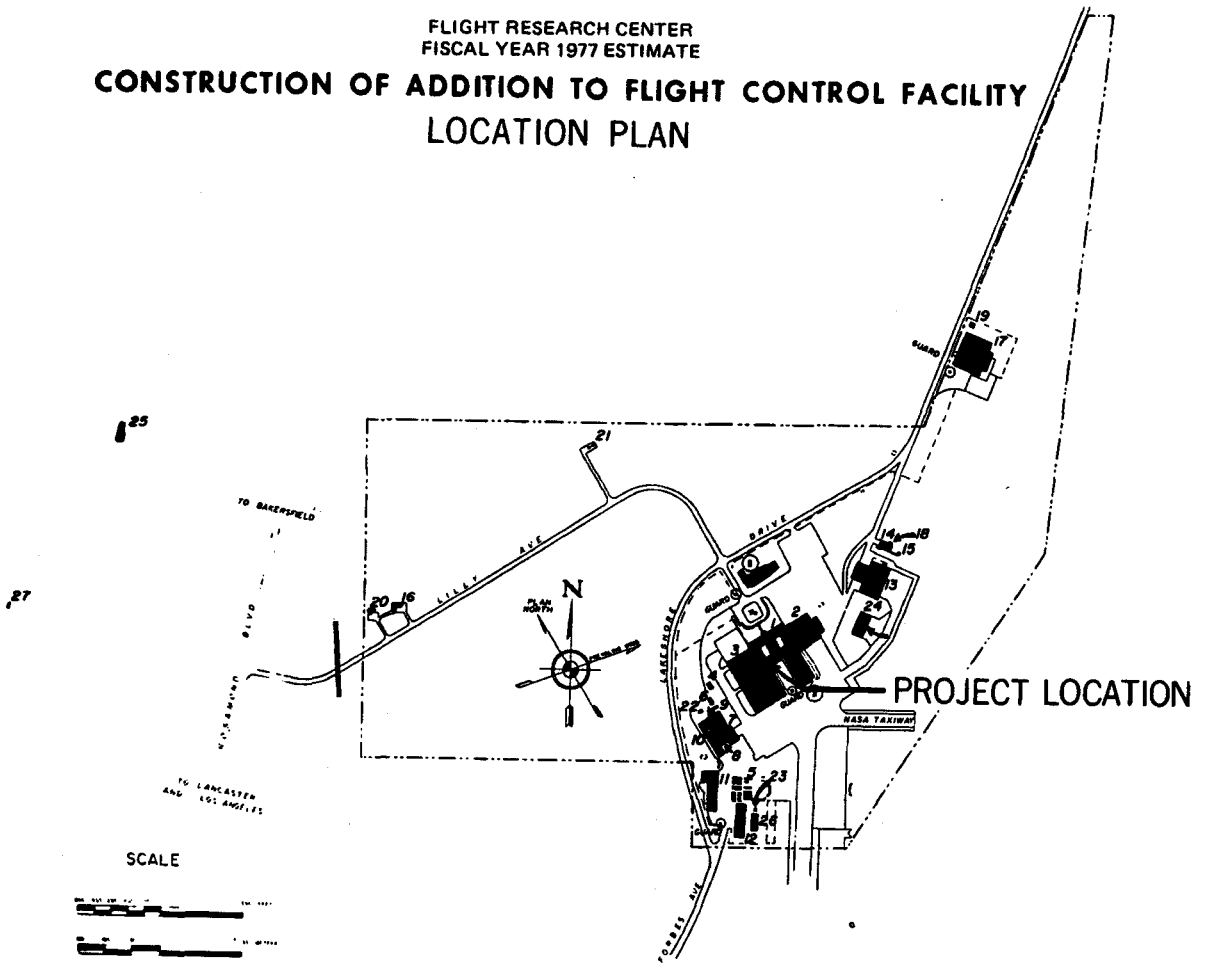
FLIGHT RESEARCH CENTER

	Amount	Page No.
Office of Tracking and Data Acquisition:		
Construction of addition to flight control facility.....	750,000	CF 2-1

FLIGHT RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATE

CONSTRUCTION OF ADDITION TO FLIGHT CONTROL FACILITY

LOCATION PLAN



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Addition to Flight Control Facility
INSTALLATION:	Flight Research Center
	FY 1977 CoF ESTIMATE: $750,000

LOCATION OF PROJECT: Edwards, Kern County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Tracking and Data Acquisition

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	53,000	---	53,000
Other affiliated funding	---	3,567,000	3,567,000
Total	53,000	3,567,000	3,620,000

SUMMARY PURPOSE AND SCOPE:

The purpose of the project is to enhance the operational efficiency, safety of flight monitoring and flight data processing of the Flight (Mission) Control Facilities utilized by the Flight Research Center (FRC) for aeronautical flight research. These objectives will be obtained from this project by providing the needed space to collocate the necessary members of the flight control team and their supporting equipment in a central control area with ready access to flight display boards, other technical specialists involved and computer data outputs.

To make space available to accommodate this centralized control area, an addition will be made to the south side of Building 4800 extending the floor area of the second and third floors by approximately 8,410 square feet (781 square meters). The increased space will accommodate a new and larger control area plus

provide the necessary space for the tracking data computer, telemetry ground station, television acquistion and recording, and random and high frequency data analysis items of equipment.

PROJECT JUSTIFICATION:

The Flight Research Center (FRC) currently conducts flight research of some of the most important research aircraft in the world today. With the continuing drive for increased efficiency and cost effectiveness in the area of flight research, the typical research aircraft today is more highly instrumented with more sophisticated sensors and data acquisition systems than ever before. Correspondingly, the ground control station necessary to process the flight data has grown more complex, extensive, and sophisticated. FRC has kept pace with demands by continual updating and improvements of its Flight Control Facility. However, the lack of physical space has now become a most serious constraining factor.

Because of the lack of space, the flight controllers (people who must react quickly, efficiently, and in a coordinated fashion, especially in emergency situations) must be located in separate areas. By shortening the lines of communication, and providing better working space with access to the appropriate computer data outputs, the overall efficiency, hence the safety of flight, will be significantly enhanced.

The most valuable output of flight research is data. Real time data displays are utilized by flight controllers to monitor the progress of any particular flight in order to assure accomplishment of mission objectives in a safe and efficient manner. Post-flight data processing gives engineers and scientists the information they require to perform the analyses that provide the real benefits from flight research. In recent years, data display and data processing have been identified as key factors in limiting the FRC's attempts to make flight programs more efficient, hence, less costly.

Processed data is required to be displayed on the ground during flight so that ground controllers can assure Flight Safety, assist in setting up the exact flight conditions to obtain the required research data, assure that all instrumentation and aircraft systems are functioning properly for the experiment, and take the appropriate action when unanticipated events occur. This eliminates the need for additional flights to obtain data missed in prior flights. Real time data is also required to assure flight safety in proceeding from one test point to another.

Rapid post-flight data processing is required so that the project engineer can assess from the research team the status of flight results and plan the details of the next flight. Typical time required to process data after flight should not exceed two working shifts, but it is not possible for FRC to meet this goal on major projects at present. Failure to achieve this "turn around" generates pressures that could result in either delayed flight schedules or flying without proper assessment of data from the previous flight.

These problems were recognized and corrective action taken, new ground systems are coming into being at FRC, but now the major limiting factor in obtaining maximum efficiency is physical floor space restrictions.

This facility will be used to support most of the future aeronautical flight research programs as well as the Space Shuttle Approach and Landing Test (ALT) and Secondary Landing Site (SLS) tests. A partial list of these programs is:

YF-12
Highly Maneuverable Aircraft Technology (HiMAT)
F-8 Digital Fly-By-Wire
Tilt Rotor Research Aircraft
Drones for Aerodynamics and Structural Testing
Fuel Conservation Flight Experiments

The situation which has evolved is not surprising since this control room has not undergone any basic change in size or layout since about 1960. High technology aircraft such as the F-15, F-8 (Digital Fly-By-Wire), and YF-12 require more systems monitoring and display facilities to conduct safe and efficient flights. While the technical equipment has been approved, funded, and are being provided, interior installation in the present space will result in a condition which is operationally unacceptable to FRC until the proposed project is approved and completed.

PROJECT DESCRIPTION:

This proposed project will provide for a two-story addition, approximately 8,410 square feet (781 square meters), to the south side of Building 4800, extending the existing areas of the second and third floors. The structure will be constructed with steel supporting columns and beams, steel floor decking and insulated metal roof. The exterior wall will be of steel studs with a stucco surface esthetically matching the existing building. The second floor will provide offices for the Range Systems, Range Operations, and Tracking and Communications Telemetry. A meeting room, rest rooms, halls and stairways are also included with this project. The addition to the third floor will provide for the Division's operating equipment in connection with the existing operations area. The new space will be occupied by the telemetry ground station equipment, the flight control room, a technical viewing room and a stairway.

The existing third floor area of Building 4800 will be reconfigured, allowing safe structural loading conditions on the floor, with adequate spacing and clearances of equipment and the installation of a tape storage room.

A separate electrical and air conditioning system will be installed which will allow operation of the facility from an independent on-site generated power source. In this mode the facility will be able to operate for critical flight test programs without risk of mission failure due to commercial power outages.

All necessary utilities and adequate fire protection system are included with this project.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				735,000
Architectural and structural	SF	8,410	44.00	370,000
Mechanical	SF	8,410	32.00	270,000
Electrical	SF	8,410	11.30	95,000
Equipment				15,000
750 KVA transformer	EA	1	15,000	15,000
Fallout Shelter (not feasible)	---	---	---	---
Total				750,000

LIST OF RELATED GRAPHICS:

Location Plan
Single Line Drawing - Second Floor
Single Line Drawing - Third Floor

OTHER EQUIPMENT SUMMARY:

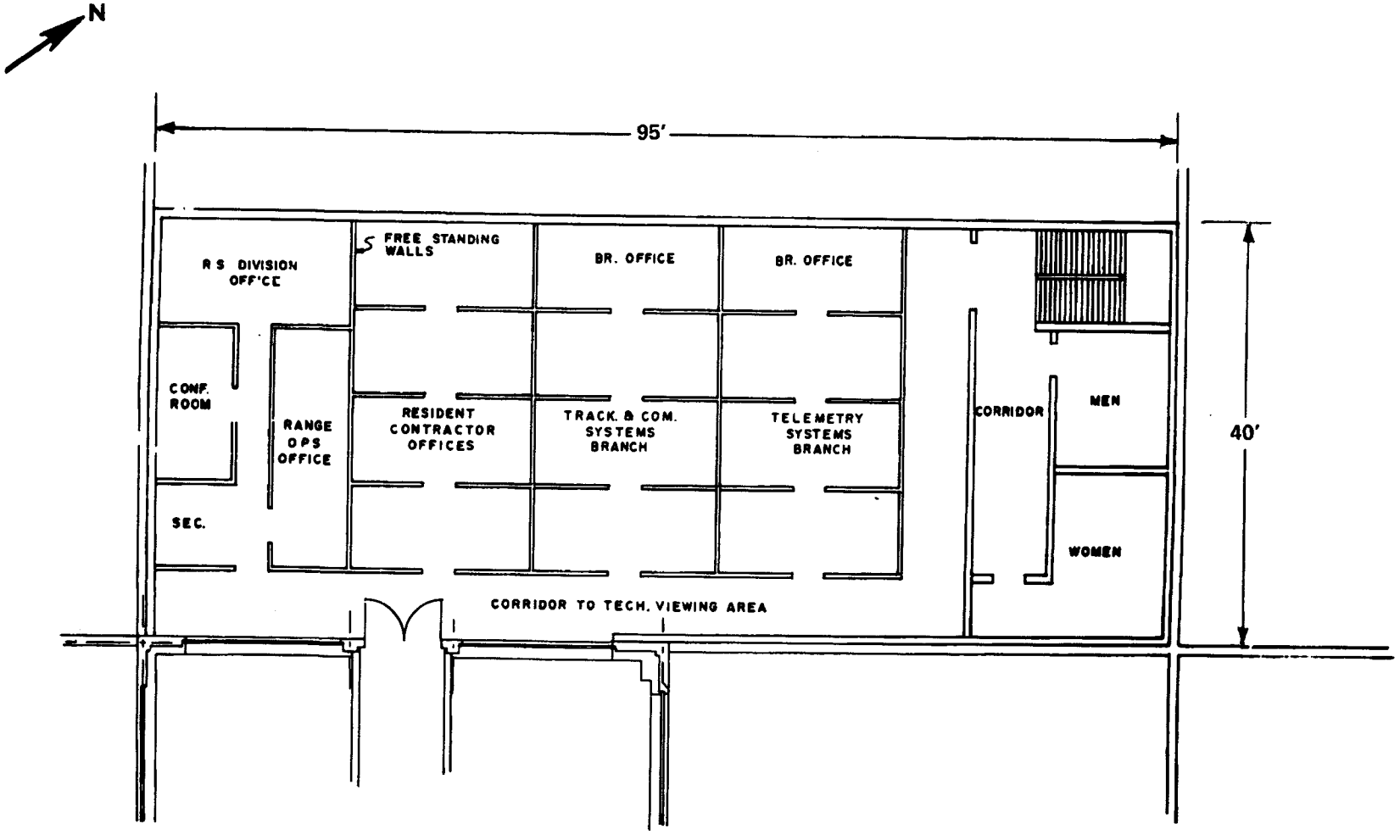
Existing noncollateral equipment such as consoles, computer, peripheral equipment valued at about $1,700,000 will be used with this facility. There are no known additional collateral equipment required to be used with this facility.

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.

FLIGHT RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATE

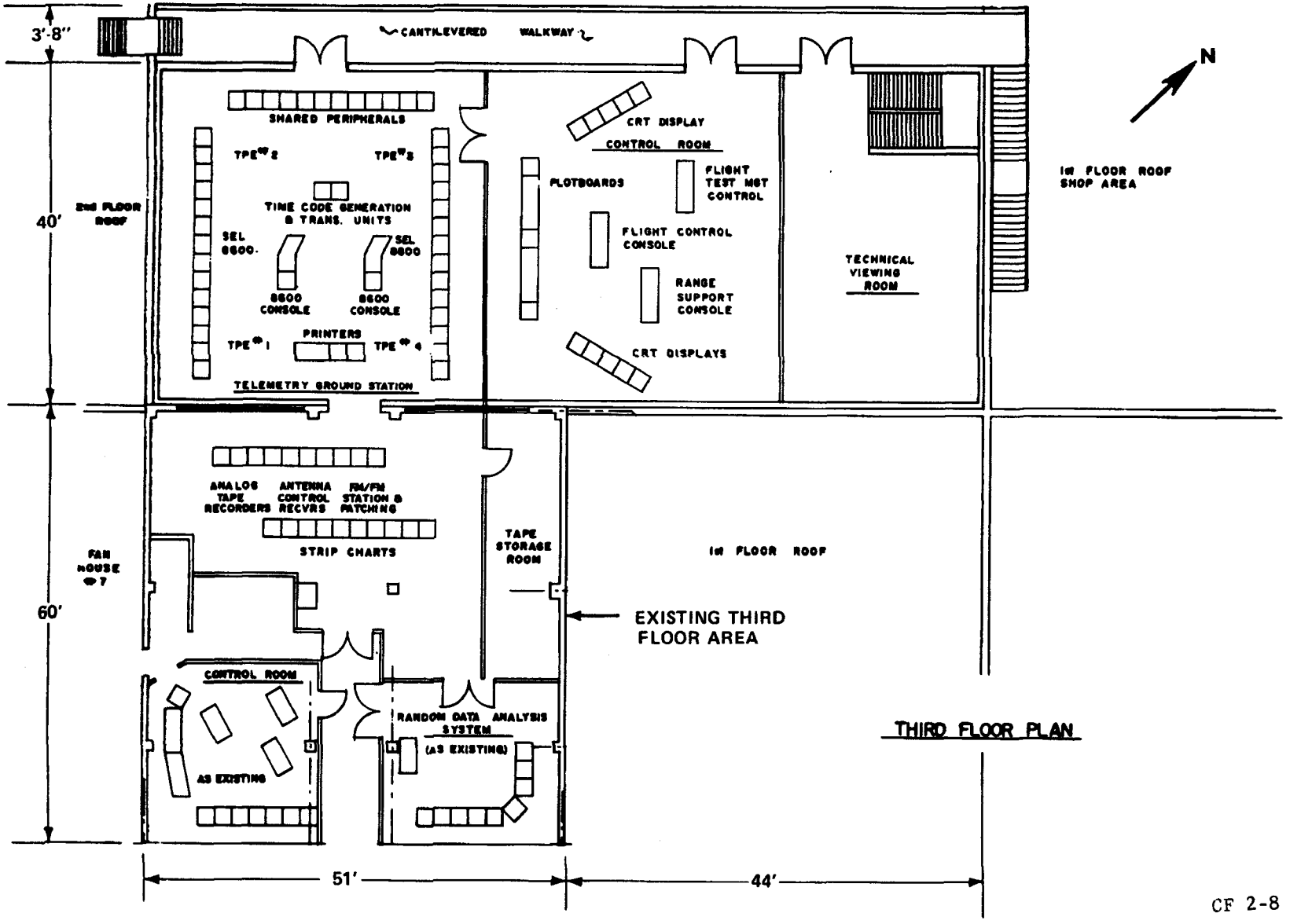
CONSTRUCTION OF ADDITION TO FLIGHT CONTROL FACILITY



SECOND FLOOR PLAN

FLIGHT RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATE

CONSTRUCTION OF ADDITION TO FLIGHT CONTROL FACILITY



CF 2-8

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

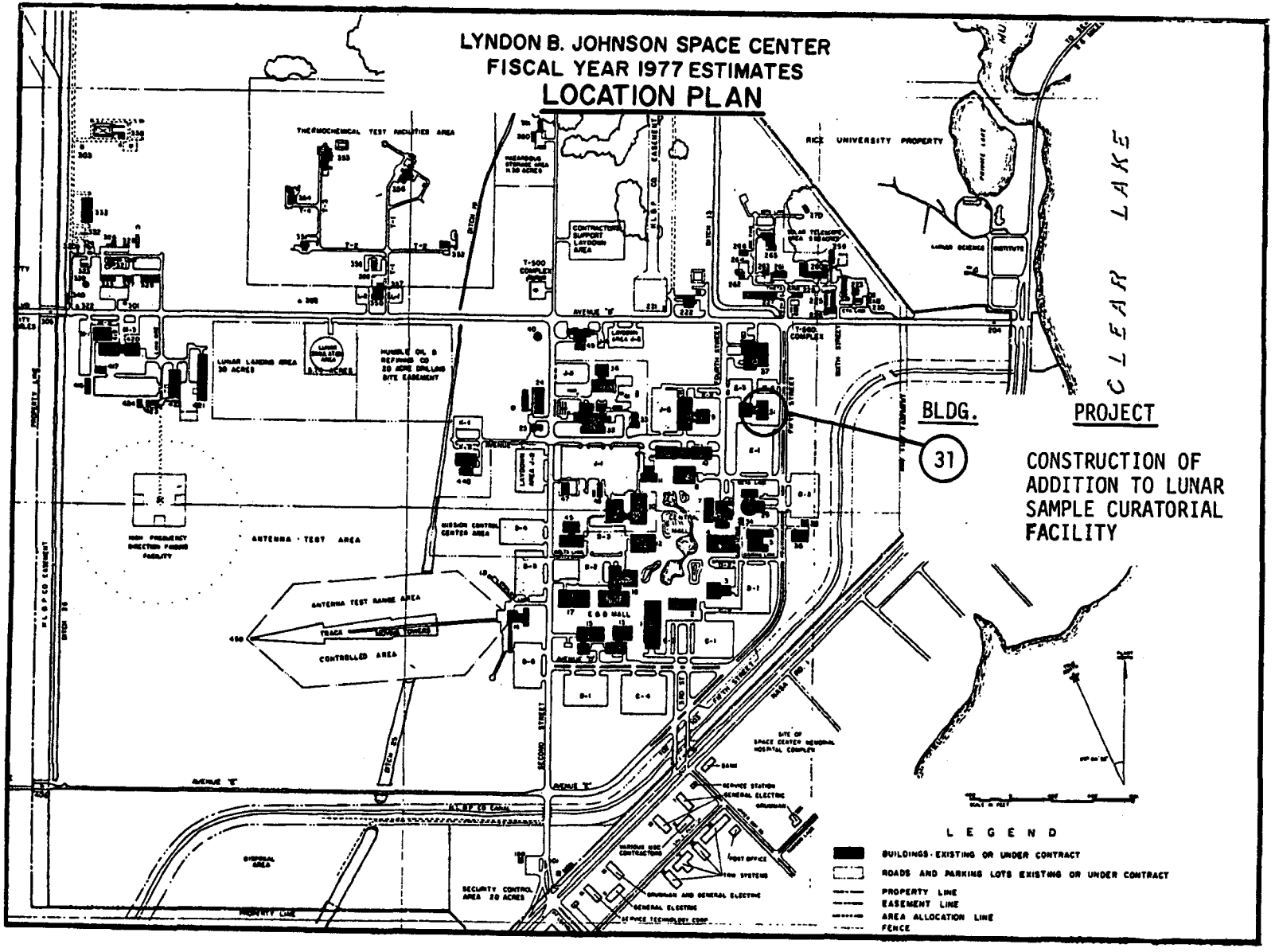
CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

SUMMARY

LYNDON B. JOHNSON SPACE CENTER

	Amount	Page No.
Office of Space Science:		
Construction of addition to lunar sample curatorial facility.....	2,800,000	CF 3-1


LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
LOCATION PLAN
CLEAR LAKE
RICE UNIVERSITY PROPERTY
BLDG.
PROJECT
31
CONSTRUCTION OF ADDITION TO LUNAR SAMPLE CURATORIAL FACILITY
LEGEND
BUILDINGS - EXISTING OR UNDER CONTRACT
ROADS AND PARKING LOTS EXISTING OR UNDER CONTRACT
PROPERTY LINE
EASEMENT LINE
AREA ALLOCATION LINE
FENCE

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Addition to Lunar Sample Curatorial Facility
INSTALLATION:	Lyndon B. Johnson Space Center
FY 1977 CoF ESTIMATE:	$2,800,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	391,000	---	391,000
Other affiliated funding	55,000	1,946,000	2,001,000
Total	446,000	1,946,000	2,392,000

SUMMARY PURPOSE AND SCOPE:

This project provides for a 15,000-square foot (1,394m^2) addition to the existing Lunar Sample Curatorial Facility (Building 31) at Johnson Space Center (JSC) to allow safe, secure, and effective storage, inspection, study, and scientific analysis of lunar samples.

PROJECT JUSTIFICATION:

The Apollo Program brought 842 pounds (382 kg) of lunar material to earth. The lunar samples are a tangible result of a great national effort and constitute an invaluable scientific resource that will require study into the indefinite future. These invaluable scientific resources cannot be replaced since

there are no current plans to return to the moon. It is imperative then that this material be stored and processed in a facility that provides maximum protection from potential hazards, such as intense storms, theft, and vandalism. Equally important is the fact that the experience and technology gained since 1969 in procedures for cataloging, handling, and studying lunar samples now permit a better definition of requirements for building a facility that will meet the need for lunar sample curation into the future.

Because of the concern and risks involved in housing all the lunar sample material at one location, NASA has recently taken measures to alleviate this situation. After considerable study of alternative sites remote from JSC, a facility located at Brooks Air Force Base, San Antonio, Texas, was selected as the optimum place for storing a representative sample (20 to 30 percent) of the variety of materials in the collection. The required modifications to prepare the facility to receive and store the material safely and effectively is nearing completion, and it is expected that the lunar samples will be stored at this remote site early in CY 1976.

It has been recognized, however, that the major portion of curatorial activities will remain at Johnson Space Center, where the specialized curatorial expertise to carry out the vital research exists. It has also been recognized that the existing facilities at JSC should be improved to afford a more effective environment for the preservation and processing of the samples. Based on recent studies, it is considered that present facilities at JSC do not provide the fullest protection of lunar samples from natural and man-made hazards. For example, Building 31 affords very little protection from heavy storms, especially those involving tornadoes, floods, and hurricanes, or from excessive building and ground shock waves, sabotage, or vandalism. The hazard from hurricane surge tides increases as local ground subsidence in the JSC area continues. The crowded and limited capabilities available, as well as the concern for improved protection, have led NASA to disperse large portions of the samples in various locations at Johnson Space Center. These samples should be returned to the principal working collection for inspection by the curatorial personnel and for ready accessibility to the scientists. This project provides for a secure storage vault and the associated laboratory facilities for these essential scientific activities.

NASA has considered the use of the Lunar Receiving Laboratory, Building 37, to accommodate the curatorial functions. This alternative proved less economical and less effective than the facilities proposed in this project. The Lunar Receiving Laboratory was constructed to provide for the quarantine of returned lunar materials and astronauts. At that time, the main concern was to ensure that potential life forms from the moon would not be allowed to contaminate the earth. The facility was not configured to handle the present scope of curatorial activities. Generally, the Lunar Receiving Laboratory included features such as sophisticated cabinetry for biospecimen exposure to lunar material, systems for physical and chemical analysis, low-level vacuum systems for sample processing, incineration of all waste, crew living quarters, and emergency medical facilities. Also, it was designed for post-mission contamination control and not for long-term secure sample storage and inventory management. Most of these unique systems were removed several years ago and are now being used by another Government agency. This removed equipment,

although unique for quarantine purposes, was different from the cabinetry and mode of operation required in today's curatorial activity. Using this facility would require major modifications and a new addition with a properly positioned vault to protect against hazards. The modifications and addition would cost more than this FY 1977 project.

For this reason, and because nearly all curatorial activities and equipment are now located in Building 31, it has been determined that the continued use of the present curatorial facility, with the proposed addition, is the best and most effective solution to meeting the critical needs of the lunar curatorial functions.

The lunar material has been cataloged into nearly 46,000 samples, which are being studied by approximately 150 principal investigators and 1,000 other scientists. The quantity of lunar samples and the number of interested scientists are much greater than originally anticipated. There are currently no available laboratories which permit visiting scientists to examine pristine lunar samples. To the extent that visiting scientists are allowed to examine samples, the regular activities of the curatorial processing laboratories are hindered because both operations require the same amount of space and the same number of cabinets. There is presently no clean, secure laboratory to which a scientist can come and perform special experiments that would require large amounts of pristine material or a large fraction of a unique sample. Such facilities are required and needed whenever transfer of the subject materials to the scientist's own laboratory would involve unacceptable risks.

This project is required to provide safe secure storage and handling of the great number of lunar samples and for proper scientific characterization of these samples.

PROJECT DESCRIPTION:

This project provides for the construction of an approximately 15,000-square foot (1,394m^2) addition to the existing lunar sample curatorial facility at JSC. The two-story structure will be 61.5 feet by 115 feet (18.7m by 35.1m) with a 21-foot by 18-foot (6.4m by 5.5m) two-story connecting section. A 1,968 (net)-square foot (183m^2) ultraclean and highly secure vault for storing lunar samples is included. It will be located on the second floor, at an adequate elevation to protect the samples from potential flood damage. Processing, experiment, and simulation laboratories; data storage areas; and other support areas will also be provided.

Local and remote audible/visual alarms will be installed, and the necessary utility systems will be extended from an existing utility tunnel.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				2,800,000
Site preparation and utilities	LS	---	---	335,000
Structural and architectural (including vault)	LS	---	---	1,165,000
Mechanical systems	LS	---	---	995,000
Electrical systems	LS	---	---	270,000
Sprinkler system	LS	---	---	35,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,800,000

LIST OF RELATED GRAPHICS:

Location Plan
Building 31 Perspective
Building 31 Floor Plan

OTHER EQUIPMENT SUMMARY:

An estimated $295,000 in R&D funds for new noncollateral equipment such as lunar sample storage and processing cabinets, tables, benches, closed-circuit television, and analyzers are required to make the facility operational. Existing storage and processing cabinets and miscellaneous laboratory furniture and equipment valued at $370,000 will be relocated in the new addition.

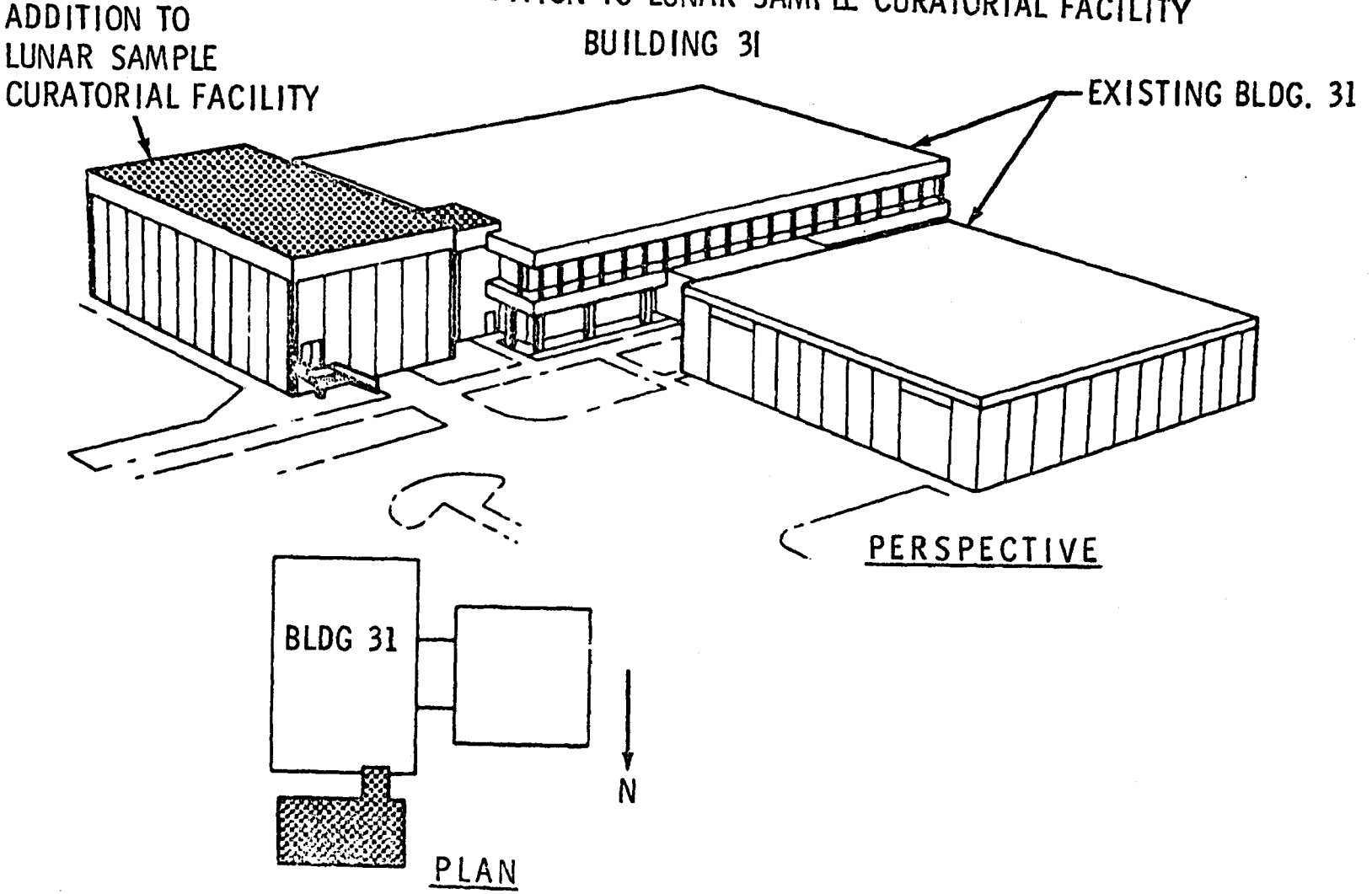
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

LYNDON B. JOHNSON SPACE CENTER

FISCAL YEAR 1977 ESTIMATES

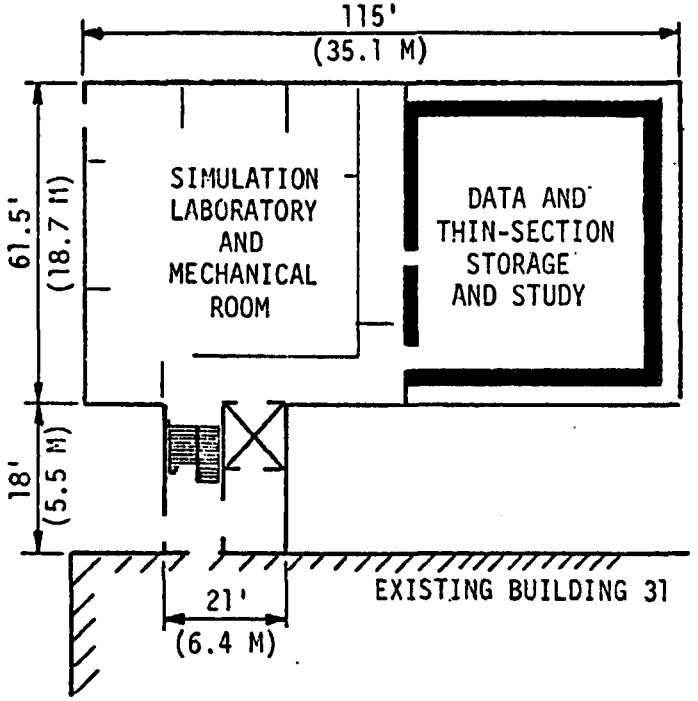
CONSTRUCTION OF ADDITION TO LUNAR SAMPLE CURATORIAL FACILITY



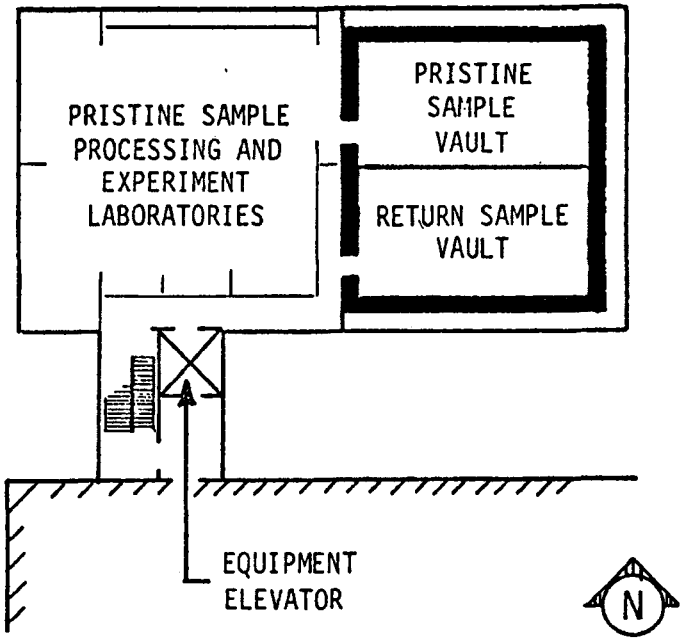
LYNDON B. JOHNSON SPACE CENTER

FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF ADDITION TO LUNAR SAMPLE CURATORIAL FACILITY BUILDING 31



FIRST FLOOR PLAN



SECOND FLOOR PLAN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

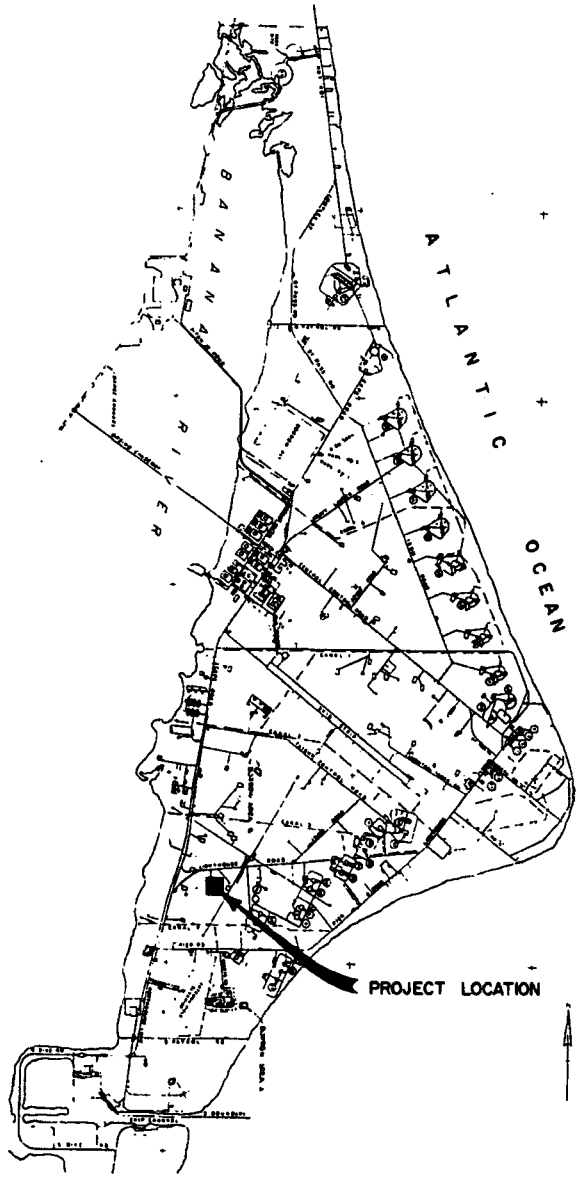
SUMMARY

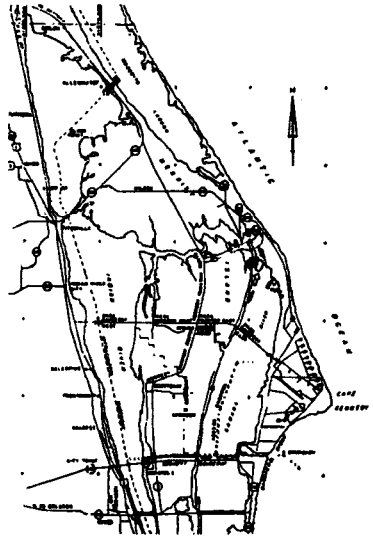
JOHN F. KENNEDY SPACE CENTER

	Amount	Page No.
Office of Space Flight:		
Construction of airlock to spin test facility.....	360,000	CF 4-1
Office of Center Operations:		
Modifications for utility control system.....	2,445,000	CF 4-8
Total.....	2,805,000	

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF AIRLOCK TO SPIN TEST FACILITY





VICINITY MAP
SCALE NONE

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Airlock to Spin Test Facility
INSTALLATION:	John F. Kennedy Space Center
FY 1977 CoF ESTIMATE:	$360,000

LOCATION OF PROJECT: Cape Canaveral Air Force Station, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	26,000	---	26,000
Other affiliated funding.....	23,000	750,000	773,000
Total.....	49,000	750,000	799,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide an addition to the Spin Test Facility (STF) for use as an airlock to the Spin Test Bay. This 2,065-square foot (192 square meters) addition is required to provide space in which preliminary operations for the third stage/spacecraft can be accomplished in a clean environment without compromising the clean environment of the Spin Test Bay. The preliminary operations to be accomplished in the airlock include unloading the third stage/spacecraft-handling can from its transporter, cleaning and handling of Delta fairings, storage and cleaning spacecraft ground servicing equipment, and placement of the assembly in the "spacecraft-handling can" and loading onto its transporter.

PROJECT JUSTIFICATION:

The Spin Test Facility (STF), built in 1966, is the only facility having a spin test capability at Kennedy Space Center, Eastern Test Range. Spin test is the rotation of a space vehicle to ascertain its dynamic balance. Since other facilities at the launch site are overcrowded, the STF is being utilized for fueling and checkout in addition to spin test. The 2,065-square foot (192 square meters) addition is required to provide an additional clean area for preliminary operations without compromising the clean area of the Spin Test Bay and to alleviate its crowded condition.

Present operations require that all third stage/spacecraft components be brought into the high bay (Spin Test Bay), removed from their shipping containers, checked out, fueled, and placed into spacecraft-handling cans prior to opening the high bay doors. All excess equipment such as shipping containers, fuel-loading carts, and fairings are stored inside the high bay while check-out operations are proceeding. This excess equipment compromises high bay cleanliness and encroaches on work space needed for spin testing. thereby tending to cause a safety hazard.

The airlock will permit the movement of excess equipment in and out of the high bay as dictated by operational requirements without compromising the integrity of the high bay environment and operations. Moreover, the effective utilization of the facility will be greatly increased by not interrupting the high bay activities which will provide greater assurance that adequate and timely support for the launch schedule will be realized.

Since this is the only facility having spin test capability, it will be used for unmanned spacecraft such as the following: (1) International Sun Earth Explorer Satellite, (2) ESRO/Maritime Communications Satellite, (3) AEROSAT/Aircraft Navigation Satellite, (4) Japan/Communications Satellite, and (5) Japan/Broadcast Satellite.

PROJECT DESCRIPTION:

This project provides the construction of a 35 ft. x 50 ft. x 45 ft. high (11 m x 15 m x 14 m) airlock structure as an addition to the east side of the Spin Test Building (Building No. 67900). The structure is a blast-proof, narrow high bay type requiring reinforced columns and four levels of reinforced concrete beams to support wall construction and to tie the building together longitudinally. The project also includes air conditioning, provision of a fire protection system, installation of interior and exterior doors, installation of a compressed air and gaseous nitrogen system, and the provision of lighting and hoist system.

Other special requirements include a class 100,000 interior, the installation of explosion proof electrical devices, and a ventilating system having final filtration efficiency of 99.9% based on 0.3 micron particle size.

The building addition also provides for a personnel airlock entry and exit room of 117 square feet (11 square meters), and a mechanical and electrical room having 198 square feet (18 square meters).

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction.....				281,000
Site work.....	LS	---	---	27,000
Architectural/structural.....	SF	2,065	61.00	126,000
Mechanical.....	SF	2,065	35.35	73,000
Electrical.....	SF	2,065	26.63	55,000
Special Construction Features.....				79,000
Hoist.....	LS	---	---	18,000
Airlock doors.....	LS	---	---	57,000
Central vacuum cleaner.....	LS	---	---	4,000
Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				360,000

LIST OF RELATED GRAPHICS:

Location Plan
Perspective Drawing
Floor Plan

OTHER EQUIPMENT SUMMARY:

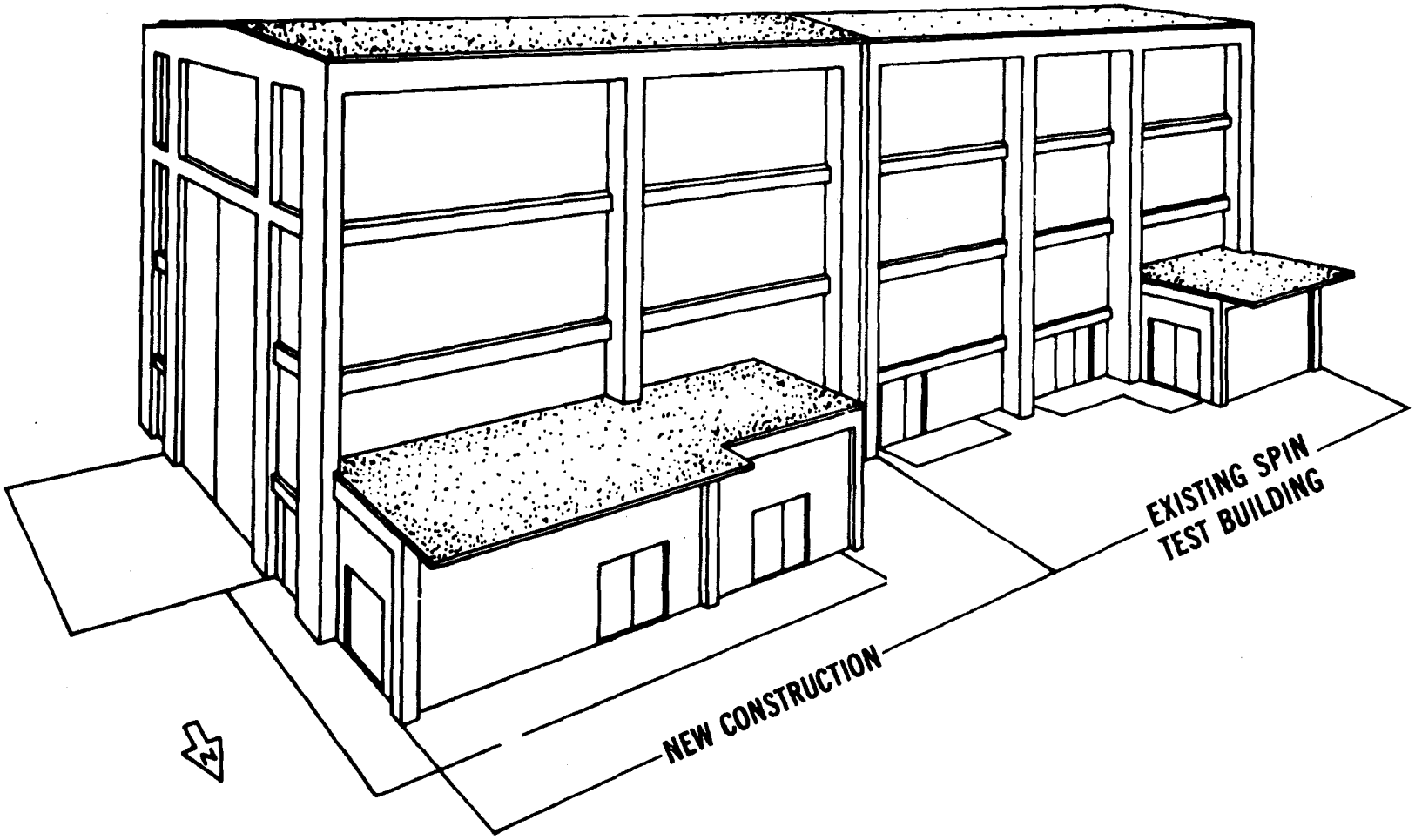
No additional equipment is required to complete this project.

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.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

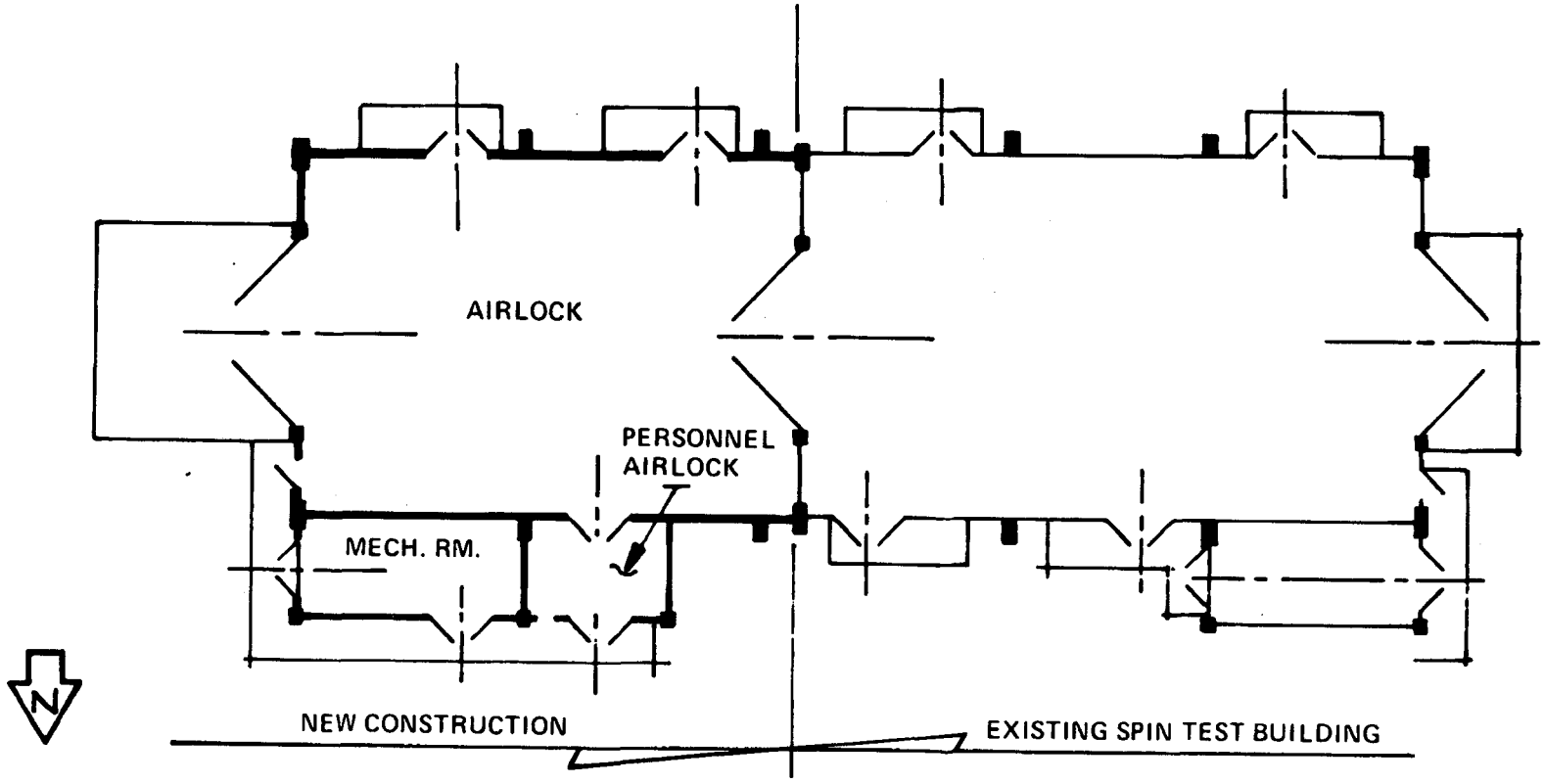
CONSTRUCTION OF AIRLOCK TO SPIN TEST FACILITY



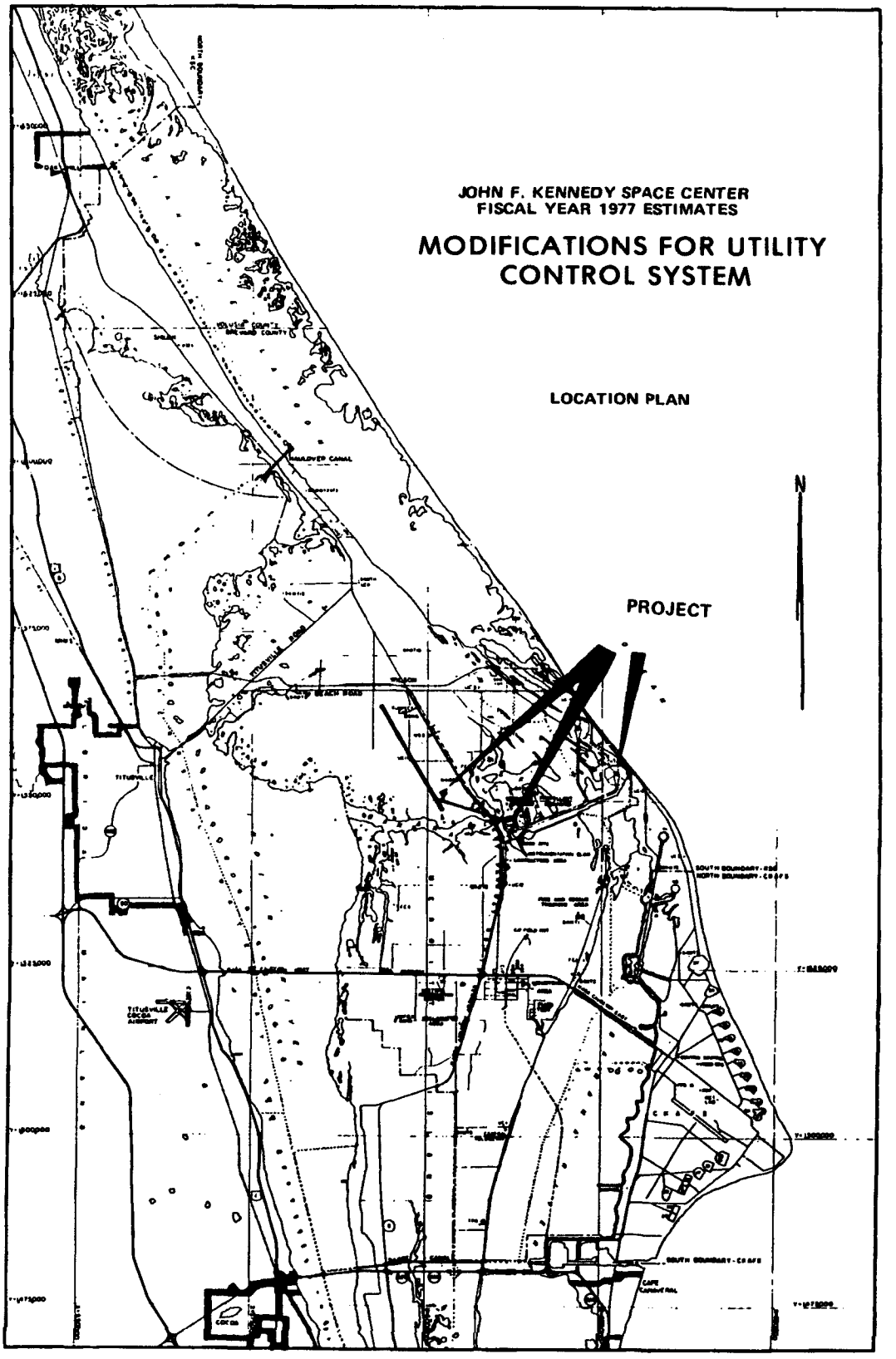
PERSPECTIVE

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF AIRLOCK TO SPIN TEST FACILITY



FLOOR PLAN


JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
MODIFICATIONS FOR UTILITY CONTROL SYSTEM
LOCATION PLAN
N
PROJECT

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modifications for Utility Control System
INSTALLATION:	John F. Kennedy Space Center
FY 1977 CoF ESTIMATE:	$2,445,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	250,000	310,000	560,000
Other affiliated funding.....	90,000	1,315,000	1,405,000
Total.....	340,000	1,625,000	1,965,000

SUMMARY PURPOSE AND SCOPE:

This project is a continuation and extension of the Utilities Control System previously funded under prior year programs and being installed in the Kennedy Space Center Industrial Area. The purpose of this project is to install the Utilities Control System in facilities in the Vehicle Assembly Building (VAB) area and Launch Complex 39, Pad "A" area to reduce costs and increase efficiency in the operation and maintenance in this portion of the Center's utility systems both during the phase down of activities prior to and through the operations phase of the Shuttle program. Such reduced costs will be made possible by installing sensing and control devices on the heating, ventilation, and air conditioning subsystems, and the subsystems of high temperature hot water, potable water, sewage treatment, fire alarm, and 60Hz electrical power to and within 51 facilities, in addition to monitoring and controlling utility sensing and

control devices being installed on subsystems in 22 new and modified facilities for the Shuttle program. The centralized monitor and control of various subsystems parameters will provide increased safety, conserve energy resources, and improve pollution control, thus contributing to better management of resources, and savings of personnel.

PROJECT JUSTIFICATION:

This is the third increment of a project initiated in CY 1974, to retain and improve the support capabilities in facilities necessary for KSC's long range launch mission role through the Shuttle program. The monitoring and control of utility heating, ventilation and air conditioning subsystems, and the subsystems of high temperature hot water, potable water, sewage treatment, fire alarm, and 60Hz 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 the launches at Complex 39. Savings in the Utility Conservation Program will 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 conditions of systems will be possible as a result of remote monitoring and control.

The Utility Control Systems complements the Launch Processing System. The Utility Control System will monitor and control subsystems, through automation, that provide basic services such as heating, ventilation and air conditioning for personnel and equipment, potable water, fire detection and protection, sewage treatment for personnel and electrical power for machinery and equipment in systems which indirectly support the processing and launching of Shuttle payloads and vehicles. The Launch Processing System will monitor and control those subsystems directly supporting the processing and launching of Shuttle payloads and vehicles.

The Utility Control System must be operationally ready by October, 1978, to support the launch site operations for first manned orbital flight. To meet this schedule, the work must start early in CY 1977, since modifications will require approximately 15 months for completion and checkout. Integration with the existing Utility Control System and with the Shuttle facilities will require approximately four months. For these reasons, this project must be included in the FY 1977 program.

This project schedules the purchase of the same type of equipment as the Shuttle Launch Processing System (LPS) to take advantage of the LPS equipment being operational one year prior to UCS utilization, insuring both hardware and software compatability and operability. In addition, system problems will have been solved and documented, and common maintenance and personnel training will be provided. The scope of this project represents the minimum facilities and subsystems necessary to allow operators at centralized control consoles to efficiently and cost-effectively monitor and control the various utility subsystems to support the initial launch capability at Launch Complex 39.

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 obtained now by periodic preventive maintenance roving field personnel, enabling immediate shutdown or corrective action 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 FY 1978, are as follows:

Approximately 35 electrical and 10 mechanical personnel at $23,000/year at present, escalated at 6% to the midpoint of the first operational year (April 1979), is about $27,000/year and equals a savings of about $1,215,000 the first year.

Energy consumption savings include both the base load and peak demand periods as follows:

A. Electrical Energy Savings - 18,000,000 KWH are presently used. This multiplied by the estimated savings of 6% is 1,080,000 KWH. This times the estimated operational year (April 1979) cost of $.039/KWH equals a savings of about $42,000 the first year.

B. Electrical Demand Savings - This project includes a feature permitting the reduction of kilowatt demand charges. This is estimated at about $35,000 the first year. This is based upon a savings of about 583,000 KWH and a demand peak savings of 6,880 KWH at $1.75/KWH projected to April 1979 at an escalation of 15%/year.

Transportation cost savings resulting from the reduction in "roving" preventive maintenance and operations personnel is as follows:

It is estimated that the 45 people no longer needed would otherwise have traveled approximately 4,000 miles per month in the discharge of their duties. It is estimated that the monthly charge for pick-up vehicles in FY 1977 will be $70.00 and the charge for mileage will be $0.08 per mile. This represents a savings of $390.00 per month or $4,680 per year. Projected to April 1979 at an escalation of 6% per year, the estimated savings will be about $5,000 the first year.

Based upon the total cost of $2,445,000 and the identified potential cost savings of $1,297,000 the first year, the "payback" period is about 1.88 years for this project.

PROJECT DESCRIPTION:

This project provides sensors and controls in various utility subsystems connected to central computing equipment via the communications cable system. The HVAC subsystem has requirements for 1,362 signals in 25 facilities to be monitored and controlled, including air handler status, compressor-motor currents, chiller and pump status and water temperatures.

The high temperature hot water subsystem has requirements for 72 signals in one facility to be monitored and controlled, including temperatures and flow rates. The potable water subsystem has requirements for 110 signals in 6 facilities to be monitored and controlled, including water pressures, storage tank levels and pump status. The sewage treatment subsystem has requirements for 127 signals from 7 sewage treatment plants and 11 lift stations, including pump status, flow rates, chlorine residue, PH analyser and air flow. The fire alarm subsystem has requirements for 888 signals in 36 facilities, including fire and smoke detectors and sprinkler flow indicators. The 60 Hz electrical power subsystem has requirements for 1,861 signals from 34 facilities, including current and voltages of transformers in substations, status of circuit breakers, and remote control of automatic transfer switches.

Remote units will also be installed in 13 facilities to collect signals from a given area and transmit them to the centrally located computer equipment. The data processing equipment supporting the monitor and control functions consists of telemetry equipment, appropriate mass storage devices, required peripherals, centrally located computer equipment with operator consoles and Cathode Ray Tube (CRT) displays. The earlier existing Monitor and Control Station will be relocated and integrated into a combined centrally located operations station in the LC 39 area.

This Utility Control System will interface with the Launch Processing System on a computer-to-computer level for exchange of information.

The related graphics indicate the facilities and subsystems for which sensors and controls will be installed under this project. In addition, the Utility Control System will monitor and control sensors and controls in facilities constructed and modified under the Shuttle program.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				1,408,000
HVAC subsystem	LS	---	---	387,000
HTHW subsystem	LS	---	---	21,000
Potable water subsystem	LS	---	---	53,000
Sewage treatment subsystem	LS	---	---	116,000
Fire alarm subsystem	LS	---	---	110,000
60 Hz power subsystem	LS	---	---	721,000
Equipment				1,037,000
Remote units	LS	---	---	394,000
Monitor and control station	LS	---	---	414,000
Relocation of Phase I monitor and control station	LS	---	---	55,000
Utilities/USC system checkout	LS	---	---	174,000
Fallout Shelter (not feasible)	LS	---	---	---
Total				2,445,000

LIST OF RELATED GRAPHICS:

Location Plan
Site Plan VAB Area
Site Plan Launch Pad 39A

OTHER EQUIPMENT SUMMARY:

Sensors, controls, and some remote units will be installed in the HVAC subsystems, sewage subsystems, fire alarm subsystems, and 60 Hz electrical power subsystems in the facilities being modified and/or constructed and funded under the Shuttle CoF program. These are required for the initial operations of

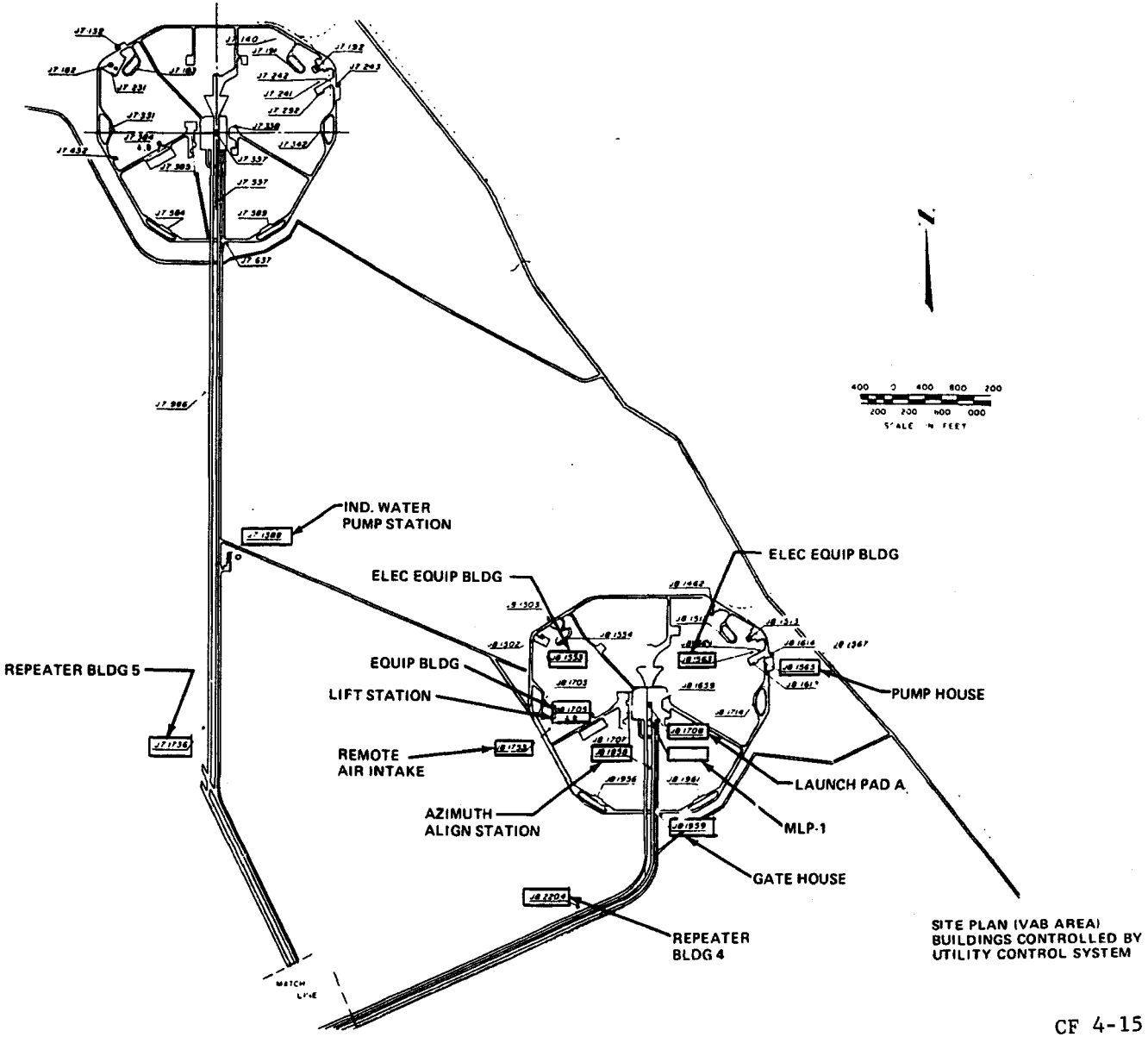
these Shuttle Facilities, but are not a part of the project as outlined above. The total estimated cost of this other equipment is approximately $615,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that about $3 million will be required in future CoF programs to complete this project and provide monitoring and control of the 60Hz electrical power in the Industrial Area and integration of the total system. However, this FY 1977 third increment is fully operable and usable by itself and not dependent on any such future funding.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

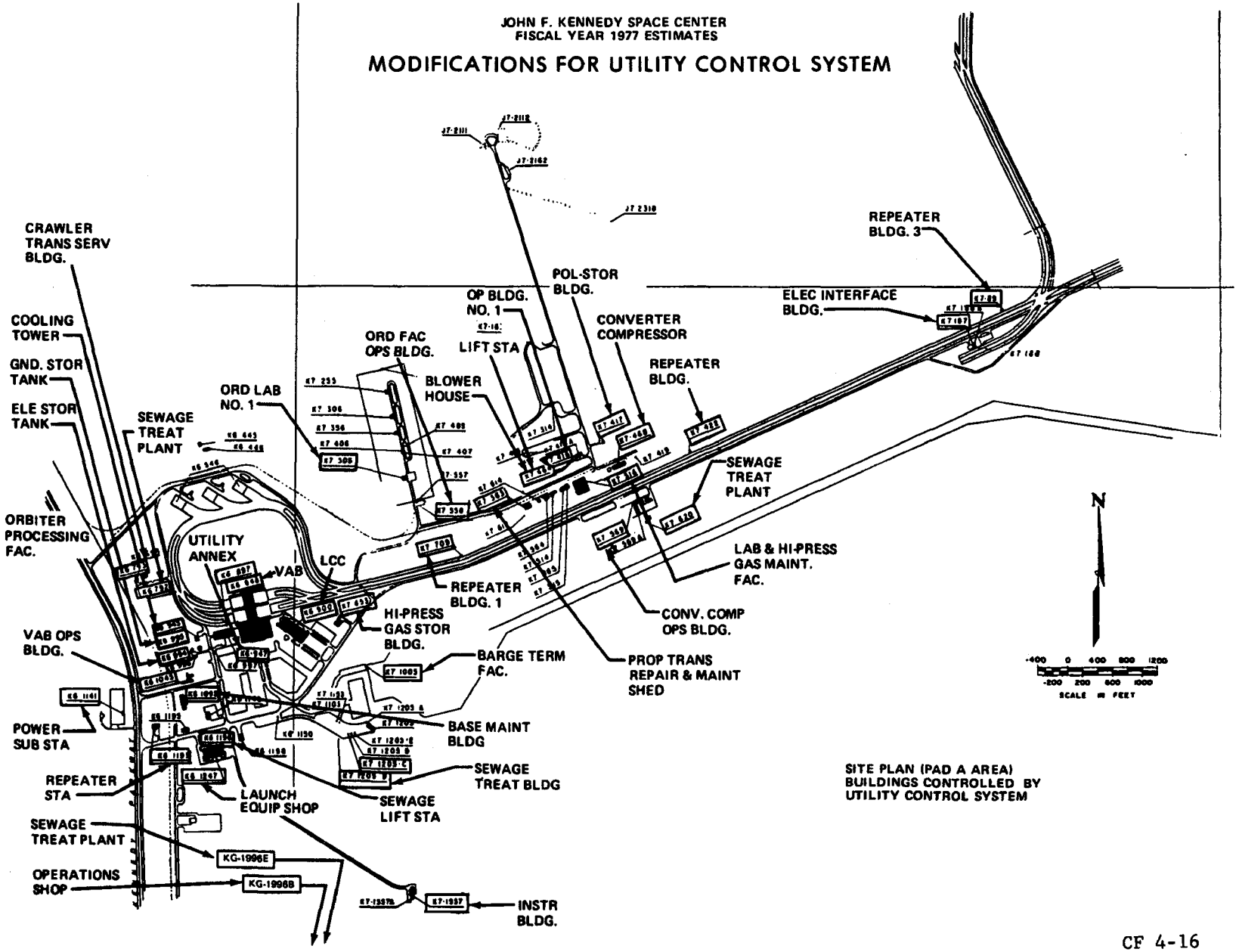
MODIFICATIONS FOR UTILITY CONTROL SYSTEM



SITE PLAN (VAB AREA)
BUILDINGS CONTROLLED BY
UTILITY CONTROL SYSTEM

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS FOR UTILITY CONTROL SYSTEM



SITE PLAN (PAD A AREA)
BUILDINGS CONTROLLED BY
UTILITY CONTROL SYSTEM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

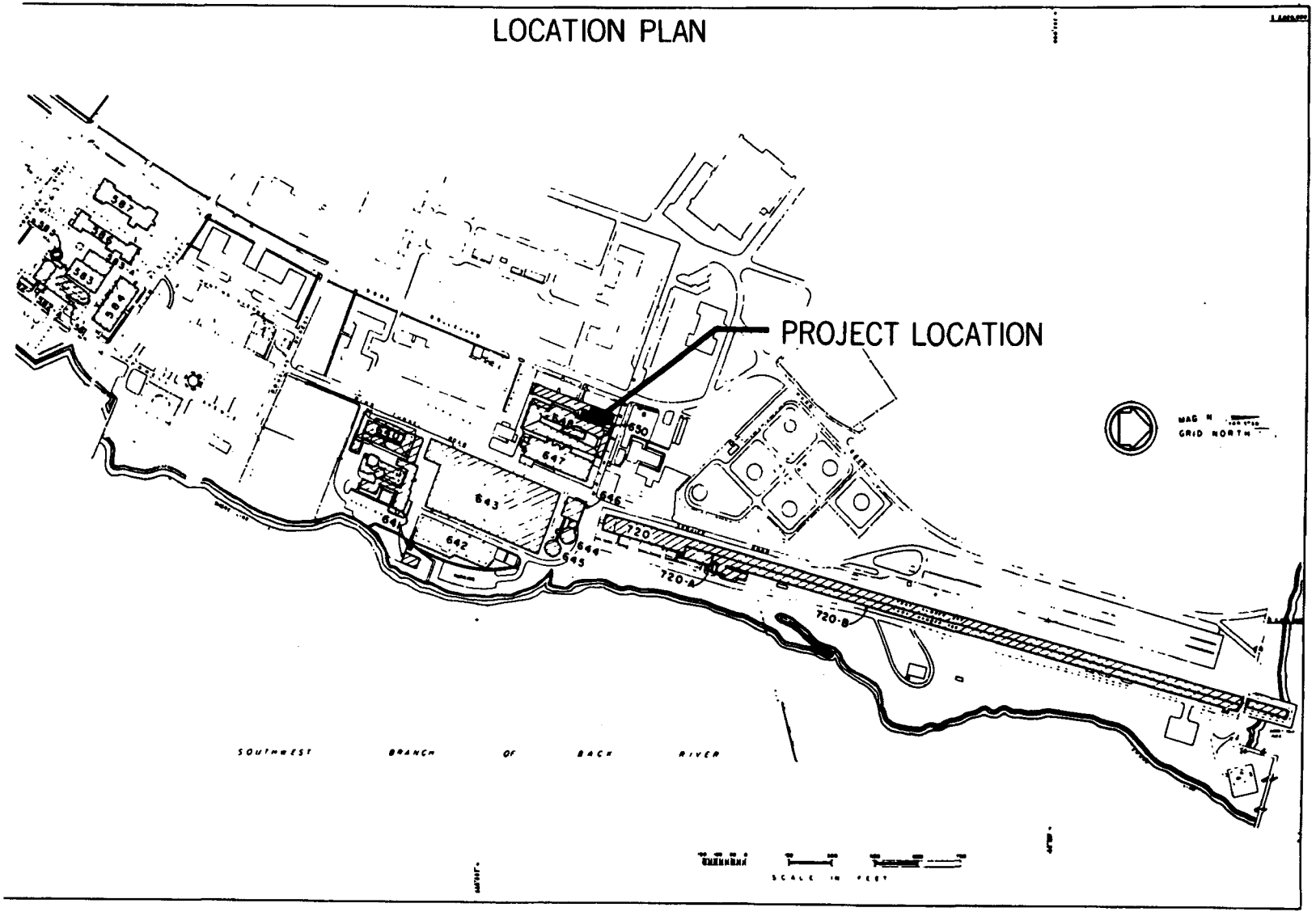
SUMMARY

LANGLEY RESEARCH CENTER

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Construction of addition for aeroelastic model laboratory.....	730,000	CF 5-1
Office of Center Operations:		
Construction of data reduction center annex.....	2,970,000	CF 5-6
Construction of refuse-fired steam generating facility.....	2,485,000	CF 5-12
Total.....	6,185,000	

LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF ADDITION FOR AEROELASTIC MODEL LABORATORY



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Addition for Aeroelastic Model Laboratory
INSTALLATION:	Langley Research Center
FY 1977 CoF ESTIMATE:	$730,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	58,000	---	58,000
Other affiliated funding	---	13,423,000	13,423,000
Total	58,000	13,423,000	13,481,000

SUMMARY PURPOSE AND SCOPE:

This project will provide for an addition of an aeroelastic model laboratory to the Transonic Dynamics Tunnel (TDT), Building 648. The aeroelastic model laboratory will house a new cable model support system, a model shake test run-up area; and a data system and instrumentation service area.

The TDT is a unique facility designed specifically to meet aeroelastic testing requirements. The demand for the facility is such that a backlog of programs totalling approximately two years duration presently exists. This proposed addition will increase operational efficiency of the TDT by increasing the time the tunnel is available for testing. It will allow for extensive pre-test preparation of models outside

of the tunnel test section, a capability which is severely limited at present. It will also consolidate all pre-test model preparation activities into one area. Currently, the rotor test equipment is located in Building 1294 which is situated in the West Area about 4 miles (6.2 kilometers) away.

PROJECT JUSTIFICATION:

The Transonic Dynamics Tunnel is a unique facility in that it was designed specifically to meet aeroelastic testing requirements. Specifically, the tunnel uses Freon gas rather than air, as a test medium. Freon properties make it possible to build dynamically scaled aeroelastic models of current highly structurally efficient aircraft. The speed of sound in Freon is one-half that of air, which reduces the tunnel power requirements since the air Mach numbers can be achieved in Freon at one-half air speed. Other features are a mechanism to quickly change test conditions to reduce forces when flutter occurs, a computerized data acquisition system designed to handle aeroelastic data, a gust generator, and a screen to catch models that may break up during flutter tests before they destroy the tunnel blades. There is no known facility in existence in the "free world" that has been designed to meet these requirements.

It is anticipated that the proposed addition will improve the efficiency of tunnel operations in terms of occupancy time per tunnel test by about 15 to 20% for a typical operational year. At the present time, the tunnel has a total backlog of work for approximately two years with a definitive schedule established for the first year. Based on this 1976 schedule, eight to ten weeks test occupancy time can be saved out of a total tunnel operational year of 45 weeks, allowing seven weeks down time for maintenance. Models of most high speed U. S. developed aircraft are tested in this tunnel for flutter clearance and other aeroelastic conditions. During 1976, DOD and NASA aircraft programs will account for 50% of tunnel time, 36% for R&T programs, and 14% for maintenance. DOD support included testing such airplanes as the F-4, F-14, F-16, B-1, and C-141. The NASA programs include highly maneuverable aircraft, two supersonic speed configurations and four entries of shuttle models; three for flutter and one for parachute evaluation.

This project will also provide engineers and technicians with a consolidated space for setting up models, data evaluation, and providing "real time" test direction.

PROJECT DESCRIPTION:

The project will be a 4,965-square foot (461 square meter) third floor addition to the Transonic Dynamics Tunnel, Building 648. The exterior of the addition will be similar in appearance to the existing building and the structural design will be compatible with that of the existing structure. The new addition will be divided into an aeroelastic model preparation area which will include an active cable mount model support, duplicating the one in the tunnel, a protected rotor run-up area, and a data system and instrumentaiton service area. All necessary utilities will be provided to the new addition.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				545,000
Building addition	SF	4,965	68.50	340,000
Mechanical	LS	---	---	90,000
Electrical and substation	LS	---	---	115,000
Equipment				185,000
Cable mount system	LS	---	---	120,000
Instrumentation	LS	---	---	65,000
Fallout Shelter (not feasible)	---	---	---	---
Total				730,000

LIST OF GRAPHICS:

Location Plan
Single Line Drawing with Perspective

OTHER EQUIPMENT SUMMARY:

No other collateral or noncollateral is involved.

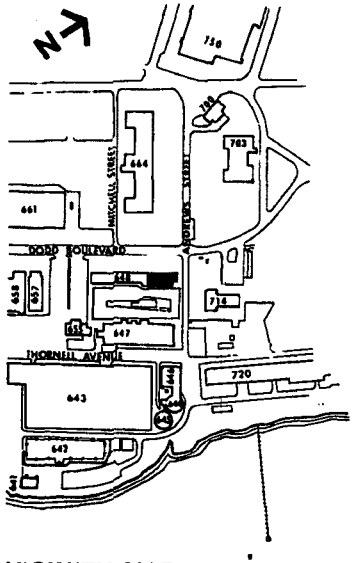
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

LANGLEY RESERACH CENTER

FISCAL YEAR 1977 ESTIMATES

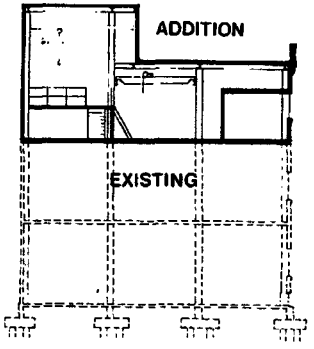
CONSTRUCTION OF ADDITION FOR AEROELASTIC MODEL LABORATORY



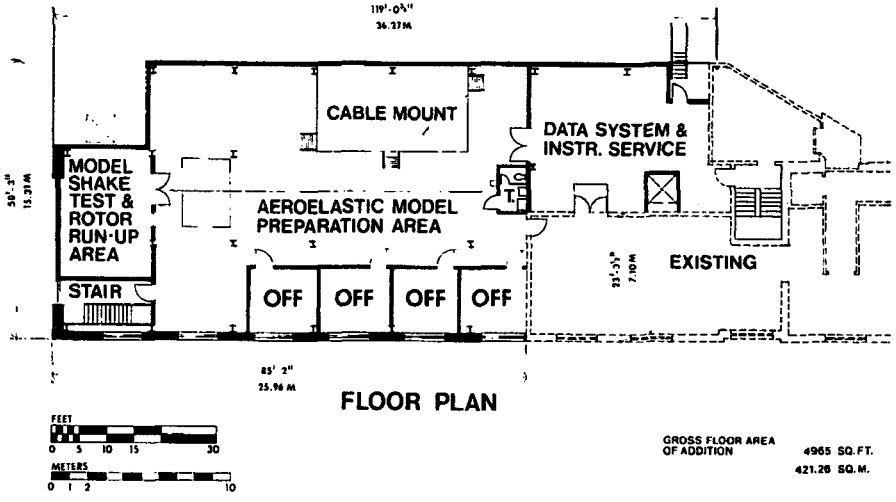
VICINITY MAP

FEET 0 50 100

METERS 0 10 20

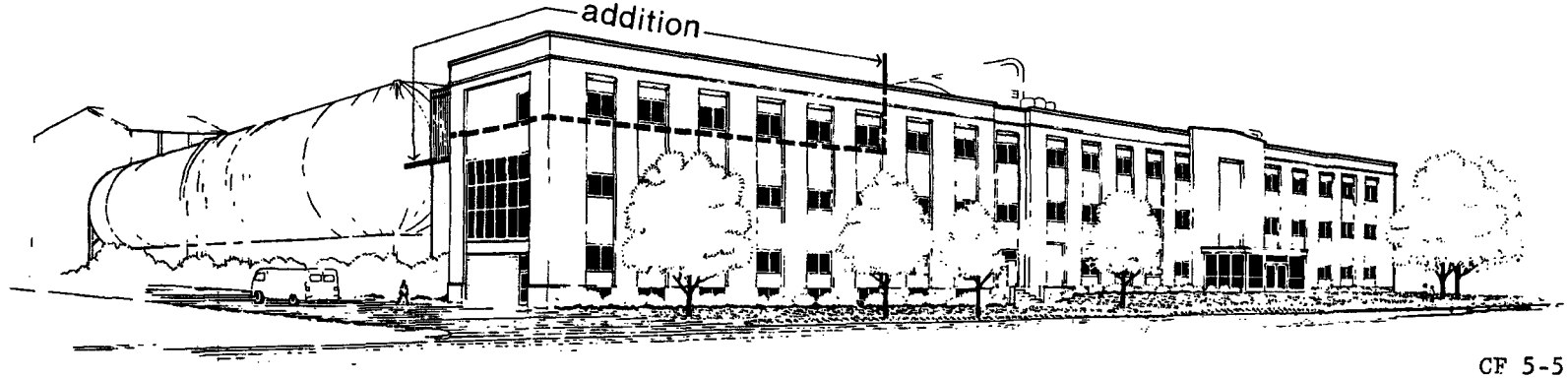


SECTION



FLOOR PLAN

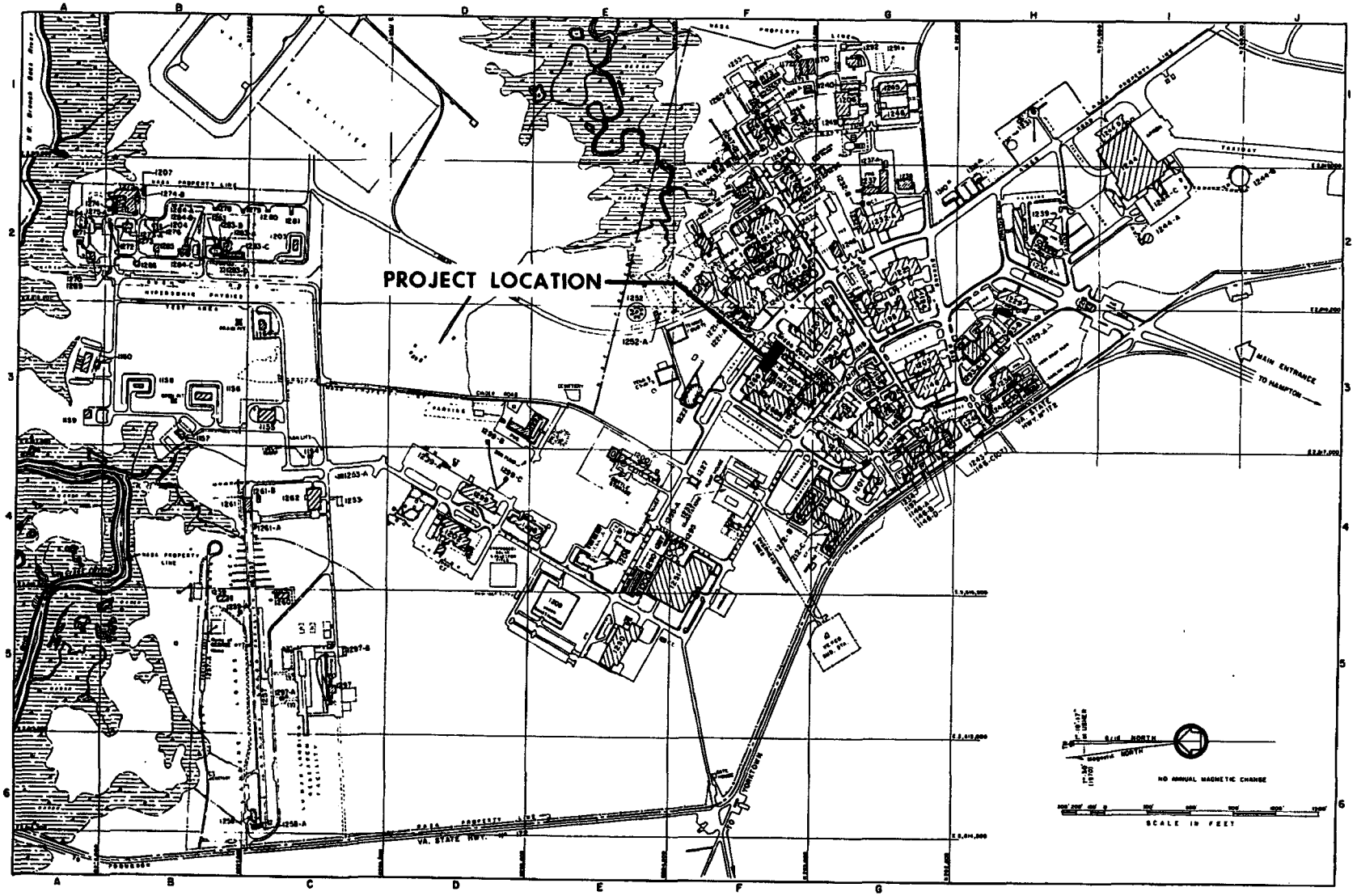
GROSS FLOOR AREA OF ADDITION 4965 SQ.FT. 421.26 SQ.M.



LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF DATA REDUCTION CENTER ANNEX

LOCATION PLAN



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Data Reduction Center Annex
INSTALLATION:	Langley Research Center
FY 1977 CoF ESTIMATE:	$2,970,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	228,000	---	228,000
Other affiliated funding.....	---	8,332,000	8,332,000
Total.....	228,000	8,332,000*	8,560,000

* NOTE: This value excludes $38,977,000 of noncollateral R&D computer equipment.

SUMMARY PURPOSE AND SCOPE:

This project will provide critically needed floor space for improving the computational capability of the Langley Research Center (LaRC). Requirements for such space have continued to grow in pace with increasing demands by the research programs for computational support. Realignment and consolidation actions to gain space for additional equipment have been extensively employed. By relocating personnel to other buildings, and by converting office space to maintenance and tape storage functions, space has been gained for the initial installation of the String Array (STAR) Computer.

The proposed construction is a 30,000 square foot (2,787 sq. m.) annex to the Data Reduction Center, Building 1268, to be located immediately southeast of that building. Approximately a 15,000 square foot (1,394 sq. m.) area with an elevated floor will be provided to house the environmentally controlled computer equipment. In addition, 5,000 square feet (465 sq. m.) of space are required for mechanical and electrical utilities, with the remaining space devoted to housing supporting operations and maintenance personnel.

PROJECT JUSTIFICATION:

Virtually all research activities at LaRC require heavy use of computation and data handling facilities. The increased complexity and cost of aerospace designs have led to the development of more comprehensive analysis programs, more elaborate models which are tested with resulting large volumes of data, and increased use of real time simulation to evaluate overall designs. As computer studies become more practical alternatives to wind tunnel and flight tests, the demand for computational support continues to grow. The curtailment of experimental testing to reduce the Center's energy requirements and limitations in the research personnel complement have catalyzed the application of computers to the solution of research problems.

The expanding use of computing is delineated in a LaRC assessment that identifies several research areas requiring increased computational support in succeeding years. Major hardware and software installations now underway and scheduled for the next two years should result in a substantial improvement in the computing capability available to support Center programs. The installation of the STAR computer will provide capacity for solving large analytical problems which have been impractical in the past. The availability of this computer to the LaRC staff and to researchers at other NASA Centers will constitute a major Agency research capability. Effective use of this computer will require a period of program development to capitalize on its capabilities and increased speed. Anticipating this evaluation period, the initial STAR system was acquired with minimal memory and peripheral devices. Subsequent expansion of memory, disk, and mass storage capacity, along with the development of the STAR communications subsystem, will be required to permit its effective use throughout the Agency. The accompanying installation of hardware to expand the real time simulation computing capacity will provide a means for detailed modeling of rotor systems and their controls for helicopter studies and for advanced control studies required by such projects as the Active Controls Technology Program. The recent introduction of interactive computing facilities is providing vast improvements in computer accessibility, but requires increased on-line file storage. These new capabilities will be fully exploited by providing increased mass storage and computer communications.

Although some existing equipment now in use will be removed, the aggregate increase in required equipment, utility, and personnel space cannot be accommodated within the available floor space. Intensive site planning activities have been underway for sometime to arrange for the installation of equipment

scheduled for delivery through 1977. Major relocations of both personnel and equipment within the present space, as well as to other buildings, will be required. These actions will provide only interim arrangements under circumstances which cannot be sustained without seriously compromising operations. This proposed new facility will provide space for the mass storage and computer communications equipment to be installed in the 1979-80 time frame. Because of the immediate need to use space that was originally planned for simulation equipment for flight control and handling qualities studies, advancement of that research capability will be seriously constrained.

PROJECT DESCRIPTION:

This project will provide for a 30,000-sq. ft. (2,787 sq. m.) annex to the Data Reduction Center, B-1268. The various areas within this facility will be designed to provide space for archival data storage and retrieval, 5,000 sq. ft. (465 sq. m.); on-line mass data storage equipment, 5,000 sq. ft. (465 sq. m.); network communications and control equipment, 5,000 sq. ft. (465 sq. m.); equipment maintenance, 1,250 sq. ft. (115 sq. m.); computer management personnel, 2,700 sq. ft. (251 sq. m.); tape storage, 1,800 sq. ft. (167 sq. m.); systems analysis, 1,250 sq. ft. (115 sq. m.); hall, toilets and stairwells, 3,000 sq. ft. (279 sq. m.); and mechanical and electrical equipment, 5,000 sq. ft. (465 sq. m.).

The construction of this new facility will consist of a metal frame structure, exterior walls of brick and metal panels, and built-up roofing. This project also includes heating, air conditioning, lighting, special electrical, and all necessary utilities. Equipment bays will be outfitted with elevated flooring and provisions for related electrical and air conditioning equipment. Cable ducts will be provided to allow interconnection of equipment in the annex to main frame computing equipment in the Data Reduction Center. Fire protection is provided throughout this facility with an Automatic Fire Detection and Wet Pipe Sprinkler Systems. Also included in the project are the utilities outside of the building with the electrical, sanitary and water connections to the existing systems. The exterior electrical system will include a new substation and all of the necessary electrical equipment required to make this system operational.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction.....				2,970,000
Site development.....	LS	---	---	17,000
Architectural/structural.....	SF	30,000	30.20	906,000
Mechanical (inside 5' line).....	SF	30,000	26.65	800,000
Electrical (inside 5' line).....	SF	30,000	10.70	321,000
Fire Protection Systems.....	SF	30,000	3.70	111,000
Special Electrical.....	LS	---	---	160,000
Utilities (outside 5' line).....	LS	---	---	655,000
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				2,970,000

LIST OF RELATED GRAPHICS:

Location Plan
Single Line Drawing with perspective

OTHER EQUIPMENT SUMMARY:

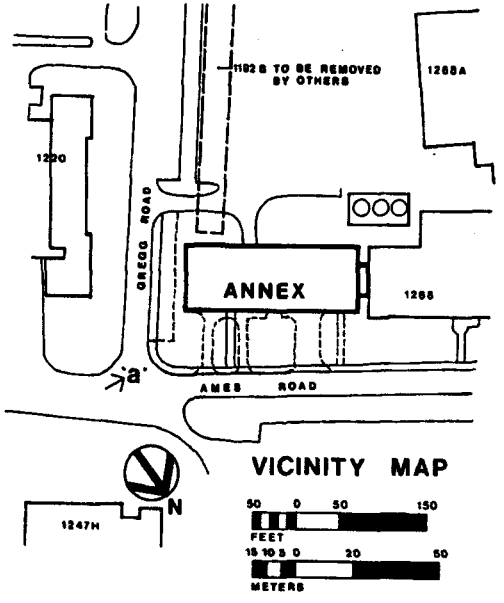
The Data Reduction Center Annex will house approximately $10,000,000 of computer equipment of a noncollateral nature provided from R&D resources. There is no additional collateral or other equipment required by this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

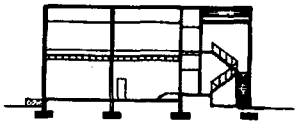
At the present time, there is no foreseen requirement which would require future CoF funding for this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

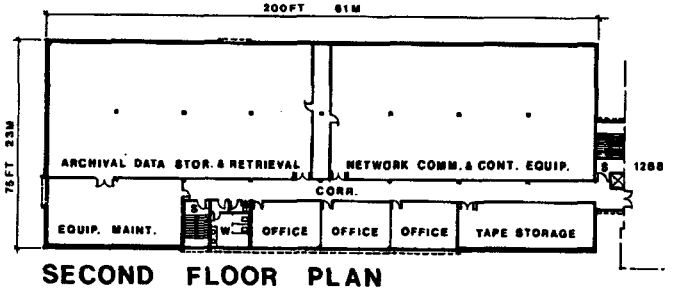
CONSTRUCTION OF DATA REDUCTION CENTER ANNEX



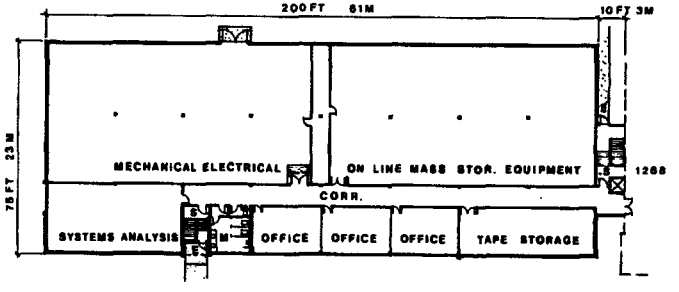
VICINITY MAP



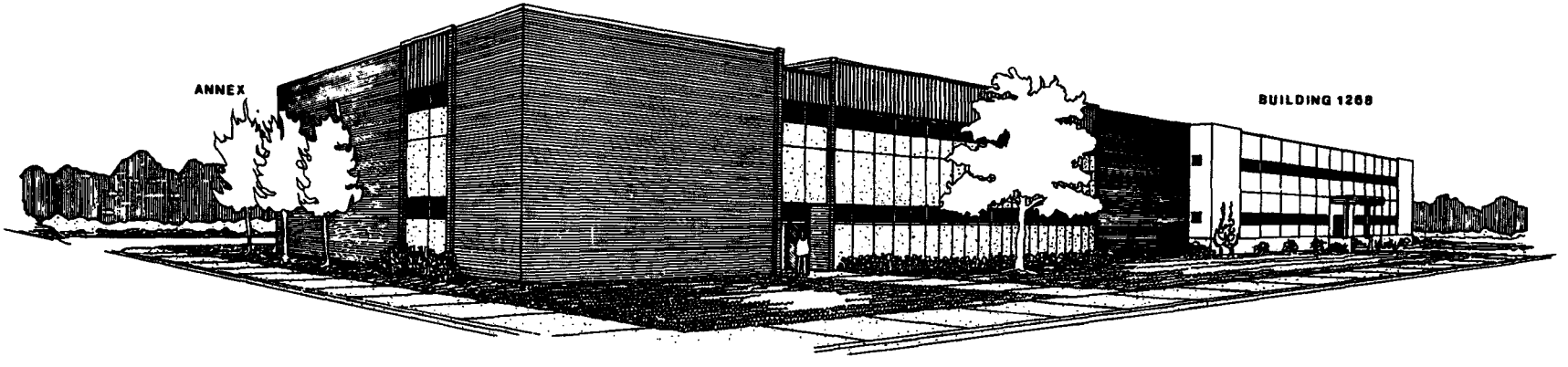
SECTION



SECOND FLOOR PLAN



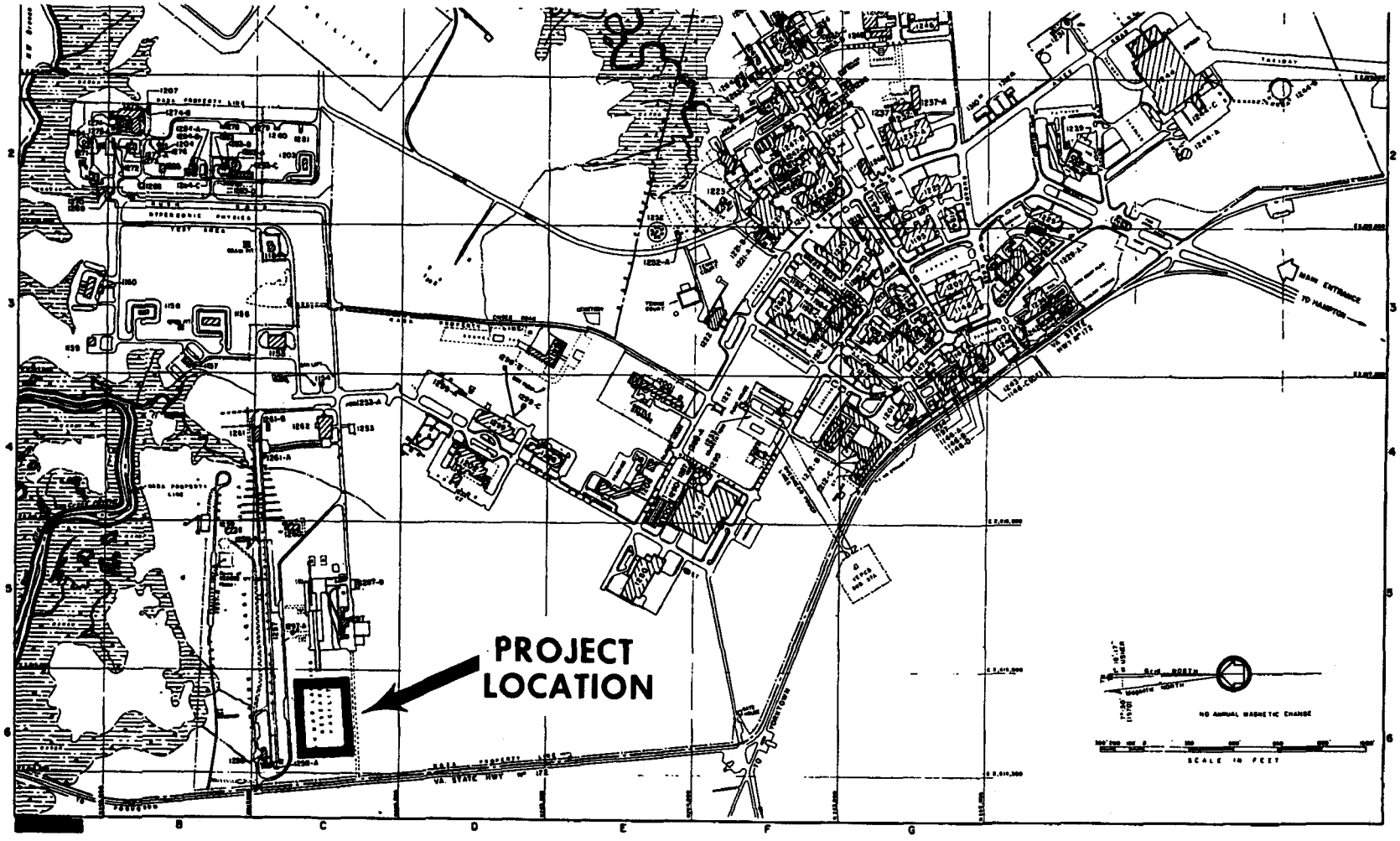
FIRST FLOOR PLAN



LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF REFUSE-FIRED STEAM GENERATING FACILITY

LOCATION PLAN



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Refuse-Fired Steam Generating Facility
INSTALLATION:	Langley Research Center
FY 1977 CoF ESTIMATE:	$2,485,000 *

LOCATION OF PROJECT: Hampton, Virginia

*NOTE: This is the NASA portion of a jointly-funded facility.

COGNIZANT HEADQUARTERS OFFICE: Office of Center Operations

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.....	37,000**	---	37,000
Other affiliated funding.....	---	---	---
Total.....	37,000	---	37,000

** NOTE: This is to be a jointly financed project in the manner indicated below with such joint financing to provide for both design and construction activities.

SUMMARY PURPOSE AND SCOPE:

This project provides for construction of a Refuse-Fired Steam Generating Facility at Langley Research Center (LaRC) which is jointly sponsored by LaRC, USAF/Langley Air Force Base (USAF/LAFB), and the City of Hampton, Virginia. The facility will have a capacity for burning about 225 tons (204,000 kilograms) of refuse daily and converting this energy into steam. Operation of the facility will alleviate the area's problems of both the Government and the community (solid waste disposal) as well as provide a significant reduction in fuel oil (energy) requirements for LaRC. The total cost of the project is estimated at $8,410,000 to be met on an agreed basis between the U.S. Government (NASA/LaRC and USAF/LAFB)

and the City of Hampton, Virginia. Under this agreement, NASA/LaRC will provide $2,485,000 additional to the $37,000 planning and design funds already made available, the USAF/LAFB $800,000, and the City of Hampton, Virginia, the remaining $5,088,000 to make up the total estimated cost.

Title to the facility will be vested in the LaRC and a long term agreement with the City of Hampton, Virginia, is planned for its operation and maintenance including the provision of steam needed by LaRC.

LaRC is participating in this project which responds to Executive Order 11752 which encourages the full cooperation of the Federal Government with local governments for the prevention, control and abatement of environmental pollution and also in response to the current energy situation. Additionally, it is anticipated this facility will help reduce the long term maintenance and operational costs at the Center.

PROJECT JUSTIFICATION:

LaRC and LAFB currently dispose of refuse by a landfill operation performed on property located on LAFB. The general elevation of the land is such that in processing the burial of the refuse, the water table is exposed and in contact with the refuse. This results in "leaching out" of contaminants from the refuse to the ground and tidal water. Suitable land for improved disposal operation is not reasonably available in the general area. The City of Hampton's landfill site experiences similar problems with respect to water pollution. In addition, the location of the City's landfill site is in direct line with the approach to the LAFB runway. Attraction of birds to the landfill site operations generates a "bird strike" problem with potential impact to aircraft using LAFB. The proposed Refuse-Fired Steam Generating Facility will eliminate the above problems.

In addition, the proposed facility offers a significant contribution to the energy conservation program. At present, LaRC obtains steam from its oil-fired boiler plant, using approximately 3,500,000 gallons (13,248,000 liters) of fuel oil per year. This plant now supplies steam for building heating and hot water requirements and for research facility loads such as steam ejector associated with the various wind tunnels. The proposed refuse-fired plant will result in an estimated "savings" of 2,900,000 gallons (10,976,000 liters) of fuel oil per year, which translates into about $800,000 per year at current fuel oil costs (27.6¢/gallon). The existing steam plant will continue to be utilized for peak loads generated by research operating demands and during severe winter conditions.

This refuse-fired plant will produce a nominal amount of nonorganic, nonpollution residue which will be disposed of at the City of Hampton's present landfill area. The existing Government's landfill operation will be terminated when the new facility becomes operational. The salvage of some scrap metals will further reduce the residue from the plant.

The proposed facility will be located at LaRC and title will be vested in the LaRC. The Center will enter into a long term agreement with the City of Hampton, Virginia, for the operation and maintenance of this facility and for the provision of steam to LaRC. It is planned that operating and amortization costs will be offset by steam charges to LaRC which will be based on current production costs for equivalent steam quantities. It is estimated that the LaRC investment of some $2.5 million will be amortized through "cost savings" in four to five years.

In summary, the new Refuse-Fired Steam Generating Facility will eliminate the very marginal landfill operations on Government property, provide substantial reduction of the City's landfill operations, meet the Environmental Protection Agency's pollution regulations, eliminate "bird strike" hazard impact to LAFB aircraft, and conserve natural energy resources (fuel oil).

PROJECT DESCRIPTION:

The project provides for construction of a boiler plant capable of burning as fuel about 225 tons (204,000 kilograms) per day of waste products to generate some 56,000 pounds per hour (25,400 kilograms/hour) of steam at about 350 psig (2,413,000 newton/meter^2). The plant will consist of one boiler and ancillary systems which will include forced and induced draft fans, feed water system, ignition and combustion controls, as well as stack emission treatment meeting environmental standards. Incorporated in the plant complex will be material handling and processing equipment, conveyors, and other related systems and services necessary to make a complete self-sustaining plant. The plant will be located in the West Area of the Center adjacent to State Highway 172 and west of the Impact Dynamics Research Facility, Building 1297. Included in the project are an entrance road to this proposed facility and security fencing for the area. Existing electrical power, water and sewer systems will be extended to provide these services to the facility. A steam distribution line to the proposed facility is included with this project.

The environmental impact of this facility has been assessed and it is expected to be comparable with similar type plants located in the area. During the design and operation of this facility, the abatement of air and water pollution will be taken into consideration. The proposed construction will have no impact on the environment at LaRC. The operation of the facility will exhaust emissions of air pollutants lower than the existing heating plant and are not expected to have any harmful effects on the environment. An amendment to the Institutional Environmental Impact Statement will be prepared to reflect the addition of this facility and its operation.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				6,440,000
Boiler train	EA	1	---	2,070,000
Piling and concrete (foundations, ramps, roads, and paving)	LS	---	---	570,000
Building and structural steel	LS	---	---	815,000
Mechanical and electrical equipment	LS	---	---	2,985,000
Equipment				1,970,000
Material handling and processing, conveyors, blowers, pumps, etc	LS	---	---	1,970,000
Fallout Shelter (not feasible)	---	---	---	---
Total for Design and Construction				8,410,000
Included in this project for NASA financing.				2,485,000

It is noted that this project is an exception to normal procedure, in that as a jointly financed project, it includes design and construction costs since these are to be shared by the three sponsors.

LIST OF RELATED GRAPHICS:

Location Plan
Single Line Drawing

OTHER EQUIPMENT SUMMARY:

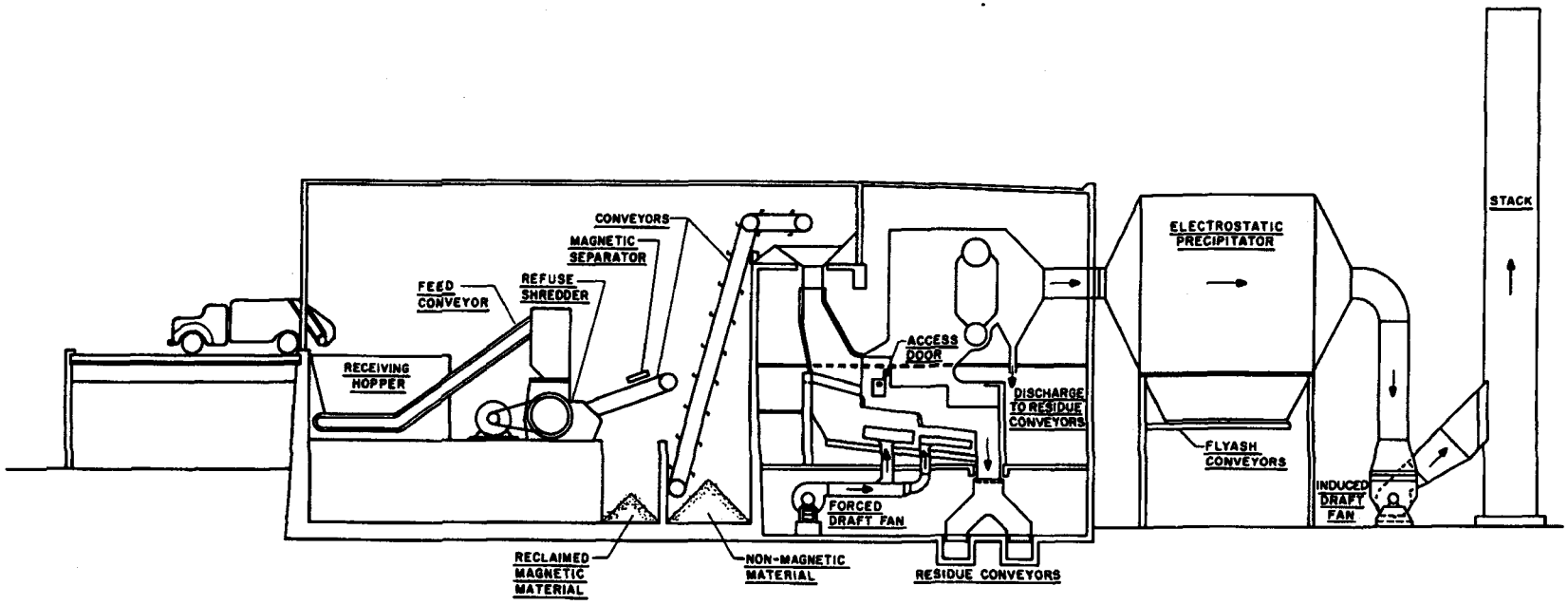
None is required to support the presently planned concept of operation.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF REFUSE-FIRED STEAM GENERATING FACILITY



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

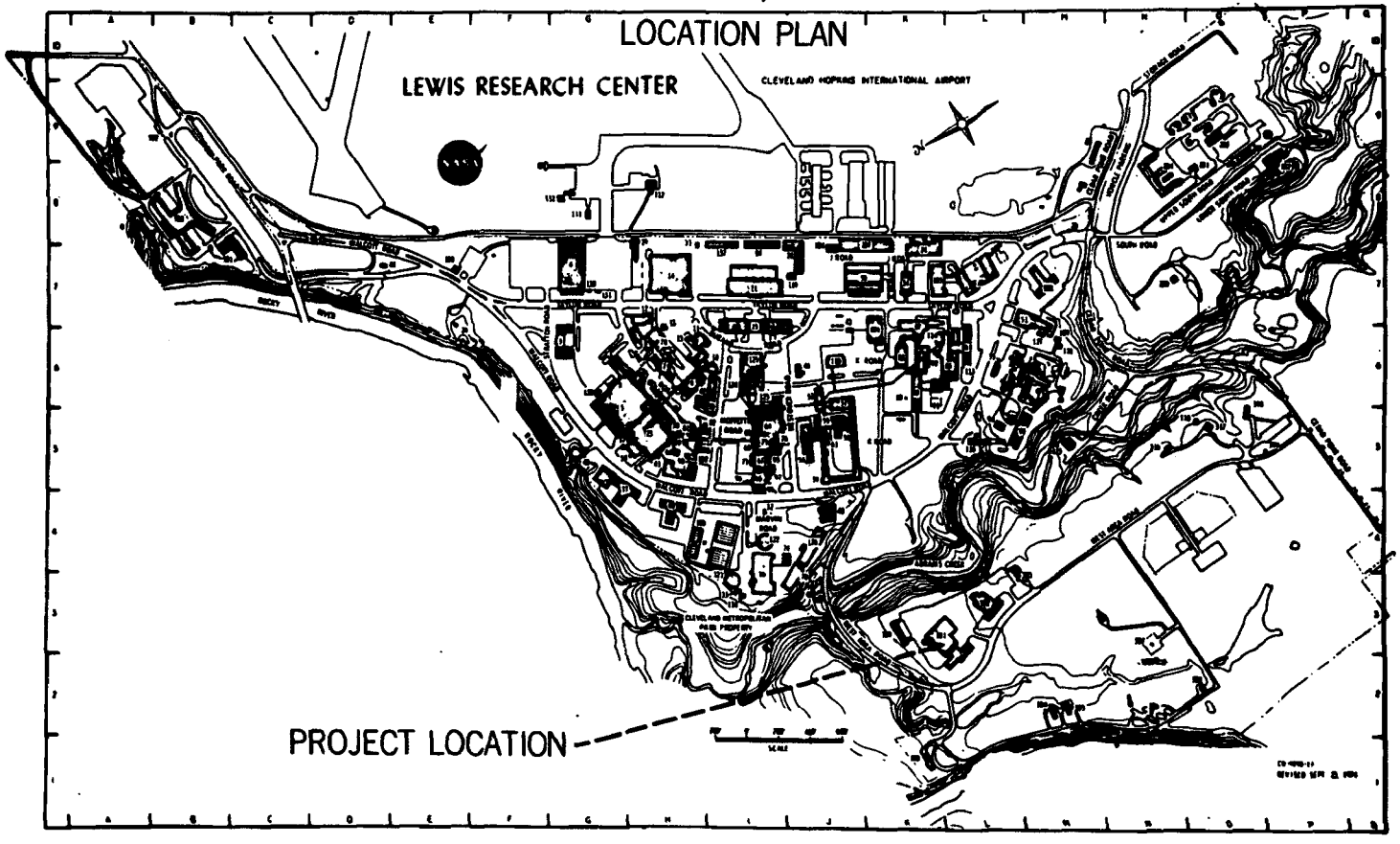
SUMMARY

LEWIS RESEARCH CENTER

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Modification of refrigeration system, electric propulsion laboratory.....	680,000	CF 6-1
Rehabilitation of combustion air drying system, engine research building.	1,490,000	CF 6-6
Total.....	2,170,000	

LEWIS RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATION OF REFRIGERATION SYSTEM, ELECTRIC PROPULSION LABORATORY



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modification of Refrigeration System, Electric Propulsion Laboratory
INSTALLATION:	Lewis Research Center
	FY 1977 CoF ESTIMATE: $680,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	52,000	---	52,000
Other affiliated funding	---	5,169,000	5,169,000
Total	52,000	5,169,000	5,221,000

SUMMARY PURPOSE AND SCOPE:

This project will provide the necessary modifications to the refrigeration system of the two existing space environmental vacuum tanks located in the Electric Propulsion Laboratory, Building 301. This facility is for the testing of spacecraft, solar arrays, and ion thruster propulsion systems and components in simulated space conditions. Since the facility became operational in 1961, liquid nitrogen has been used as the refrigerant to meet the space temperature requirements in the vacuum tanks. Recent and projected increases in the cost of liquid nitrogen necessitate the modification of the refrigeration system to one less expensive to operate.

This project provides a new "closed-loop" mechanical refrigeration system capable of maintaining the cold wall temperature between -75°F (-59°C) and -100°F (-73°C) which is considered adequate to meet present and foreseeable test requirements.

PROJECT JUSTIFICATION:

Two of the Electric Propulsion Laboratory vacuum tanks are used to test electric ion thruster propulsion systems and components, spacecraft and solar arrays such as the Communication Technology Satellite. The outer space environment temperature requirement is currently being simulated by a liquid nitrogen cooling system at -300°F (-184°C) cold wall temperatures within the vacuum tanks. The present and foreseeable testing, however, can be conducted at a cold wall temperature between -75°F (-59°C) to -100°F (-73°C).

At the cold wall temperature level requirements of -75°F (-59°C) to -100°F (-73°C) the proposed "closed-loop" (freon) mechanical refrigeration system addition will provide this cold wall refrigeration at a substantial savings in energy and operational costs as compared to the existing "open-loop" liquid nitrogen refrigeration system.

At present cost levels, an annual operational cost "savings" could be $540,000. This would probably increase to over $750,000 in 1980 reflecting the increasing cost of liquid nitrogen which can be reasonably anticipated. Within one year after installation of the proposed new refrigeration system, the capital investment would be returned and thereafter reflect an annual "savings" of possibly even larger amounts. The existing liquid nitrogen system will remain installed and intact for any future use which may evolve requiring the greater capabilities.

PROJECT DESCRIPTION:

The project provides a 40-ton capacity "closed-loop" (freon) mechanical refrigeration system, stainless steel cold walls (baffles) with radiation shielding in two vacuum tanks, refrigeration piping with insulation, utility services, electrical power and controls, and a building addition of about 690 gross square feet (64 square meters) to house the refrigeration equipment. Remote control of the refrigeration system will be from an existing control room.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				40,000
Building addition	SF	690	58.00	40,000
Equipment				640,000
Mechanical refrigeration equipment	Ton	40	8,000.00	320,000
Stainless steel (cold wall baffles)	Lbs	7,000	7.80	55,000
Equipment installation	LS	---	---	105,000
Provision of electric power and controls	LS	---	---	160,000
Fallout Shelter (not feasible)	---	---	---	---
Total				680,000

LIST OF RELATED GRAHPICS:

Location Plan
Single Line Drawing

OTHER EQUIPMENT SUMMARY:

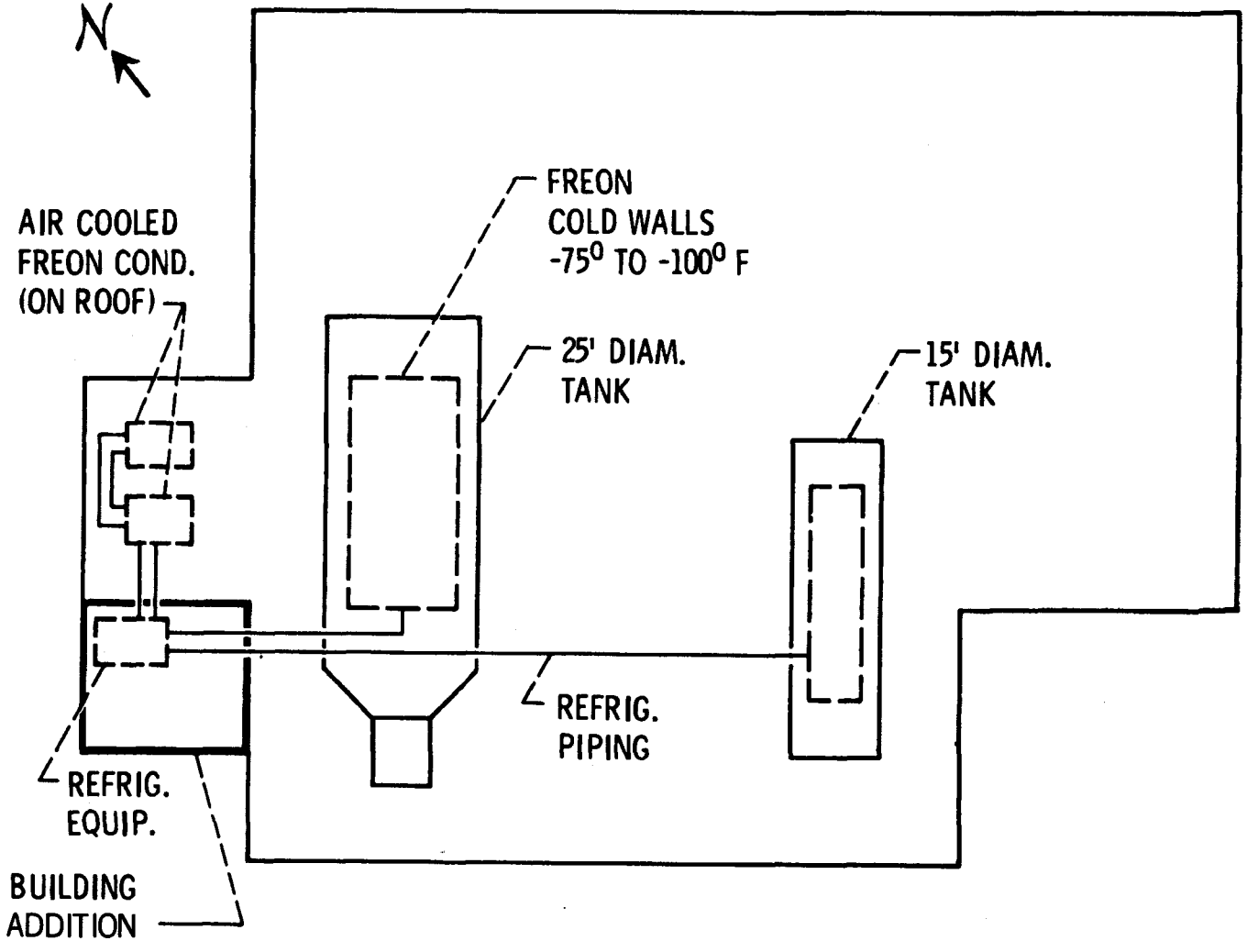
No other collateral or noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no currently foreseen future funding requirements to complete this project within the defined scope.

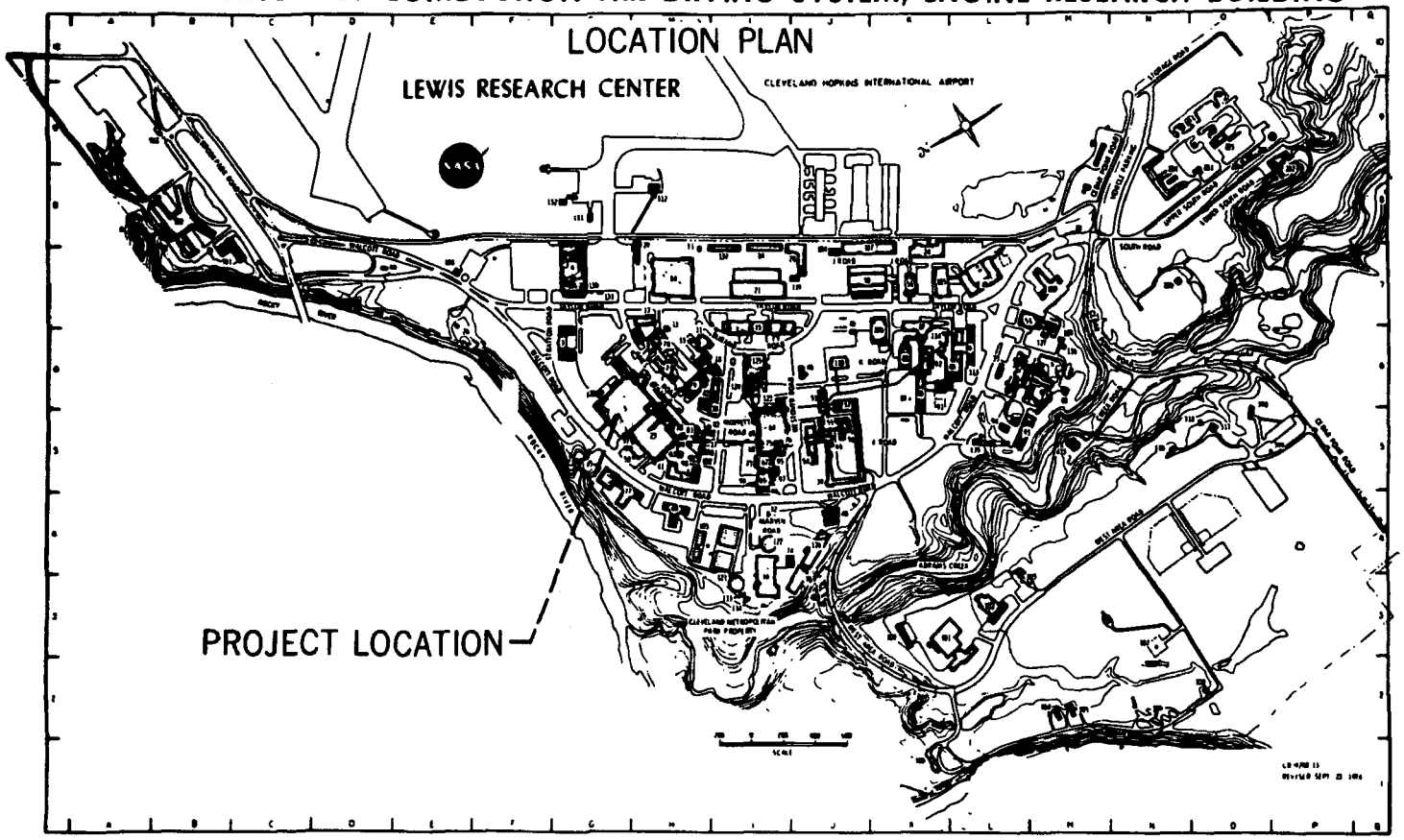
LEWIS RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATION OF REFRIGERATION SYSTEM, ELECTRIC PROPULSION LABORATORY



LEWIS RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES

REHABILITATION OF COMBUSTION AIR DRYING SYSTEM, ENGINE RESEARCH BUILDING



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Rehabilitation of Combustion Air Drying System, Engine Research Building
INSTALLATION:	Lewis Research Center
	FY 1977 CoF ESTIMATE: $1,490,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	25,000	---	25,000
Other affiliated funding	---	11,141,000	11,141,000
Total	25,000	11,141,000	11,166,000

SUMMARY PURPOSE AND SCOPE:

This project will provide for the replacement of the combustion air drying system in the Engine Research Building (ERB). Within this building there are 55 individual test cells involved in a wide variety of research projects. Although the individual requirements of these cells vary greatly, they collectively depend on the ERB central air handling system for their operation. This central air system must have the capability to simulate a broad spectrum of test environments including extremely low moisture content for basic component research in support of air breathing, rocket and ion engine programs.

The existing air drying system which utilizes ammonia refrigeration equipment has been in service for over 30 years. Because of its present condition, it can no longer meet the users' demand for dry air. Further, ammonia leaks have been detected and repairs made in the vicinity of the equipment and within the individual test cells inside of the building.

The new combustion air drying system to be provided by this project will consist of chilled water to air heat exchangers and desiccant dryers with sufficient capacity to meet all present and known future test requirements at the Lewis Research Center (LeRC).

PROJECT JUSTIFICATION:

The existing ammonia combustion air drying equipment has been identified by the LeRC Safety Office as a high "risk" item which should be replaced. Reliability is deteriorating and maintenance requirements are increasing. Condition of the existing system is such that its performance has to be degraded from its original design capacity of 70 pounds per second (32 kilograms per second) to 55 pounds per second (25 kilograms per second). Further, the existing system can only provide dry air at -20°F (-29°C) dew point temperature. This reduced capability is not sufficient for meeting many present test requirements which include basic component research in support of air breathing, rocket and ion engine programs. Many of these investigations require that the moisture content of the incoming air be controlled within specified limits. In some cases meaningful test data can only be obtained if the vapor level is reduced to an absolute minimum. Within practical limits, this test requirement can be met by providing dry air at a dew point temperature of -100°F (-73°C). The proposed new combustion air drying system will provide 70 pounds per second (32 kilograms per second) of dry combustion air at a dew point temperature of -100°F (-73°C). Reliability will be increased and maintenance requirement will decrease. Further, the new system will eliminate the current safety risks associated with the existing ammonia system.

PROJECT DESCRIPTION:

This project consists of removing the old dryer equipment, consisting of ammonia compressors, condensers, heat exchanger, interconnecting piping, and associated concrete foundations. New dryer equipment will be provided consisting of three heat exchangers, two 250-ton capacity package-type water chillers, three desiccant dryer tanks with a regeneration system, interconnecting piping, and associated concrete foundations. Necessary valves, electrical work, controls and safety devices are also included with this project.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				60,000
Site preparation	LS	---	---	35,000
Building modifications	LS	---	---	25,000
Equipment				1,430,000
Precooler	EA	1	90,000	90,000
Refrigeration air dryer	EA	2	240,000	480,000
Desiccant air dryer	EA	3	207,000	621,000
Valves, piping and equipment installation.	LS	---	---	179,000
Provision of electric power and controls..	LS	---	---	60,000
Fallout Shelter (not feasible)	---	---	---	---
Total				1,490,000

LIST OF RELATED GRAPHICS:

Location Plan
Single Line Drawing

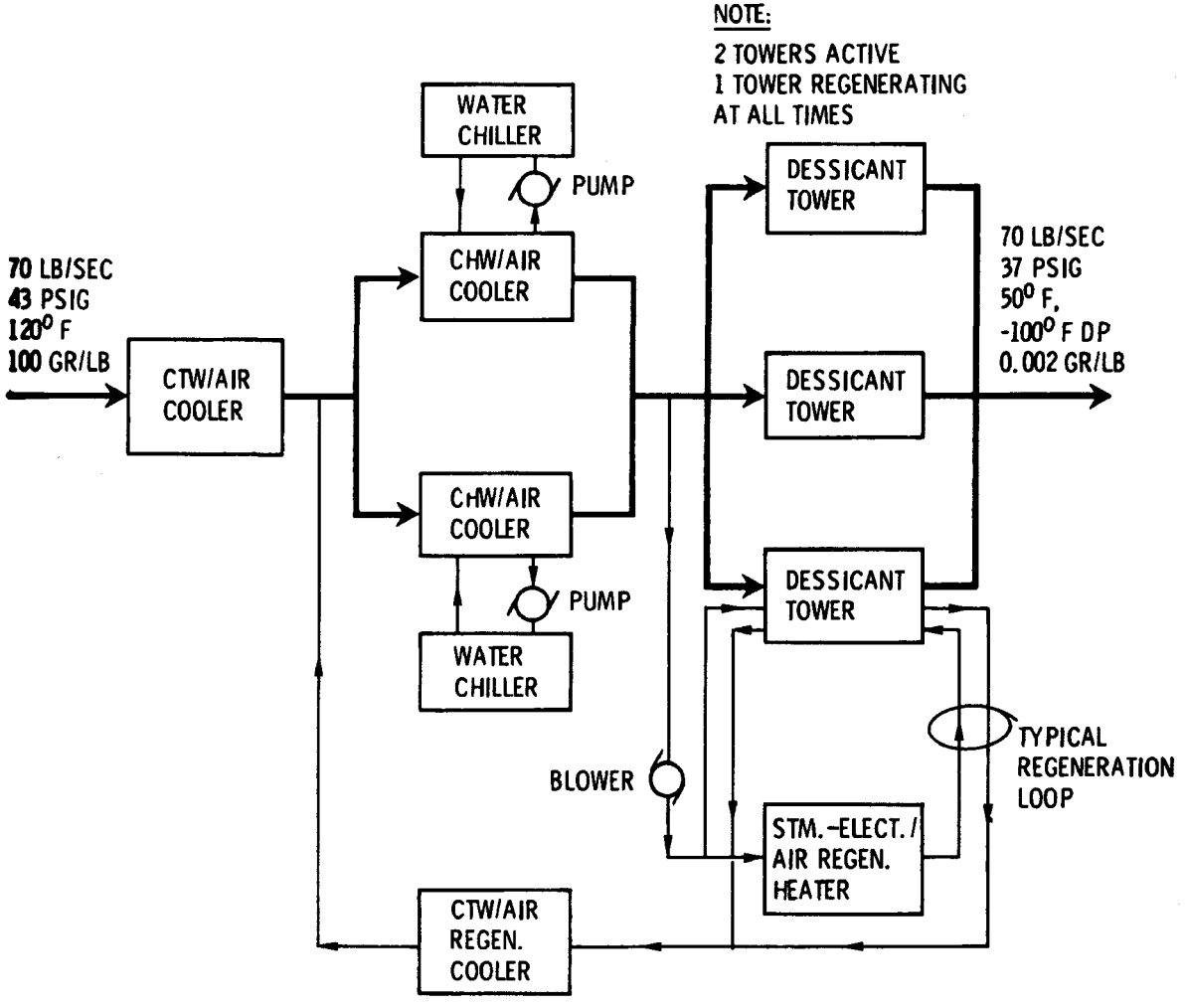
OTHER EQUIPMENT SUMMARY:

No other collateral 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 within the defined scope.

REHABILITATION OF COMBUSTION AIR DRYING SYSTEM, ENGINE RESEARCH BUILDING



NEW AIR DRYING SYSTEM FLOW DIAGRAM

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

SUMMARY

LARGE AERONAUTICAL FACILITY

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Construction of national transonic facility (LaRC).....	25,000,000	CF 7-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE: Large Aeronautical Facilities	
	FY 1977 CoF ESTIMATE: $25,000,000

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

SUMMARY PURPOSE AND SCOPE:

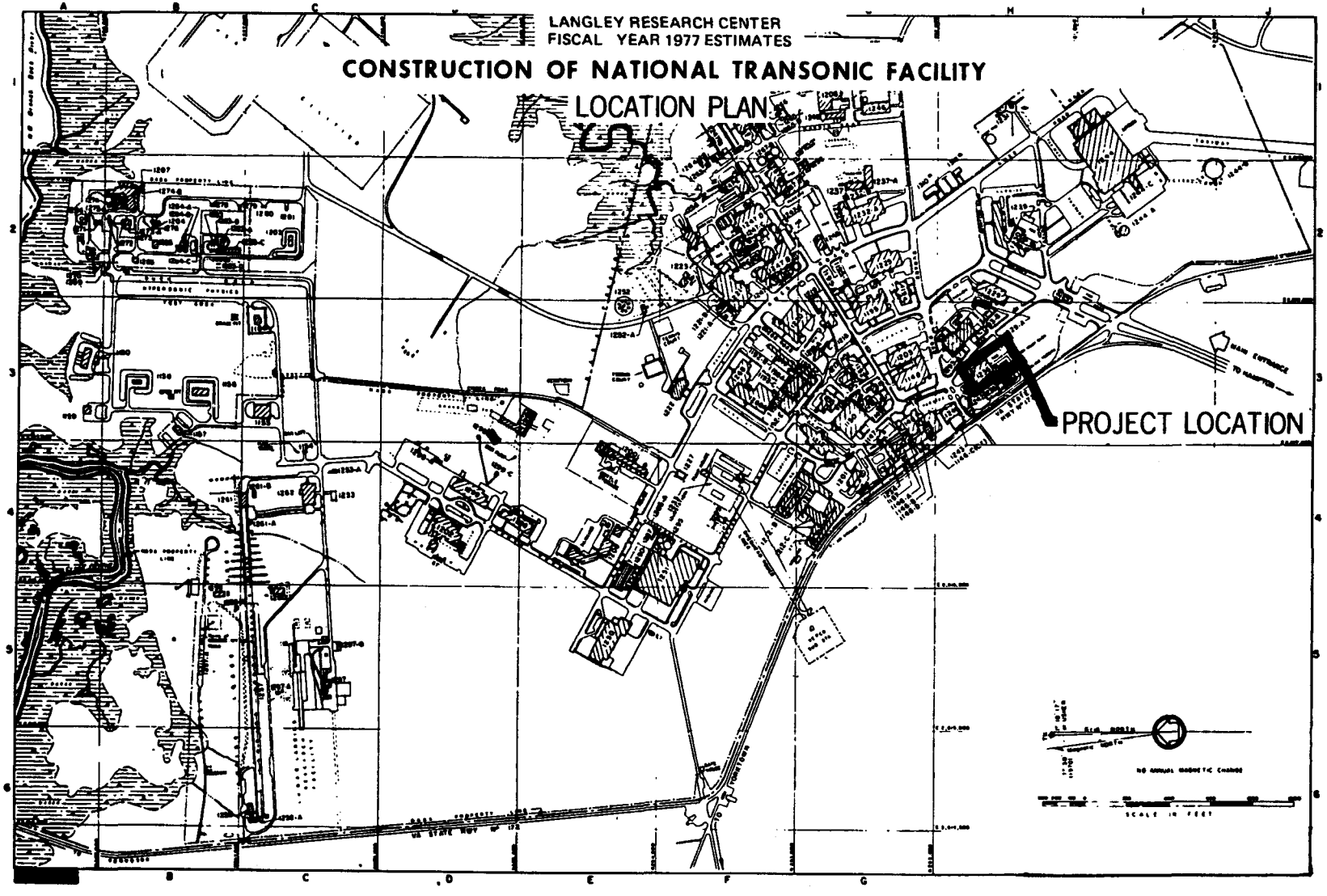
The purpose of this project is to provide for the construction and modification of large aeronautical research and development testing facilities. The planning related to these large aeronautical facilities has been supported jointly by NASA and Department of Defense. These facilities are included in a program/plan to provide for major and unique aeronautical test facilities required over the next two decades. The facilities will have the testing capability necessary for the development of technology that will 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) which will combine into a single facility the capabilities needed to satisfy the research needs of NASA and the development needs of Department of Defense (DOD).

2. Modification of 40 x 80-Foot Subsonic Wind Tunnel. This is a full-scale wind tunnel located at Ames Research Center (ARC) 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.

The NASA Fiscal Year 1977 request provides for the initiation of long-lead procurement items for the construction of the National Transonic Facility at LaRC. Future years' Construction of Facilities (CoF) resources will, of course, be needed to complete this facility. This year's estimates under Facility Planning and Design also provide for the completion of the final design for the NTF and for the continuation of the design effort on the 40 x 80-Foot wind tunnel modifications. Consideration will be given to the requirements for the modification of the 40 x 80-Foot Subsonic Wind Tunnel in future years' programs.


LANGLEY RESEARCH CENTER
FISCAL YEAR 1977 ESTIMATES
CONSTRUCTION OF NATIONAL TRANSONIC FACILITY
LOCATION PLAN
PROJECT LOCATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of National Transonic Facility
INSTALLATION:	Langley Research Center
FY 1977 CoF ESTIMATE:	$25,000,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	2,160,000	---	2,160,000
Other affiliated funding	---	4,942,000	4,942,000
Total	2,160,000	4,942,000	7,102,000

NOTE: Additional Planning and Design resources will be provided on an interim basis as outlined in the Facility Planning and Design Budget Estimates.

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction of a high Reynolds number transonic tunnel which will satisfy the research needs of NASA and the development needs of DOD. This facility will provide a capability to test a broad spectrum of aeronautical vehicles including civilian, commercial, military, and space vehicles at up to full-scale Reynolds number. It will incorporate a cryogenic approach for achieving high Reynolds number without excessive model loads and will use the evaporation

of liquid nitrogen to obtain a low temperature test medium in an otherwise conventional fan-driven wind tunnel circuit. 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 configurations. This ability to separate these effects has heretofore been unattainable in ground facilities, thus the new tunnel provides an entirely new realm of research capability.

During FY 1975, both NASA and the USAF had planned dedicated transonic facilities to satisfy their respective needs for high Reynolds number research and development testing of future aircraft. A High Reynolds Number Tunnel (HIRT) employing a "Ludwieg tube" concept to be located at the Arnold Engineering Development Center, Tullahoma, Tennessee; and another, called the Transonic Research Tunnel (TRT), a continuous-flow, cryogenically-cooled facility to be located at the NASA Langley Research Center (LaRC) were considered. Subsequently, rising construction costs for both facilities, coupled with the successful demonstration of the "cryogenic concept" at LaRC, led the Aeronautics and Astronautics Coordinating Board to reconsider the need for two separate and distinct facilities. As a result, it was determined that a single facility to be provided at a lower cost and using the "cryogenic concept" could best serve the immediate needs of both NASA and DOD. It has also been agreed that this single facility would be located at LaRC.

PROJECT JUSTIFICATION:

There is an urgent need, established over recent years, for several new ground-based 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 regime. This need is supported by 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). This requirement stems from the recognition that experimental data obtained from existing low Reynolds number transonic wind tunnels often leads to erroneous conclusions with regard to flight vehicle performance predictions. This is especially true for conditions where local velocities over the vehicle surface exceed the speed of sound and where shock-boundary layer interaction effects occur. The transonic flight environment is common to a broad spectrum of flight vehicles, such as civilian, commercial, military, and space. This environment also produces Reynolds number sensitive aerodynamic problems which are generally not amenable to analytical study and, thus, require accurate experimental data at or near flight Reynolds number for an adequate solution.

Therefore, a wind tunnel which will permit accurate experimental measurement at transonic speeds approaching flight Reynolds number is necessary for the continuing development of new technology. This will allow increases in efficiency, performance, size and range of civil and military aircraft

which is the basis for maintaining national leadership in aircraft design and the superiority of U.S. military flight vehicles. Thus, the urgency for the new testing capability suggests that this facility should be available at the earliest possible time.

The capability to simulate full-scale Reynolds numbers on a model in a wind tunnel at which Mach numbers near 1.2 requires a workable test section size of 8.2 x 8.2 feet (2.5 m x 2.5 m) with a maximum operating pressure on the order 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 is no known wind tunnel in existence in the United States or Europe that will satisfy the above requirements.

PROJECT DESCRIPTION:

The project will provide for the construction of a fan-driven closed circuit wind tunnel 200 feet (61 m) long by 48 feet (14.6 m) wide, varying in diameter from 40 feet (12.2 m) to 11 feet (3.4 m), having an operating pressure range from 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 from 155°F to -300°F (341.5°K to 88.7°K). Cryogenic gas temperature will be obtained by evaporating liquid nitrogen into the tunnel circuit. Thus, cold nitrogen gas will be used as a test medium. The tunnel pressure shell will be fabricated from nickel steel and 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 x 2.5 m) slotted test section to produce Mach numbers over the range between 0.2 and 1.2.

The cryogenic approach described above has been identified as the most effective energy reduction technique of achieving high Reynolds numbers without excessive model loads.

A three dimensional model support and angle-of-attack system having an angle range of 24 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 tunnel will be constructed on the site of the currently existing 4 x 4-foot (1.2 x 1.2 m) supersonic tunnel and will use its electric motor drive system. These motors 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 will be provided to match the compressor with the motors at both ambient and cryogenic temperatures. A liquid rheostat will also be provided to achieve a constant torque from the motor over a wide range of RPM, thus improving the power characteristics of the

motors for the new application. An additional 60,000 HP synchronous drive motor (44,760 KW) (10 minute rating) will be required to provide the higher Reynolds numbers. The proposed facility will also utilize the existing cooling tower, pumps, auxiliary equipment and buildings. A new two-story shop addition of approximately 33,500 square feet (3,112 m^2) to accept the larger transonic test section will be provided. This 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 be provided on the site to allow nitrogen flows to the tunnel at rates up to about 1,100 lbs. (499 Kg per second). This flow is required to remove the heat generated by the compressor during constant cryogenic temperature operation. Additionally, a vent and pressure control is provided to maintain constant pressure during data gathering. The vent will be provided with a muffler and exhaust stack to meet pollution control standards.

Due to the size and nature of this facility, it is considered appropriate to plan its financing on a progressive basis over three fiscal years. An analysis of schedules and capabilities indicates that such funding will not materially impact the operational schedule for this large facility which is presently envisioned as being mid-1981 which is based on this FY 1977 increment of funding. Preliminary engineering estimates indicate that the total ultimate cost of this facility will most probably be $65 million depending on the time frame of construction and the ultimate degree of cost escalation encountered. Considerable preliminary engineering and special studies have already been completed. The final design for this facility was initiated in October 1975.

The FY 1977 request will provide for the demolition and removal of the existing tunnel shell and that portion of the building not to be reused. Also included in this project is the construction of foundations for the new tunnel and building utilizing the existing foundations where possible. Approximately 600 new piles varying in length from 27 feet (8.2 m) to 40 feet (12.2 m) will be required. The new piles will consist of a combination of treated wood, concrete and steel as required for the specific location and loading.

This fiscal year also will permit the procurement of all the materials for the tunnel pressure shells. The funds for the first phase of the fabrication and erection of the tunnel pressure shell are also included in this year's estimates. It will also provide for the fabrication of the tunnel structure components (i.e.; test section, model support section, screens and turning vanes); the fan components (fan blades and stator vanes and hub); the tunnel cooling coil; and the model support system. The first phase of the tunnel drive system which includes the procurement of the additional drive motor is also included. Two subsequent phases of the drive system will include the procurement of the remaining items such as gearbox units, drive shafts and bearings, and the installation of the drive system.

Preliminary studies concerning possible environmental impacts caused by this facility have been completed. These studies have indicated that noise, venting of large volumes of nitrogen gas, and possible formation of ground fog caused by cold nitrogen gas venting are potential problem areas. However, these areas can be adequately controlled through the design of this facility and LaRC anticipates no adverse effects on the environment. It is therefore planned to amend the overall Langley Research Center Environmental Impact Statement to cover the National Transonic Facility.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition.....	---	---	---	---
Construction.....				18,900,000
Demolition and foundations.....	LS	---	---	1,400,000
Tunnel pressure shell: materials, fabrication, and erection (Phase I).....	LS	---	---	8,700,000
Tunnel structure components fabrication.....	LS	---	---	8,800,000
Equipment.....				6,100,000
Tunnel drive system (Phase I).....	LS	---	---	2,600,000
Fan components fabrication.....	LS	---	---	2,300,000
Cooling coil fabrication.....	LS	---	---	400,000
Model support system fabrication.....	LS	---	---	800,000
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				25,000,000

This estimate provides only for the FY 1977 increment of the total facility, now estimated to cost about $65 million which would be funded in this and perhaps two additional fiscal years.

LIST OF RELATED GRAPHICS:

Location Plan
Perspective View
Second Floor Plan and Tunnel Layout
Tunnel Aerodynamic Lines
Test Section Elevation

OTHER EQUIPMENT SUMMARY:

Existing collateral equipment consisting mainly of the electric drive motors and a portion of the building for the 4-Foot Supersonic Wind Tunnel will be used in this facility. The total "book value" of the 4-Foot Supersonic Wind Tunnel is about $4,942,000. No other noncollateral equipment is involved.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete the construction of the National Transonic Facility, about $40 million additional will be required in future years.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

SPACE SHUTTLE FACILITIES

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Space Shuttle Facilities
INSTALLATION:	Various Locations
	FY 1977 CoF ESTIMATE: $39,825,000

LOCATION OF PROJECT: Locations are identified in the following documentation

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project.

	Planning and Design	Construction	Total
Specific CoF funding.....	10,265,000	99,317,000	109,582,000
Other affiliated funding.....	---	672,919,000	672,919,000
Total.....	10,265,000	772,236,000	782,501,000

The above is summary data only for the projects included in this submittal. For clarification purposes it is noted that prior to FY 1977 a total of $24.3 million has been made available for shuttle for planning and design in addition to a total of $230 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 1977, 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 completing construction of the Orbiter Processing Facility (OPF), which were both initiated with FY 1975 resources. As a continuation of the FY 1976 project it is also planned to modify existing facilities to provide capacity for the recovery, washing, refurbishment, and subassembly of solid rocket boosters (SRB's) and SRB parachutes. The construction of a shuttle/carrier aircraft mating facility is also included.

Fiscal Year 1977 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 1976 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, and orbiter manufacturing and assembly facilities is complete and the facilities are operational. Construction of orbiter landing facilities is underway and modification of launch facilities has started. The remaining facilities authorized in prior years are in the final design phase.

The FY 1977 request is intended primarily to continue modifications to provide launch capability for the shuttle vehicle at KSC. These facilities are needed for initial operations at the launch and landing site. Three projects begun with prior year resources--modifications to Launch Complex 39, construction of the Orbiter Processing Facility (OPF), and modifications for SRB processing facilities--are continued. With the exception of Mobile Launch Platform II (MLP II), construction of the facilities must be completed six to twelve months before the first manned orbital flight to support extensive activation, launch processing system installation and prelaunch test and checkout. The request for MLP II begins the transition to provide launch capability to support higher flight rates at KSC. This facility is required at the time the second orbiter is delivered to KSC to provide support for integrating that orbiter with the ground facilities and equipment, as well as

support for the flight mission profile planned for 1981 and beyond.

The remaining projects in the FY 1977 request are intended primarily to support vital ground and flight test activities. They include continuing two prior years' projects which provided facilities for proper crew training and external tank manufacturing. A project for rehabilitation and modification of existing facilities uniquely required to support the shuttle program is also included.

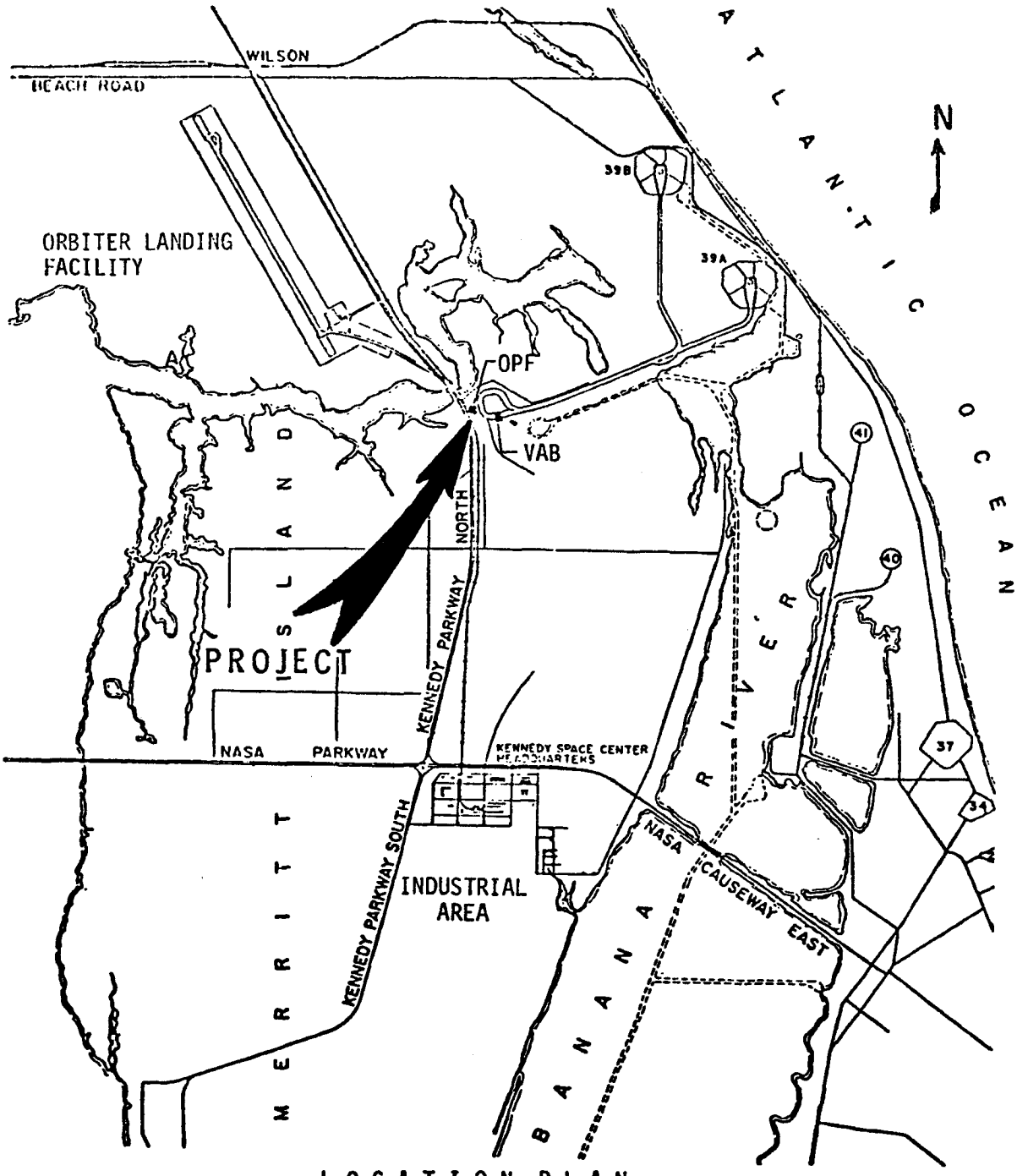
Current space shuttle planning is based on achieving a first manned orbital flight in the second quarter of CY 1979 and attaining a flight capability of approximately 15 missions in CY 1981. This FY 1977 request is necessary to meet specific targets or intermediate milestones directly related to the major milestones. The individual project descriptions specify those respective milestones to which the facility is related.

PROJECT COST ESTIMATE:

Launch and Landing Facilities	35,355,000
Construction of Orbiter Processing Facility, Kennedy Space Center, Florida	3,750,000
Modifications to Launch Complex 39, Kennedy Space Center, Florida	19,855,000
Modifications for Solid Rocket Booster Processing Facilities, Kennedy Space Center, Florida	9,700,000
Construction of Shuttle/Carrier Aircraft Mating Facilities, Kennedy Space Center, Florida	2,050,000
Ground Test Facilities	2,540,000
Modifications for Crew Training Facilities, Johnson Space Center, Texas	780,000
Rehabilitation and Modification of Shuttle Facilities, Various Locations	1,760,000
Manufacturing and Assembly Facilities	1,930,000
Modification of Manufacturing and Final Assembly Facilities for External Tanks, Michoud Assembly Facility, Louisiana	1,930,000
TOTAL	39,825,000

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF ORBITER PROCESSING FACILITY



LOCATION PLAN

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Orbiter Processing Facility
INSTALLATION:	John F. Kennedy Space Center
	FY 1977 CoF ESTIMATE: $3,750,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project. This funding data does not include $3.9 million which is being redirected to this project by a Section 3 action to provide workstands which were previously planned for implementation from R&D, but now have been determined to be proper facilities charges.

	Planning and Design	Construction	Total
Specific CoF funding	1,034,000	21,540,000	22,574,000
Other affiliated funding	---	---	---
Total	1,034,000	21,540,000	22,574,000

SUMMARY PURPOSE AND SCOPE:

This project continues work begun with FY 1975 and FY 1976 funds for the Orbiter Processing Facility (OPF) at the Kennedy Space Center. The FY 1975 project provided for one high bay and a low bay for saffing, maintenance, and checkout of the space shuttle orbiter. The FY 1976 increment provided for the construction of the second high bay structure. This year's project provides for outfitting the second high bay with the necessary gaseous, propellant, and special systems; adding 10,000 square feet (929 m^2) to the low bay for staging and logistic support activities; and erecting a security fence around the facility. This will complete the facility requirement for processing the orbiter at the Kennedy Space Center.

PROJECT JUSTIFICATION:

Upon returning from a space mission, the orbiter must undergo safing, maintenance, and checkout before it can be readied for reuse. The major operations include draining and purging all fuel systems, removing ordnance and all other hazardous elements, removing payloads brought back from space, inspecting the payload bay and crew cabin, repairing and replacing damaged components, and refurbishing the thermal protection system. The hypergolic modules that make up the reaction control system, the orbital maneuvering system, and components of the auxiliary power unit are removed in this facility; serviced and checked out in a separate facility; and then returned to the OPF for reinstallation in the orbiter. After these operations are completed, the mission payloads are inserted into the payload bay and the orbiter receives integrated system checkout before it is moved to the vehicle assembly building for integration and checkout with the external tank and boosters. To carry out these operations, which take approximately two-thirds of the total orbiter processing time between missions, the OPF is required.

The FY 1975 program provided the initial funds for the necessary facilities. That increment included constructing and equipping the first high bay for orbiter operations and the low bay for the support functions. The FY 1976 increment provided the basic structure only for the second high bay. This FY 1977 project provides for completing the OPF at the launch site. The work includes outfitting the second high bay with the essential high-pressure gas, liquid propellant, hydraulics, instrumentation, control, and other special systems necessary to carry out the vital orbiter processing functions. The project also includes an addition to the low bay to provide a staging facility for equipment and working personnel, and a chain link fence for safety and security of the operations.

It is necessary that the second high bay be outfitted and completely operational during the early phase of shuttle development. While both bays are designed to carry out all the delineated orbiter processing functions, it has been recognized that certain operations like safing are of a hazardous nature; others, such as thermal protection system refurbishment, are somewhat "dirty" and are incompatible with the clean environment required for the removal and insertion of payloads into the orbiter. For these reasons, it was deemed vital to have both bays available during the shuttle development phase when personnel are learning and developing operational procedures to perform the cited complex tasks safely and efficiently.

In this way, it is possible to separate incompatible activities if necessary during the early phases. In addition, completing the facility in the proposed time frame will greatly minimize the costly interference between the construction and the operational activities and result in the most optimum and economical means of completing the total facility construction in time to meet the needs. On that basis, FY 1975 and FY 1976 provided the required funds to implement the facility construction in the timely and efficient manner described. FY 1977 resources are necessary to complete the facility as planned.

The low bay portion of the OPF is required to provide the necessary staging and logistic support facilities for the entire operation. Since the initial planning, the functions to be performed and kinds and size of equipment needed to support the work have been better defined. The analysis revealed that additional low bay space is required to house ground support equipment and materials as well as tools, lockers, and administrative space for the large work force involved in orbiter operations. This project provides the necessary space for these important functions. Because of the hazardous operations involved in orbiter processing and because certain payloads will have security requirements, the OPF will be a restricted area. A chain link fence around the site is therefore necessary.

To meet the current schedule for the first manned orbital flight, the first orbiter must be delivered to Kennedy Space Center in the third quarter of CY 1978 for the necessary prelaunch activities. The first high bay, authorized with prior year funds, will be operationally ready by that time. The second high bay must be completed by the end of CY 1979 to support shuttle developmental flights as well as to receive the second orbiter, scheduled to arrive in the latter part of CY 1980. To achieve these objectives, FY 1976 provided the basic structure and this FY 1977 increment will complete all the required construction.

PROJECT DESCRIPTION:

This project continues construction work provided for with FY 1975 and FY 1976 funds. It provides for outfitting the second 29,200-square foot (2,712.7m^2) high bay provided for with FY 1976 monies. The outfitting includes installing the necessary special and launch-related systems -- including hypergolic; hydraulic; instrumentation/communication; environmental control; electrical; gaseous hydrogen, nitrogen, helium, and oxygen; liquid hydrogen and oxygen; compressed air; coolant; and utility control. The hypergolic system allows for disposal of hazardous fuels when the orbiter is safed. The electrical system will provide service to all portions of the workstands. Compressed air is used to operate tools. The environmental control system provides specially conditioned "clean" air to the orbiter during payload operations. The coolant system provides cooling for the orbiter during tests. Over 12,000 feet (3,657.6 m) of piping as well as the associated valves and joints, 52,000 feet (15,849.6 m) of wiring and cable, and approximately 1,000 feet (304.8 m) of duct work will be installed to accommodate these systems.

The project also provides for the construction of a two-story, 10,000-square foot (929m^2) addition to the north end of the low bay. It will be constructed of structural steel framing with masonry exterior walls and the necessary electrical and mechanical systems. In addition, 2,000 feet (609.6 m) of chain link fence with its attendant gates and posts will be installed around the entire facility site.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				3,750,000
Site preparation, fencing, and utilities	LS	---	---	180,000
Special and launch-related systems				3,100,000
Gaseous systems	LS	---	---	(480,000)
Liquid hydrogen and oxygen	LS	---	---	(500,000)
Hypergolic systems	LS	---	---	(570,000)
Electrical, instrumentation, and communication	LS	---	---	(950,000)
Environmental control	LS	---	---	(400,000)
Utility control, hydraulic and coolant systems	LS	---	---	(200,000)
Low bay addition	SF	10,000	47.00	470,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,750,000

LIST OF RELATED GRAPHICS:

Location Plan
Perspective of Orbiter Processing Facility
Floor Plan of Orbiter Processing Facility

OTHER EQUIPMENT SUMMARY:

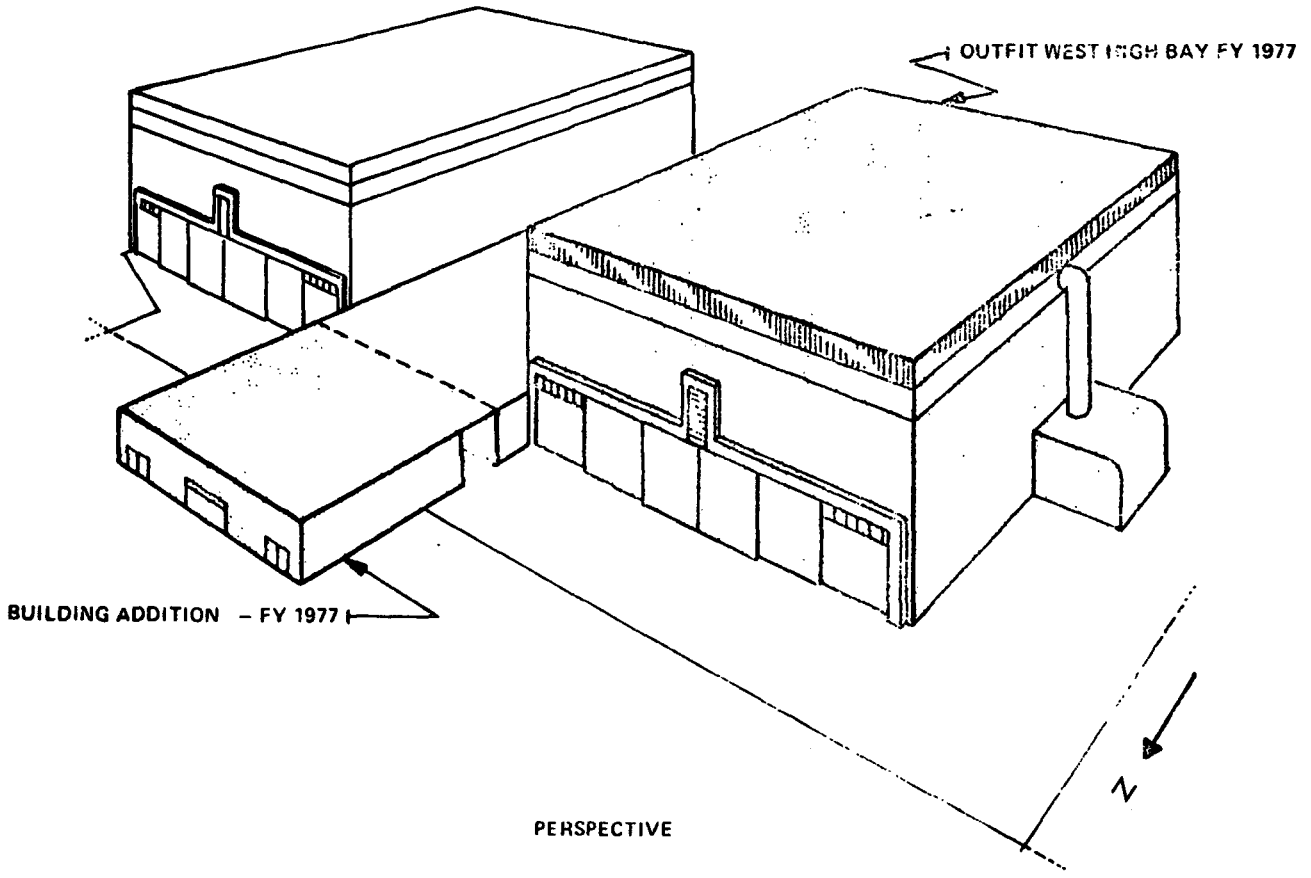
As currently defined, about $18 million to $20 million will be needed for noncollateral equipment. This equipment relates to the entire OPF, and not just this project, and consists primarily of test and checkout, servicing, handling, and auxiliary equipment required to support these orbiter processing operations.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

For presently planned usage, there are no currently foreseen future CoF funding requirements to complete this project.

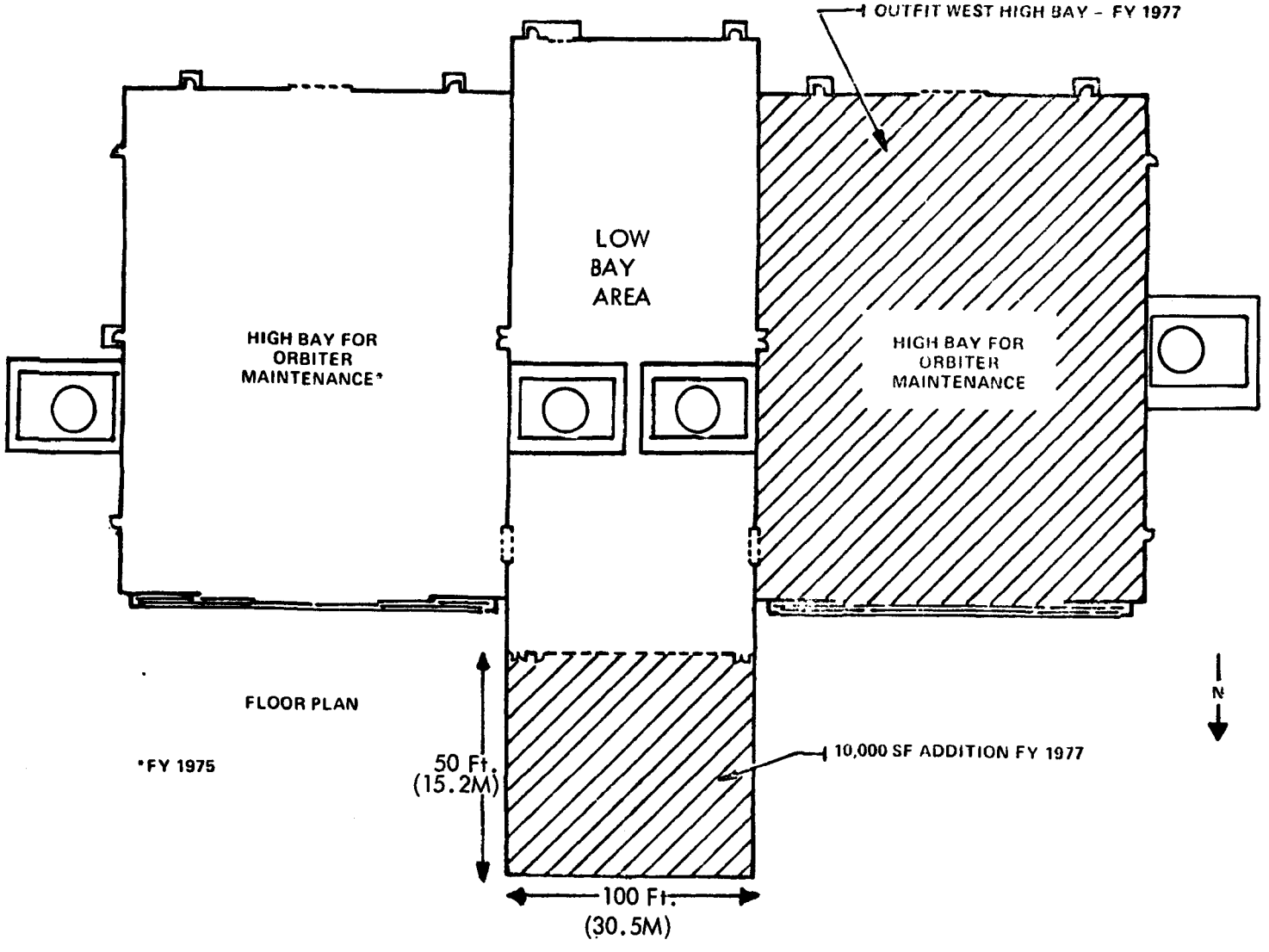
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF ORBITER PROCESSING FACILITY



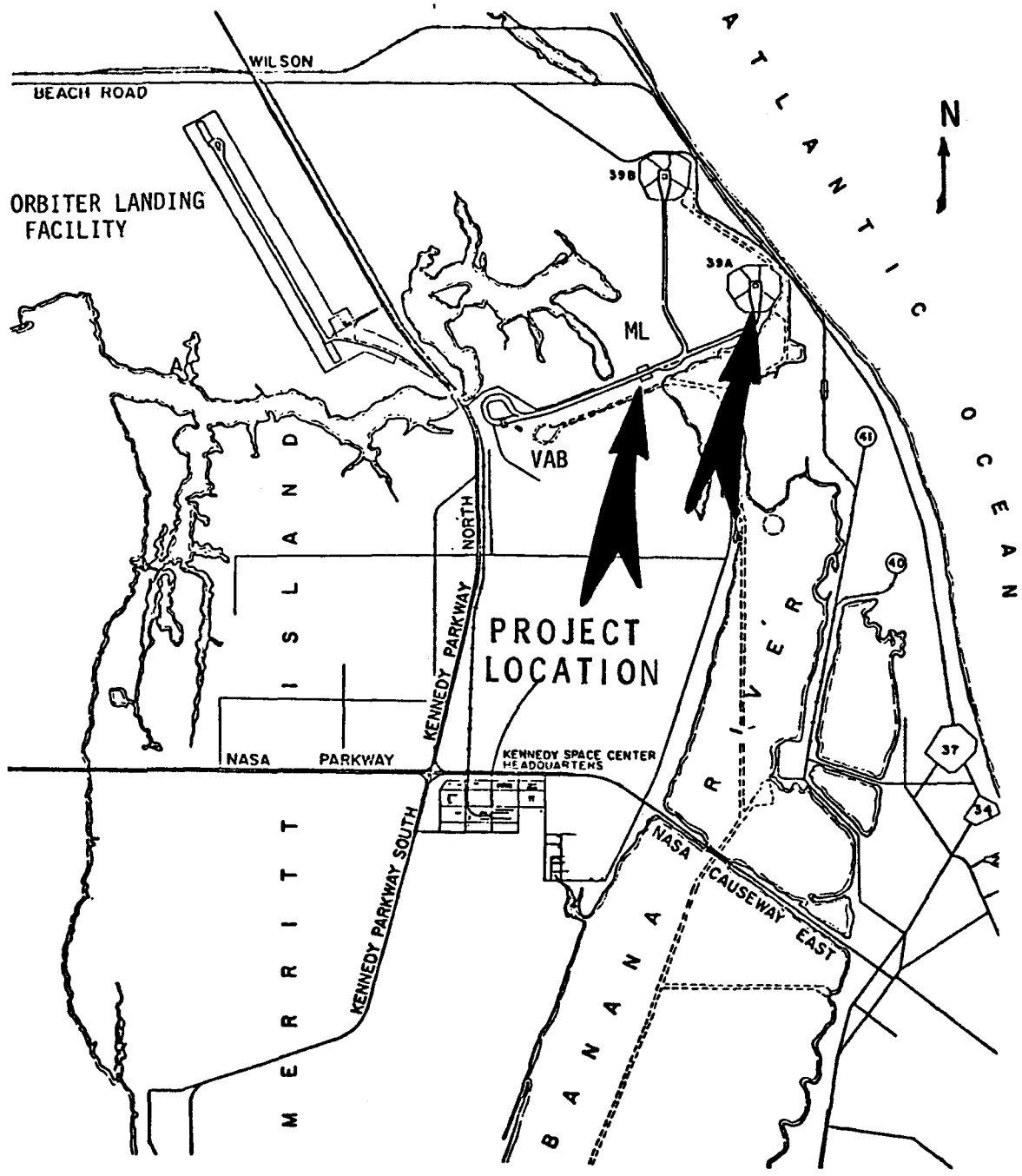
PERSPECTIVE

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
CONSTRUCTION OF ORBITER PROCESSING FACILITY



JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 39



LOCATION PLAN

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modifications to Launch Complex 39
INSTALLATION:	John F. Kennedy Space Center
FY 1977 CoF ESTIMATE:	$19,855,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	4,718,000	48,465,000	53,183,000
Other affiliated funding	---	501,538,000	501,538,000
Total	4,718,000	550,003,000	554,721,000

SUMMARY PURPOSE AND SCOPE:

This project continues modifications to Launch Complex 39 begun with FY 1975 and FY 1976 resources to prepare the complex for shuttle launches. These FY 1975 and FY 1976 projects provided for modifications to two high bays in the Vehicle Assembly Building, the Launch Control Center, one mobile launcher, and one launch pad. This project primarily provides for modifying a second mobile launcher. Modifications include removing the launch umbilical tower to decrease weight; providing exhaust holes for orbiter main engines and solid rocket boosters; and altering the mobile launch platform's structural, electrical, and mechanical systems to accommodate the shuttle vehicle configuration. The project also provides for modifications to Pad A to reduce high acoustic levels generated from firing the space shuttle main engines and solid rocket boosters so that orbiter payloads will not be damaged during launch.

PROJECT JUSTIFICATION:

The Space Shuttle Program has consistently made maximum use of reconfigured equipment and facilities from the Apollo Program. This policy has helped to ensure the most economical shuttle program possible. Consistent with this policy and for effective operations, the shuttle will be mated, integrated and checked out on an existing mobile launcher to be modified for shuttle use. The shuttle will then be moved to the launch pad, using the mobile launcher as the launch platform. Previous appropriations provided for modifications to one mobile launcher; program requirements call for a second mobile launcher at this time. It can be provided by reconfiguring another existing mobile launcher used during the Apollo Program.

The second mobile launcher is necessary to support the checkout and operations of the second orbiter, currently scheduled to arrive at Kennedy Space Center in the third quarter of CY 1980. At that time, the orbiter must undergo extensive checkout and integration with the second mobile launcher, the ground support equipment, and the launch processing system to prepare it for launch operations. Once that phase is accomplished, both the facility and the orbiter will be used to support the scheduled flights in CY 1981 and beyond.

During the operational phase of the shuttle program, current planning indicates that three mobile launch platforms will be required to achieve the planned launch rate of 40 missions per year at Kennedy Space Center. It is currently estimated that one mobile launch platform can, after some experience, support approximately 15 to 16 launches per year. However, in the early phase of shuttle operations, the capability of a single launcher is significantly less. The build-up towards the higher capability occurs gradually and could extend over a 12 to 18-month period before the ultimate capability is achieved. This is primarily because of the time required for shakedown, checkout, and integration with the ground support equipment and shuttle hardware; the long period needed to develop and perfect countdown and launch procedures; and the learning period necessary to train the launch operation ground crews. In addition, it is anticipated that each mobile launcher will require refurbishment after each launch because of the direct impact of flame from the orbiter engines and the solid rocket boosters. As the Apollo Program revealed, the required refurbishment and the time to implement it would decrease after some period of learning. For these reasons, it is necessary to provide a second mobile launcher in this time frame.

A second portion of this project is needed to modify Pad A. During recent simulated model shuttle tests at Marshall Space Flight Center (MSFC), it was determined that excessive noise levels are created during main engine and solid rocket booster firing. These high acoustic levels are greater than those that payloads in the orbiter bay can tolerate. If the high levels are not alleviated, it is likely that payloads will be damaged and therefore unable to perform during the mission. Such a condition is of course unacceptable.

It would be possible to solve this acoustic problem by strengthening the orbiter structure or "beefing up" each payload to withstand the noise levels anticipated at launch. Such an alternative would result in increasing the weight of the orbiter and/or payloads, correspondingly degrading the overall shuttle system capacity. A ground-based solution to the noise problem, on the other hand, is the most cost-effective answer, particularly in view of the fact that the high acoustic levels are encountered at launch.

Modifications to the mobile launcher will require 2-1/2 years for completion; support systems, equipment installation, checkout, and activation will require another year. The second mobile launcher must be ready by the fourth quarter of CY 1980, when the second orbiter arrives at KSC. The modifications to Pad A must be completed before the first manned orbital flight, now scheduled for the second quarter of CY 1979. It is therefore necessary that this project be funded with FY 1977 funds.

PROJECT DESCRIPTION:

This project provides for modifications to an existing mobile launcher and to Pad A at Launch Complex 39. Modifications to the mobile launcher include removing the umbilical tower; relocating vehicle support and holddown points; reconfiguring engine exhaust openings; and modifying and installing electrical, mechanical, communications, and special systems. Materials and equipment that have been removed from the mobile launcher will be preserved for reuse.

The mobile launch platform, which was originally designed to accommodate Apollo hardware, is a two-story steel structure 25 feet high by 160 feet long by 136 feet wide (7.6 m by 48.8 m by 41.5 m). An umbilical tower extends 380 feet (115.8 m) above the deck of the launch platform and weighs approximately 10.5 million pounds (4.76 million kg). Electricity to meet power needs; gaseous nitrogen and helium to purge systems during hazardous operations; a deluge system to cool the steel deck during launchings; heating, ventilating, and air conditioning (HVAC); and a fire extinguishing system are provided for the platform. Much of the piping and cabling is contained inside the platform. Propellant lines for liquid oxygen and liquid hydrogen run outside the platform to the spacecraft. To adapt this large and complex facility to shuttle requirements, major modifications will be required.

The weight of the shuttle vehicle as it moves to the launch pad exceeds the weight of the unfueled Apollo/Saturn V vehicle by approximately 1.9 million pounds (861,840 kg). The mobile launcher must therefore be lightened to avoid overloading the crawler transporter. Removing approximately 2.6 million pounds (1,179,360 kg) of steel comprising the tower, two elevators, and equipment inside the mobile launcher not required for shuttle operations will reduce the weight sufficiently. Vehicle services will be provided from a fixed tower at the launch pad rather than from the mobile launcher. This fixed tower will be later constructed from salvaged sections of the removed umbilical tower.

The shuttle will require three exhaust openings in the mobile launcher--one approximately 32 feet by 35 feet (9.8 m by 10.7 m) for the orbiter main engine exhaust and two approximately 20 feet by 42 feet (6.1 m by 12.8 m) for the solid rocket boosters--instead of the one opening provided for the Apollo configuration. Girders, framing, deck plates, heat shields, and holddown arms will have to be removed. Piping for the HVAC system; ducts for the environmental control system; and lines for the pneumatic, propellant, water, and coolant systems will have to be rerouted to accommodate the new exhaust openings. Instrumentation, communication lines, controls, 60-Hertz power, lighting, and the lightning protection system must all be modified. A new fire alarm system and a hazardous gas detection system must be provided.

New support and holddown points for the solid rocket booster and new support points for the removable orbiter erection supports will be provided. Crawler transporter/mobile launcher support points will be relocated to balance the load. The reconfiguration will require modifications to the internal structure of the launcher as well as rerouting mechanical and electrical systems.

The second part of this project provides for further specific modifications to Pad A. During acoustic tests of the shuttle vehicle scale model at Marshall Space Flight Center, it was determined that launches will produce excessive acoustic levels. For that reason, a test program was initiated at MSFC, using an 8% replica of the shuttle, to determine the ground facility options available to alleviate this critical acoustic problem. Despite the fact that this test program is still underway and the test data is continuing to be analyzed, a "baseline" feasible solution has been identified. Refinement and optimization of this solution should be available in early CY 1976.

This "baseline" solution, stemming from the results of completed tests, indicate that a high pressure water injection system will reduce the acoustic levels which must be coped with. To meet these basic requirements, a water system has been sized at a flow capacity of 400,000 to 500,000 gallons per minute (1.5 to 1.9 million liters/min). The facilities required to achieve this attenuation capability will include new hydropneumatic storage tanks and new distribution piping and nozzle spray systems. The resultant new water injection system will be independent from the existing water "quench" system at the pad. This "baseline" solution, with certain optimization, is at present considered to be a satisfactory solution for solving the excessive acoustic problem up to "lift-off".

The scale model test program is continuing in an effort to further optimize this solution in terms of nozzle patterns and locations at the pad as well as to determine how these acoustic levels may be attenuated from "lift-off" to a point up to 5-7 seconds after launch. The scope of the facility modification to satisfy this further requirement is not defined at this time and funds are not included in this project for that extended requirement.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				19,855,000
Mobile launcher structural modifications	LS	---	---	9,400,000
Remove umbilical tower	LS	---	---	(1,650,000)
Modify mobile launch platform	Ton	2,500	3,100	(7,750,000)
Mobile launcher electrical modifications	LS	---	---	965,000
Mobile launcher mechanical modifications				4,490,000
Environmental control systems	LS	---	---	(1,160,000)
Propellant system	LS	---	---	(1,200,000)
Pneumatic systems	LS	---	---	(1,430,000)
Water systems	LS	---	---	(560,000)
Fire protection	LS	---	---	(140,000)
Pad A modifications	LS	---	---	5,000,000
Hydropneumatic storage tank	LS	---	---	(2,744,000)
Distribution system (piping, spray nozzle)	LS	---	---	(2,256,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				19,855,000

LIST OF RELATED GRAPHICS:

Location Plan
Mobile Launcher Perspective

OTHER EQUIPMENT SUMMARY:

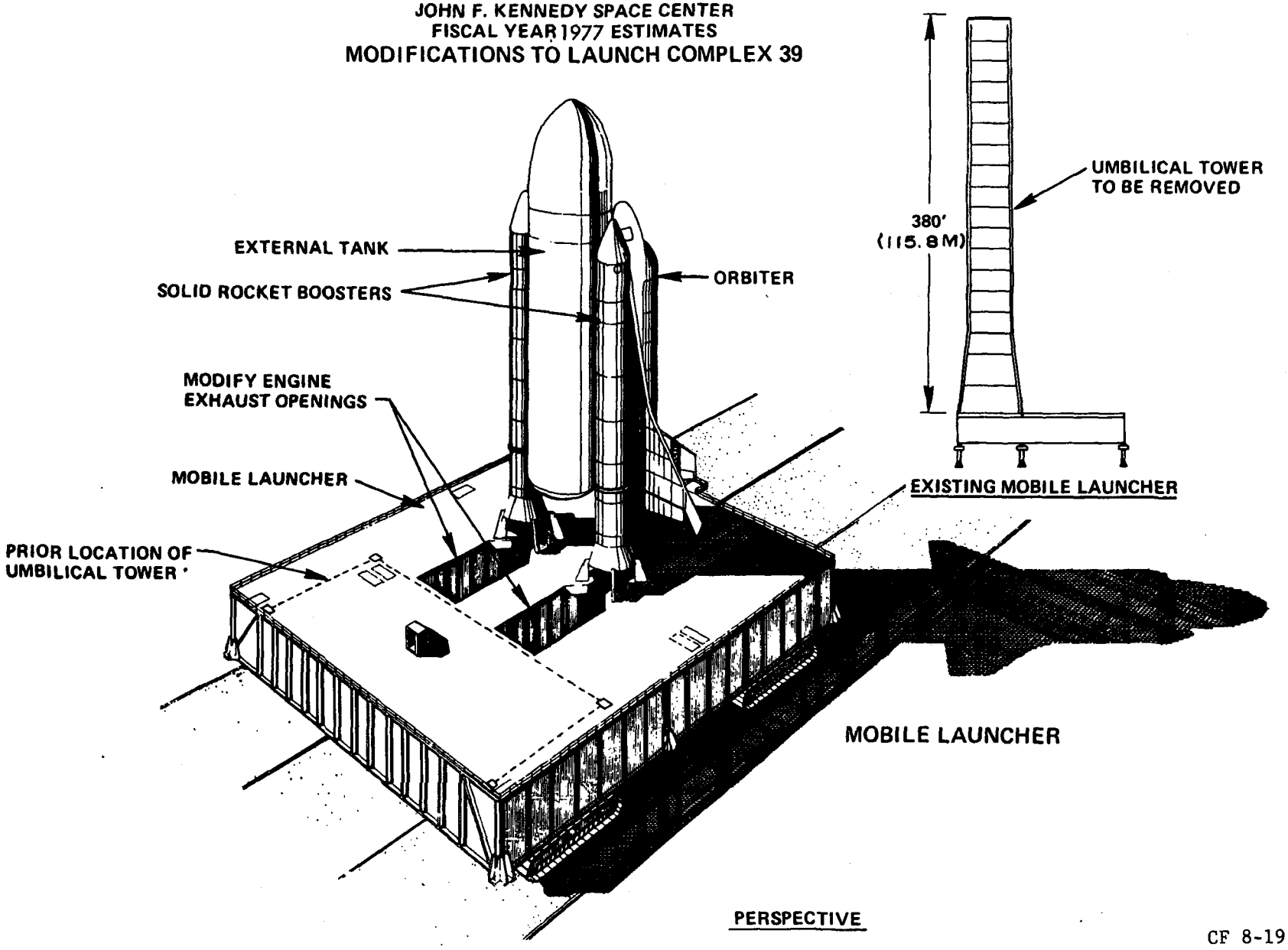
It is anticipated that approximately $3.7 million of R&D resources will be required to provide noncollateral equipment (platforms, access stands, tail service masts, solid rocket booster supports and holddowns) for initial operation of the mobile launcher.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that $43 million to $50 million from future CoF programs will be required to provide the additional launch facilities necessary to complete this project. These CoF funds will be used to modify another pad, two more high bays in the Vehicle Assembly Building, possibly a third firing room in the Launch Control Center, and to provide protection from lightning for the shuttle during transportation to the launch pad. With completion of the acoustic test program at Marshall Space Flight Center, the remaining modifications to Pad A will be required to solve the acoustic spectrum problem after "lift-off." This additional future requirement is estimated to be $3 million to $5 million and is included in the total requirement for Launch Complex 39 indicated above. Additional funds will also be required for modification of a third mobile launcher should this requirement be later validated for the increased flight rates and this is not included in the estimated future funding indicated above.

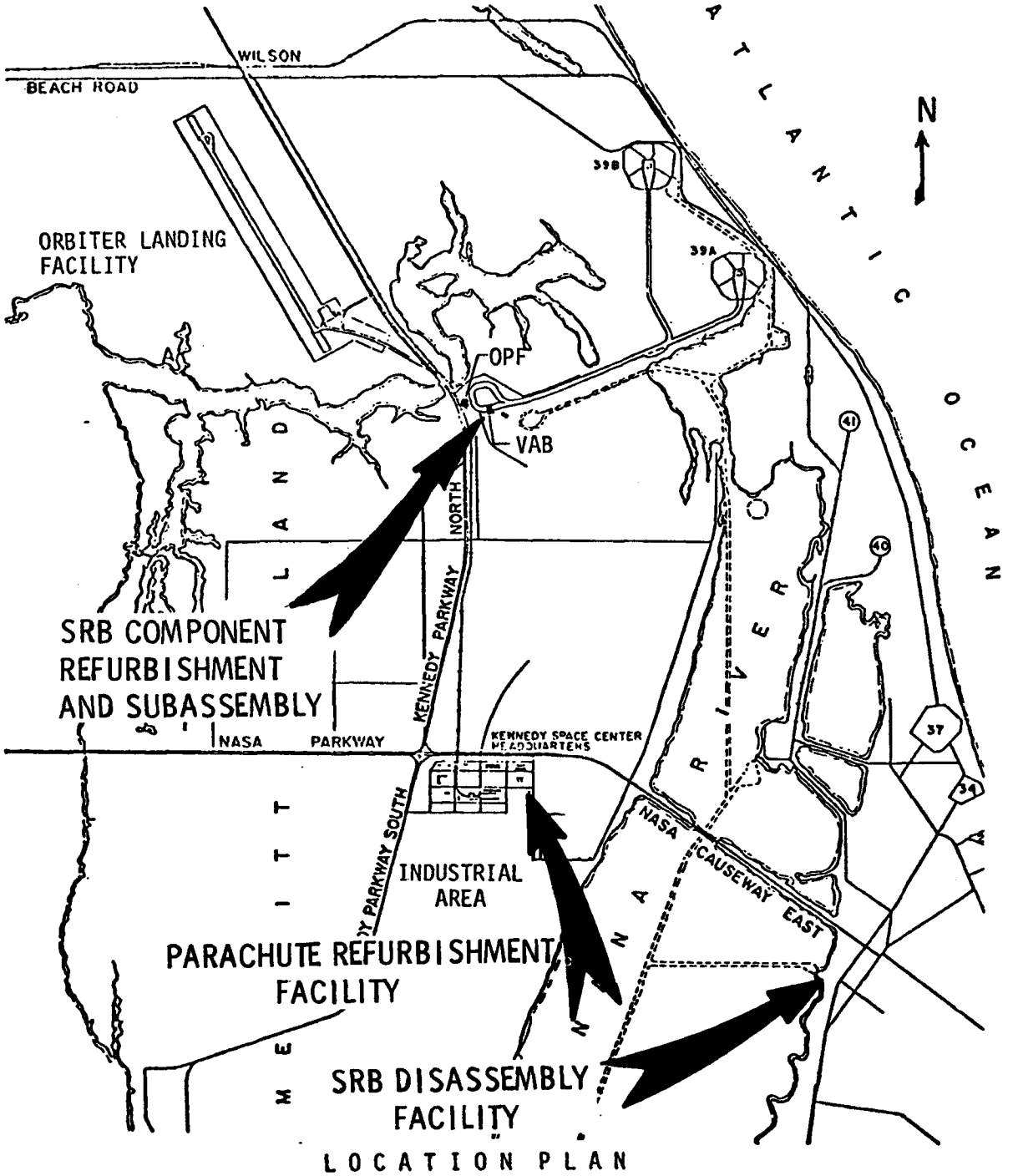
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 39



JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

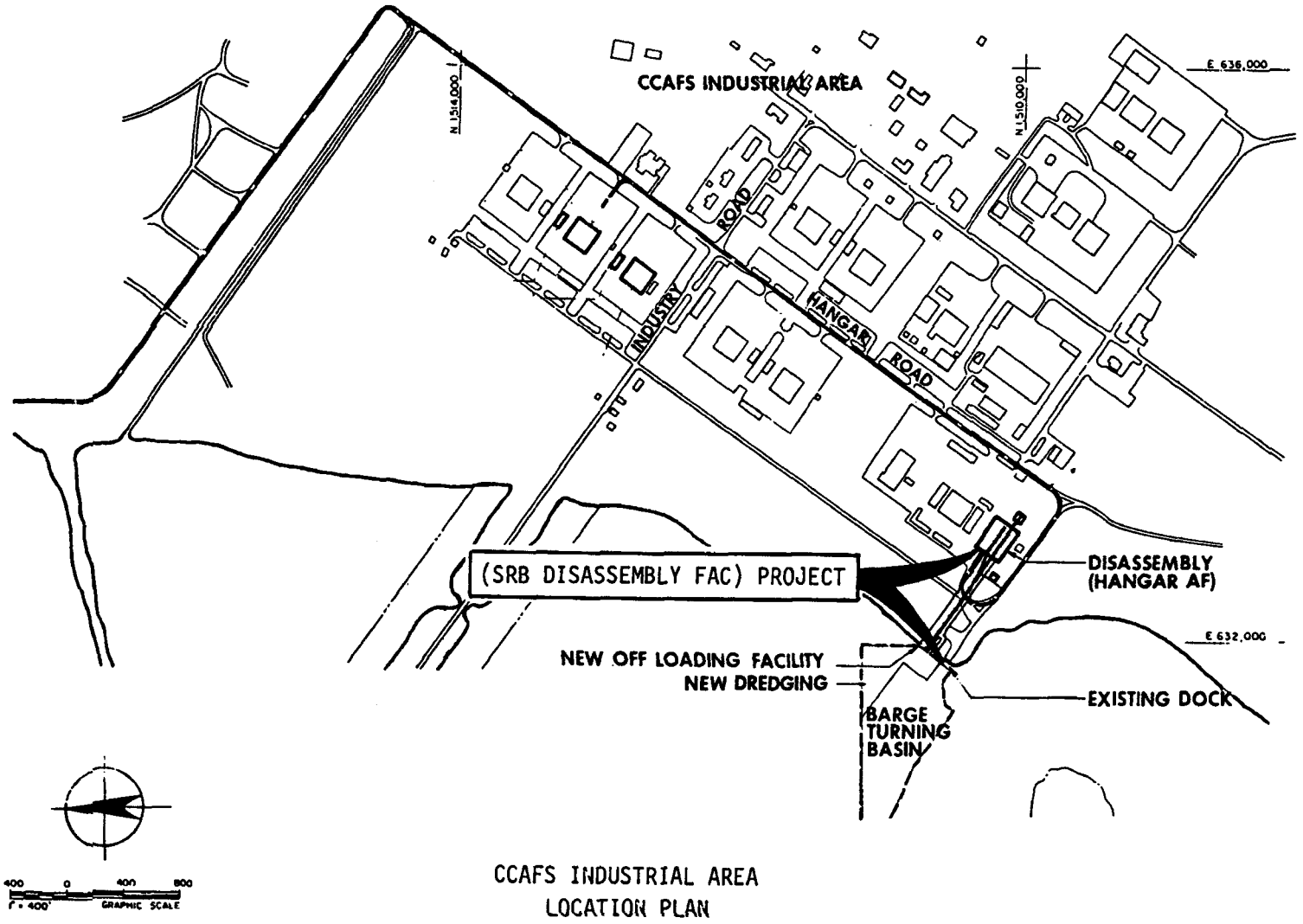
MODIFICATIONS FOR SRB PROCESSING FACILITIES



LOCATION PLAN

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS FOR SRB PROCESSING FACILITIES



CCAFS INDUSTRIAL AREA
LOCATION PLAN

CF 8-21

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE: Modifications for Solid Rocket Booster Processing Facilities

INSTALLATION: John F. Kennedy Space Center

FY 1977 CoF ESTIMATE: $9,700,000

LOCATION OF PROJECT: Kennedy Space Center and Cape Canaveral Air Force Station, Brevard County, Florida

COGNIZANT HEADQUARTERS: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,870,000	5,240,000	7,110,000
Other affiliated funding	---	156,902,000 *	156,902,000
Total	1,870,000	162,142,000	164,012,000

* NOTE: Does not include costs for Air Force-owned facilities.

SUMMARY PURPOSE AND SCOPE:

This project continues modifications provided by the FY 1976 project for solid rocket booster (SRB) processing facilities. The FY 1976 project initially provided for modifying the existing Air Force Titan III Solid Motor Assembly Building (SMAB) to provide the capability to receive and process solid rocket motors and to assemble large SRB segments before they are moved to the NASA Vehicle Assembly Building (VAB) for stacking, mating, and integrating with the external tank and orbiter. Facility utilization changes in late CY 1975 consolidated these functions in the VAB in lieu of the SMAB. These changes were adopted based on favorable costs and operational benefits of the VAB versus the SMAB. This FY 1977 project provides for modifications to existing facilities at Kennedy Space Center (KSC) and Cape Canaveral Air

Force Station (CCAFS) required to support the essential functions of retrieving, cleaning, disassembling, refurbishing, and processing SRB components, parachutes, and associated hardware. The facilities to be modified include the Saturn dock, Hangar AF, and access between the dock and Hangar AF. The facilities to be modified at KSC include Building M7-657 and the VAB low bay area.

PROJECT JUSTIFICATION:

The shuttle vehicle consists of an orbiter, an external tank, and two solid rocket boosters. Each booster is composed of four solid rocket motor segments, forward and aft skirts, a nose cone, a nozzle, a thrust vector control mechanism, separation motors, a parachute recovery system, and attachment structures. After performing their intended function, the SRB's will be separated from the orbiter/external tank and descend, via parachutes, to a splashdown area in the ocean, where they will be recovered and returned to land for subsequent reuse. The recovered SRB's will be towed directly to CCAFS. Upon arrival at the existing Saturn dock, the SRB's will be removed from the water, "safed," and washed. The other recovered components will be unloaded from the retrieval vessel and processed at designated facilities. To achieve these vital recovery and retrieval operations, this FY 1977 project is required.

After recovery and cleaning, the SRB's will be transported on a dolly rail system into Hanger AF, where they will be disassembled into component subassemblies. The SRB casing will be prepared for shipment back to the Thiokol Corporation in Utah, where it will be reloaded with solid propellants. The remaining segments, including the forward skirt and the aft skirt, will be further disassembled into components and transported to the VAB low bay for maintenance, refurbishment, and reassembly for reuse. Refurbishment of the SRB parachutes will be separately accomplished in Bldg. M7-657 in the KSC industrial area. Here the parachutes will be defouled, washed, dried, repaired, and sent to the VAB for reassembly into the nose cone. The assembled components then will be transported to High Bay 4 of the VAB for final assembly into major assembly sections. To carry out these important disassembly and refurbishment operations, the proposed facility modifications are required.

An engineering analysis indicated that the use of existing Air Force and NASA facilities is an effective and economical solution to support the necessary and complex SRB processing operations. The alternative of constructing new facilities for these activities is estimated to cost more than twice the amount required for modifying existing facilities for the same purposes.

The first manned orbital flight is currently scheduled for the second quarter of CY 1979. To achieve this goal, SRB components should be delivered to Kennedy Space Center in the third quarter of CY 1978 for the start of the assembly operations. Disassembly and refurbishment facilities must be operational by the second quarter of CY 1979 to support the first manned flight. Consequently, the SRB processing facilities must be operationally ready by these dates to meet program requirements. Modification and activation

lead times, estimated at 26 to 30 months, require that construction be started in the fourth quarter of CY 1976, thus necessitating this FY 1977 programming.

PROJECT DESCRIPTION:

This project includes continuation and extension of the work begun in the FY 1976 project for the SRB processing facilities. The major work includes:

a. Recovery and Disassembly Facilities

Retrieved SRB's will be received at the Saturn dock, lifted from the water, and placed on cradle dollies. They will then be transported to an outdoor area for safing and then to an outdoor wash rack where insulation removal and initial cleaning will be accomplished. They will then be transported to Hangar AF where the SRB's will be disassembled and undergo final cleaning, and components readied for refurbishment. In order to accommodate these operations, the existing barge basin at the Saturn dock must be dredged to 12 feet (3.7 m) and enlarged. A slip and crane of approximately 120 tons (109 metric tons) capacity will be provided at the dock. A new dolly rail system to transport the SRB will be constructed from the slip to and through Hangar AF. An outside wash station which will house a high-pressure water and scrubbing system for washing and stripping insulation from components will be constructed. To provide a drying and preserving area, stripping stands, and work platforms in Hangar AF, utilities must be expanded and adequate drains provided to handle large amounts of water. Lighting, power, communication, fire protection, and air conditioning systems must also be modified and extended.

b. SRB Refurbishment and Subassembly Facilities

After operations in Hangar AF are complete, SRB components will be transferred to the VAB Low Bay for refurbishment and subassembly buildup. To accomplish these operations, the west side of the VAB low bay (cells 1 through 4) and adjacent rooms must be modified and outfitted. Modifications to cells 1 through 4 include removal of existing work stands; installing new specifically configured workstands for the aft skirt, forward skirt, and frustum; and providing four new cranes to service these stands. Existing utility systems must also be modified to support the refurbishment and subassembly buildup in this area. To support the required painting and insulation of components during the refurbishment operations the modifications will include: removing and installing partitions to create paint and insulation booths; addition of a heating system for curing processes; installing an air exhaust filtration system; and adding a breathing air system. Turntables will be installed in the paint and insulation area to provide rotation of the assemblies during automatic spraying operations for paint and insulation. Electrical power, lighting, sprinkler, communications, and alarm systems will also be modified in these areas. An area on the second floor of the low bay will be modified to support a mixing area required for the appli-

cation of insulations. These modifications will consist of partition changes; addition of an air exhaust filtration system; and installation of mixing equipment for the insulation.

c. Parachute Refurbishment Facilities

Building M7-657 located in the KSC industrial area will be modified and enlarged to receive, clean, refurbish, repack, and temporarily store retrieved parachutes. Building M7-657 is approximately 200 feet (61 m) long by 50 feet wide (15.2 m) and was originally designed as a parachute packing facility to support the Gemini program. The existing portion will be modified to perform parachute inspection and repair functions as well as to provide for equipment storage and administrative support. New construction consists of two additions to the facility, one 8,000 square feet (743 m^2) open addition and one 12,000 square feet (1,115 m^2) enclosed addition. Parachute defouling, washing, drying, packing, and storage functions will be performed in the new additions. A monorail system is necessary to provide parachute horizontal transportation and handling capability within the facility. A parachute washer and a parachute dryer will be constructed. Expanded utility systems will be provided and fire alarm, communications and air conditioning systems will be extended throughout the area.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				9,700,000
Recovery and disassembly facilities				5,030,000
Modify dock and slip	LS	---	---	(2,120,000)
Construct 120-ton crane	LS	---	---	(1,190,000)
Modify Hangar AF	LS	---	---	(1,300,000)
Cleaning system	LS	---	---	(420,000)
Refurbishment and subassembly facilities	LS	---	---	2,500,000
Work stand area	LS	---	---	(431,000)
Bridge cranes	EA	4	175,000	(700,000)
Paint and insulation area	LS	---	---	(1,369,000)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Parachute refurbishment facilities.....	LS	---	---	2,170,000
Site preparation.....	LS	---	---	(145,000)
Architectural/structural.....	LS	---	---	(821,000)
Mechanical, electrical, utilities.....	LS	---	---	(646,000)
Wash and dry system.....	LS	---	---	(558,000)
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				9,700,000

LIST OF RELATED GRAPHICS:

Location Plan at KSC
Location Plan at CCAFS
SRB Flow at KSC
Plan (SRB Recovery and Disassembly Facility)
Floor Plan (SRB Component Refurbishment and Subassembly)
Floor Plan (Parachute Refurbishment Facility)

OTHER EQUIPMENT SUMMARY:

It is estimated that approximately $12 million in R&D resources will be necessary to provide noncollateral equipment (transporters, dollies, pallets and canisters, handling equipment, and assembly kits) for this portion of the SRB processing facilities.

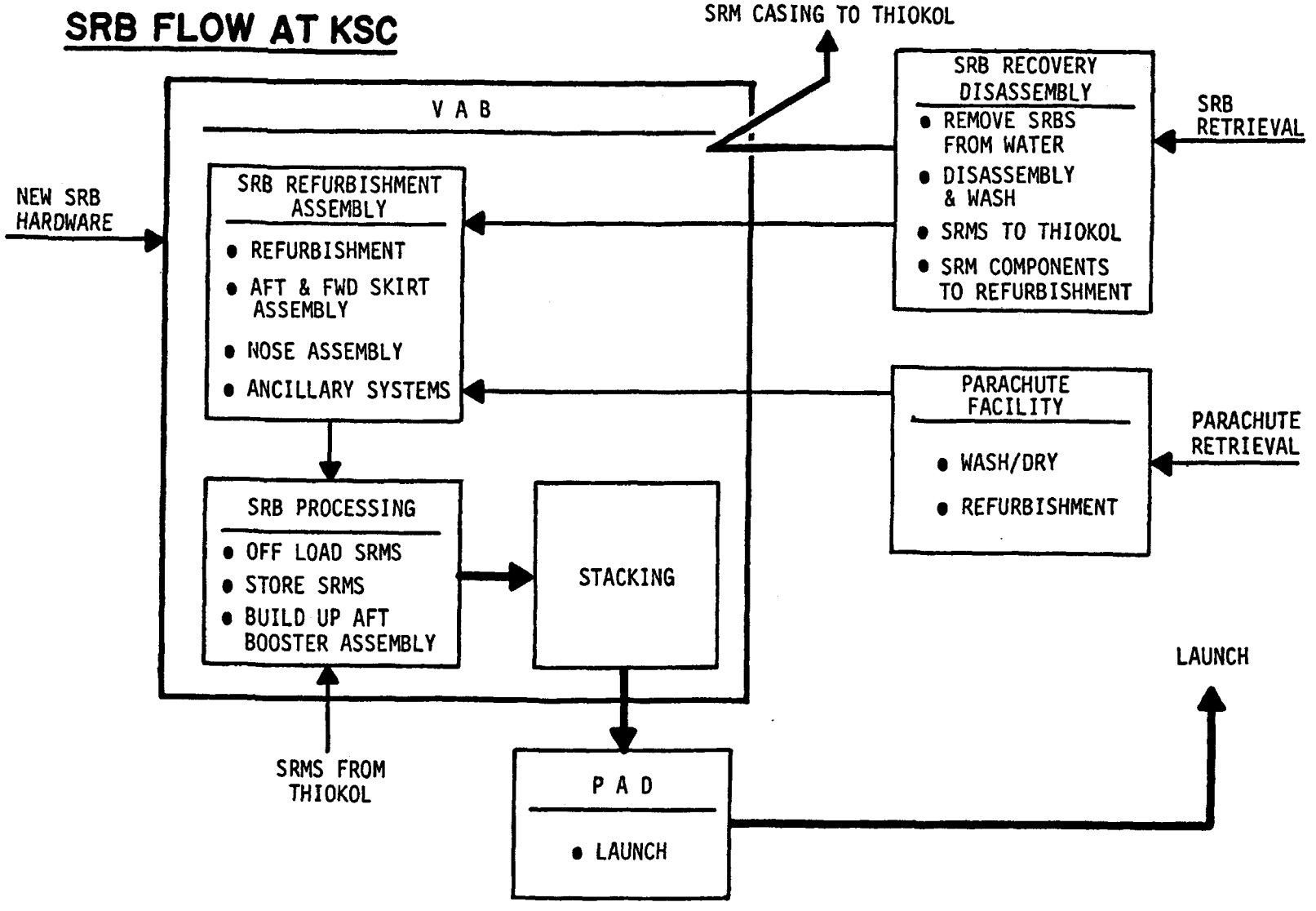
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

For presently planned usage, there are no currently foreseen future CoF funding requirements necessary to complete this project.

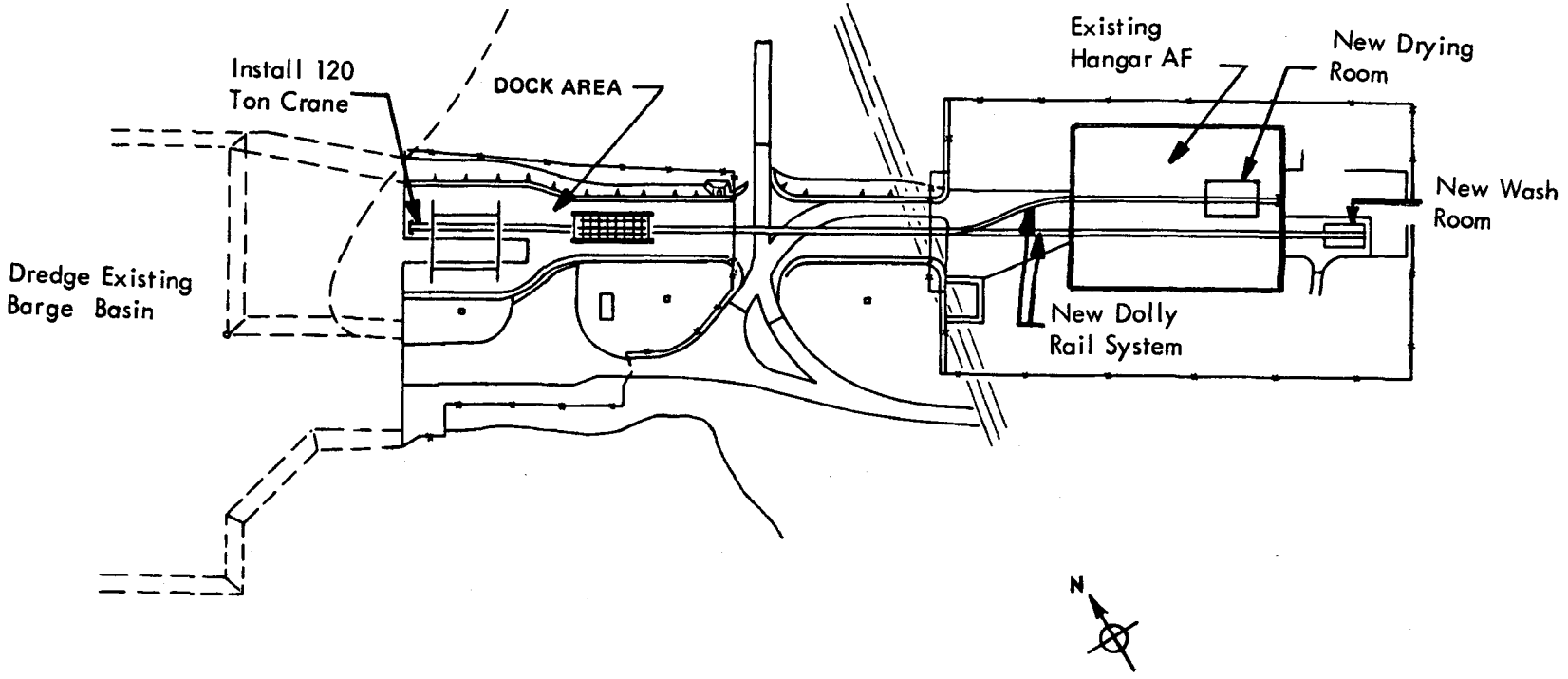
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS FOR SRB PROCESSING FACILITIES

SRB FLOW AT KSC



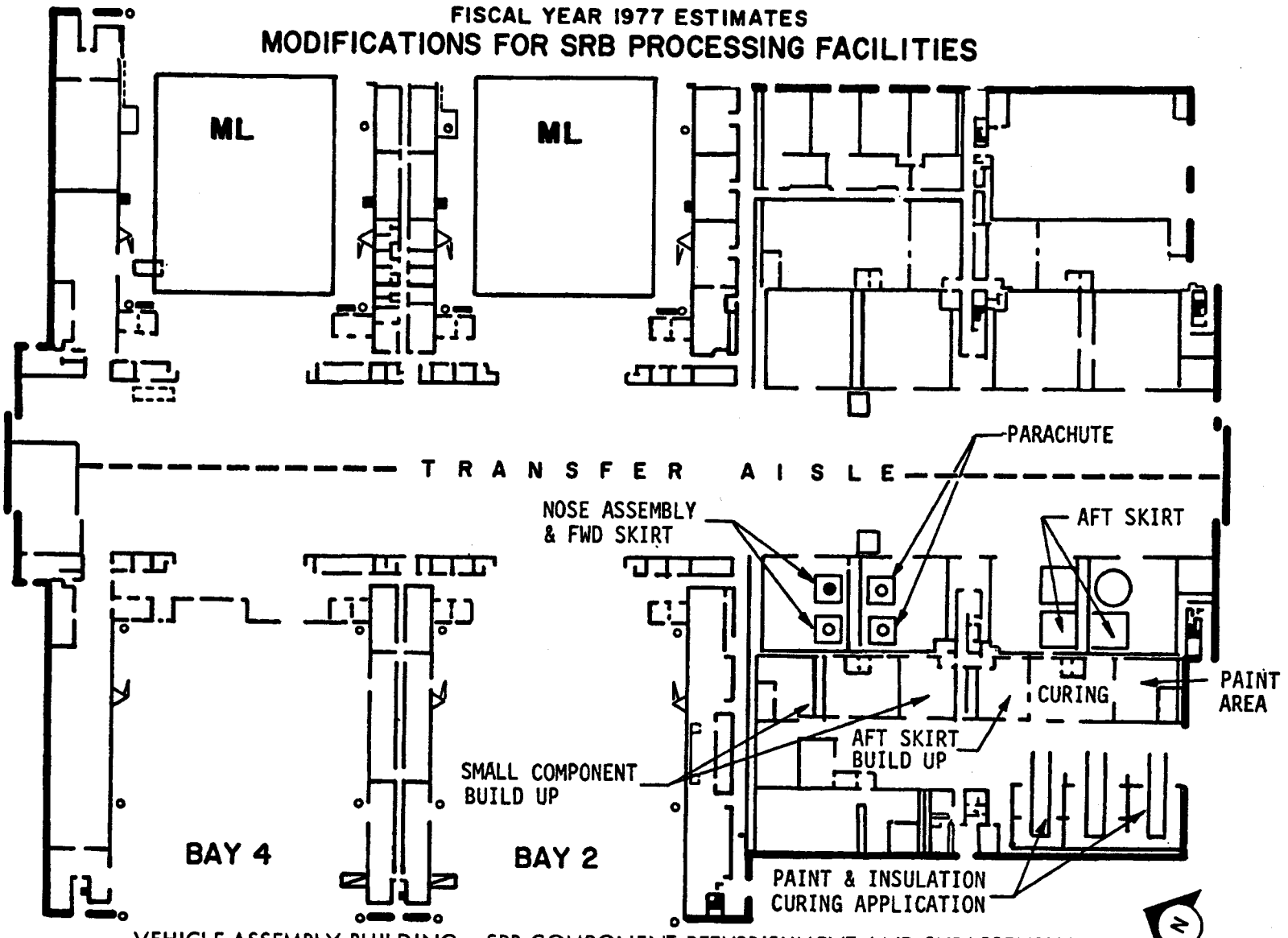
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
MODIFICATIONS FOR SRB PROCESSING FACILITIES



PLAN
SOLID ROCKET BOOSTER RECOVERY AND DISASSEMBLY FACILITY

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

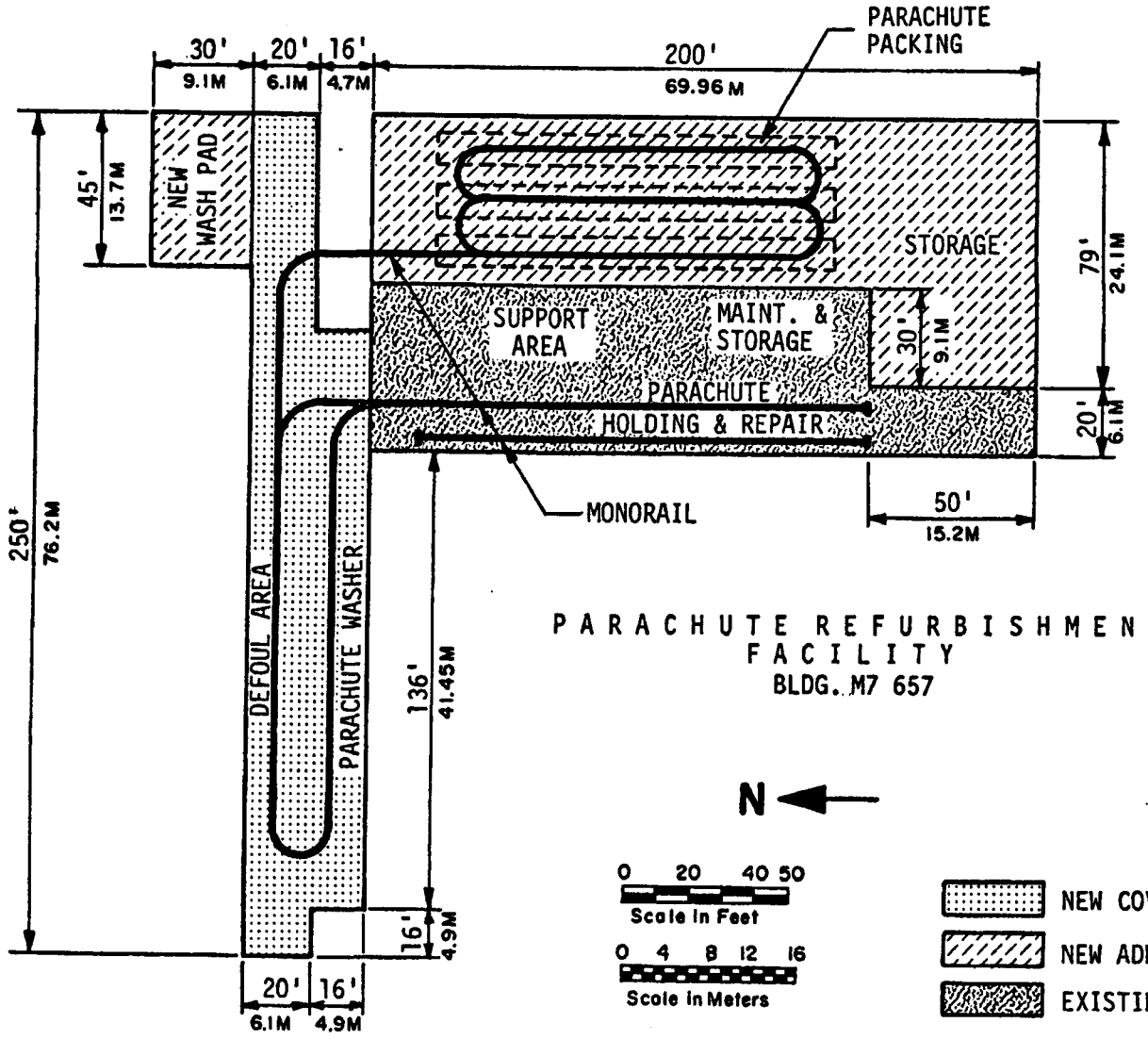
MODIFICATIONS FOR SRB PROCESSING FACILITIES



VEHICLE ASSEMBLY BUILDING - SRB COMPONENT REFURBISHMENT AND SUBASSEMBLY

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS FOR SRB PROCESSING FACILITIES



PARACHUTE REFURBISHMENT
FACILITY
BLDG. M7 657

N

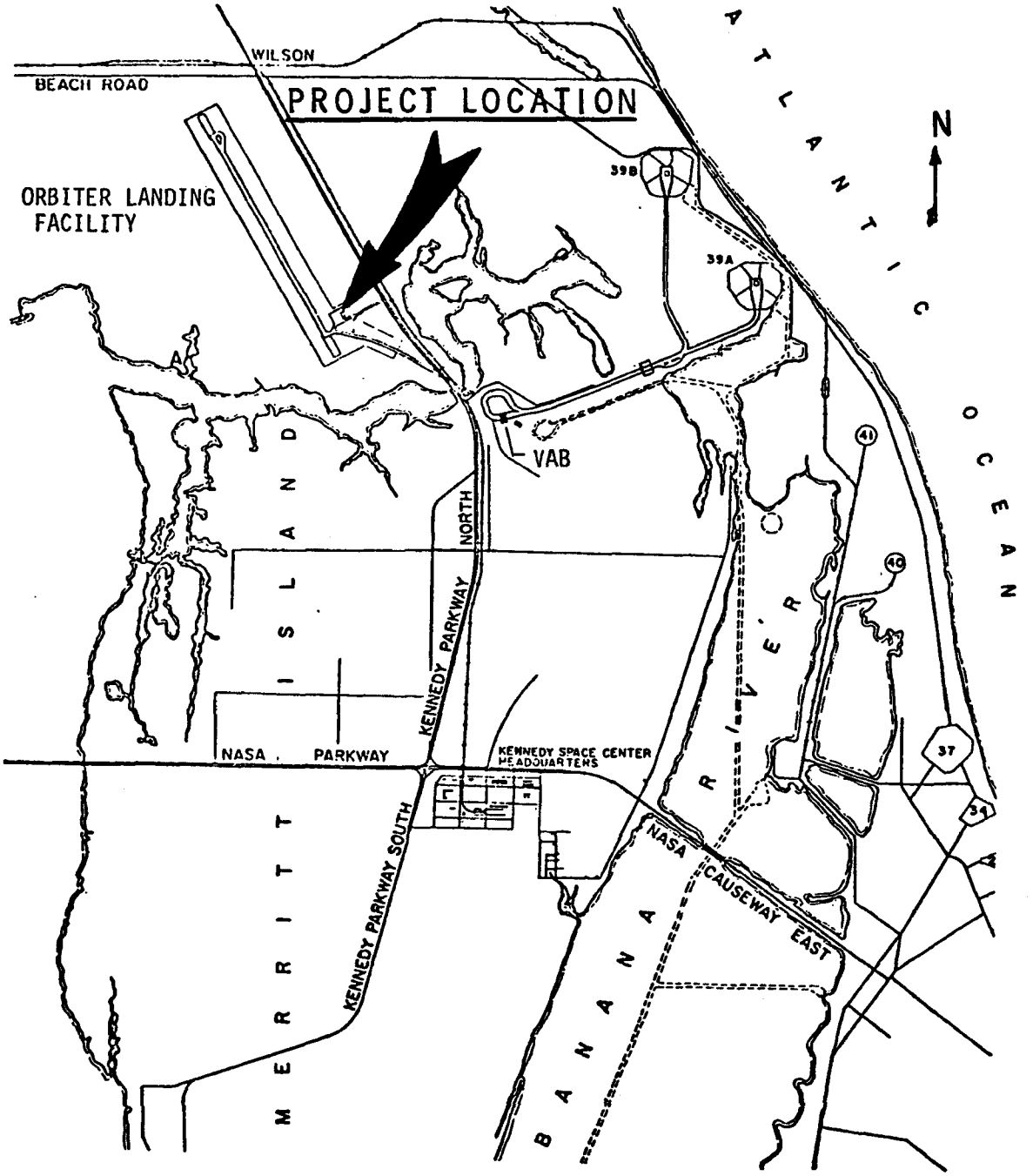
0 20 40 50
Scale in Feet

0 4 8 12 16
Scale in Meters

NEW COVERED AREA
NEW ADDITION
EXISTING

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF SHUTTLE/CARRIER AIRCRAFT MATING FACILITIES



LOCATION PLAN

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Construction of Shuttle/Carrier Aircraft Mating Facilities
INSTALLATION:	John F. Kennedy Space Center
FY 1977 CoF ESTIMATE:	$2,050,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	546,000	8,090,000	8,636,000
Other affiliated funding	---	---	---
Total	546,000	8,090,000	8,636,000

SUMMARY PURPOSE AND SCOPE:

This project is a continuation and extension of the construction work to provide shuttle/carrier aircraft mating facilities. FY 1975 resources provided for long lead procurement of hoists and steel for the mating facilities at Flight Research Center (FRC), California, and at the orbiter assembly site at Palmdale, California; the access towway between the mating facility and the existing runway system at FRC; orbiter safing facilities; and associated utilities at FRC. The FY 1976 project provided for foundations and utilities at Palmdale, and the erection of mating facilities at both FRC and Palmdale. This FY 1977 project provides the required mating facility at Kennedy Space Center (KSC). This increment will complete all foreseeable requirements for mating facilities in support of the shuttle program.

PROJECT JUSTIFICATION:

The decision in early CY 1974 to transport and flight test the orbiter in a "piggyback" arrangement on top of a Boeing 747 aircraft resulted in the requirement to construct mating/demating facilities at Palmdale and FRC. This project provides the necessary comparable facility to transport the orbiter to and from the launch site.

The first orbiter is scheduled to arrive at KSC from Palmdale in the third quarter of CY 1978. The mating facility must be operable at that time to demate the orbiter safely from the Boeing 747 aircraft. Subsequently, two more orbiters will be received at Kennedy. In addition, the mating facility will be required to receive and demate the orbiter during the orbital flight test program. At least four orbital flights will land at FRC during this program. After each landing the orbiter must be transported via the Boeing 747 carrier aircraft to KSC for processing and relaunch. During the operational phase, two to three missions per year may land at the FRC alternate landing site. In each case, the orbiter must be returned to the launch site. It is also anticipated that the three orbiters stationed at KSC may occasionally have to be returned to Palmdale for overhaul or repairs. To support these operations, this mating facility at the launch site is required.

To achieve the first manned orbital flight, currently planned in the second quarter of CY 1979, the first orbiter must be delivered to KSC in the third quarter of CY 1978. The mating facility must be operational at that time to meet this milestone. Construction and activation are estimated to require 20 to 22 months. Therefore, construction must start in late CY 1976, making FY 1977 programming necessary.

PROJECT DESCRIPTION:

This project provides for the procurement, fabrication, and erection of a mating/demating facility at KSC, as well as the necessary site preparation, concrete slab, foundation, and utilities for the facility. It will be located at the south end of the orbiter landing facility near the junction with the orbiter towway.

The mating facility includes a structural steel, gantry-type, cantilevered structure approximately 100 feet (30.5 m) high, with movable platforms and a hoist capable of lifting approximately 225,000 pounds (102,060 kg). In order to support the structure, eight reinforced concrete footings, requiring approximately 330 cubic yards (252 m^3) of concrete, will be needed. A concrete slab 160 feet by 190 feet (48.8 m by 57.9 m) and 16 inches (40.6 cm) thick will support the mating/demating operations.

A 350-kVA, 480-V, 3-phase, 60-Hz industrial power circuit from an existing substation near the landing aids control building will supply electrical utilities to the facility. A direct burial cable will be

terminated in a safety switch adjacent to the concrete foundation. A grounding system to protect against lightning will be installed at the base of the facility. Area lighting will also be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				2,050,000
Mating/demating facility	LS	---	---	1,718,000
Site preparation, utilities, slab, foundation and area lighting	LS	---	---	332,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,050,000

LIST OF RELATED GRAPHICS:

Location Plan
Photo: Shuttle/Carrier Aircraft Mating Facilities

OTHER EQUIPMENT SUMMARY:

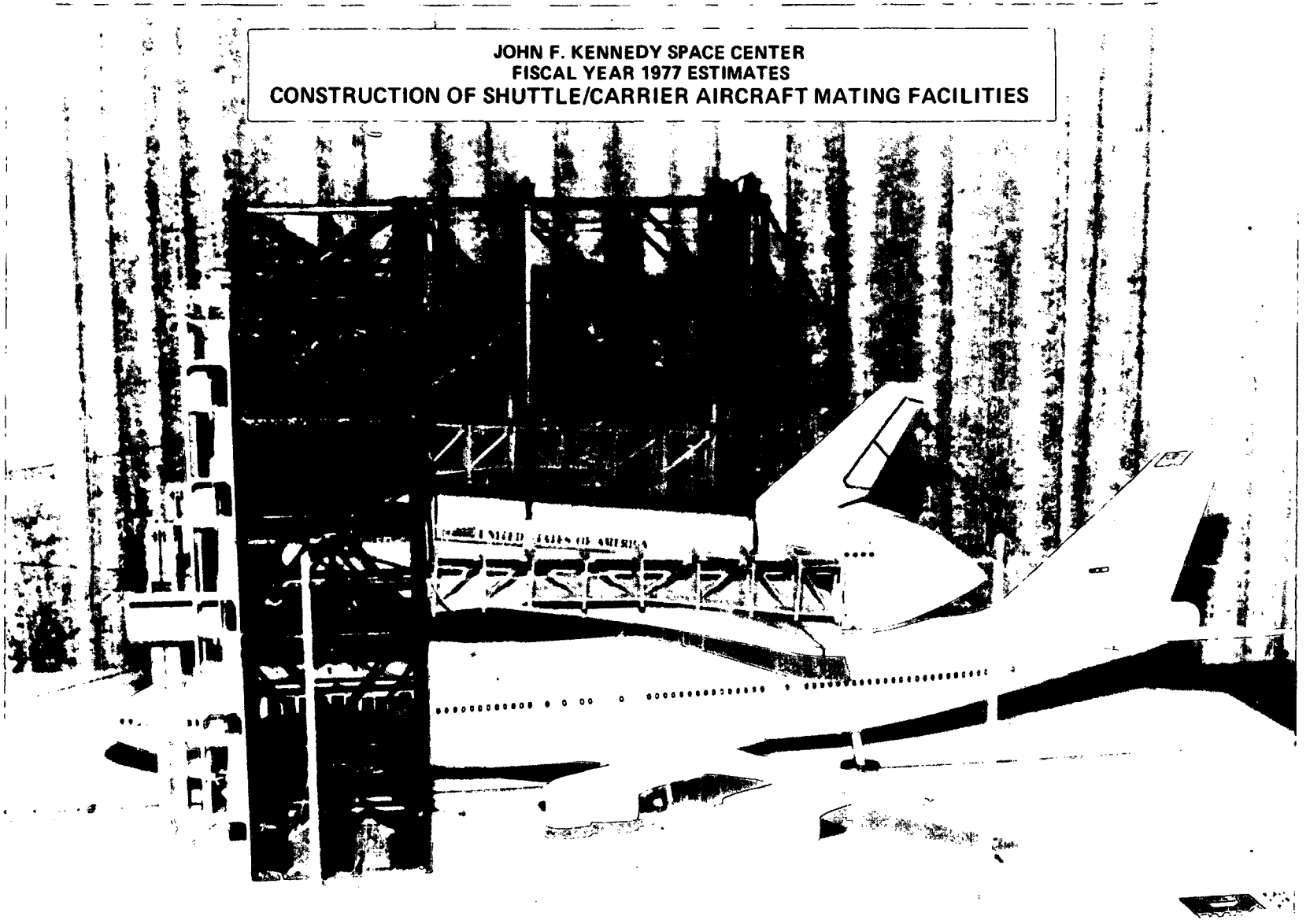
For initial operations, it is estimated that approximately $50,000 of R&D resources will be required at KSC for noncollateral support equipment to demate the orbiter from the Boeing 747 aircraft.

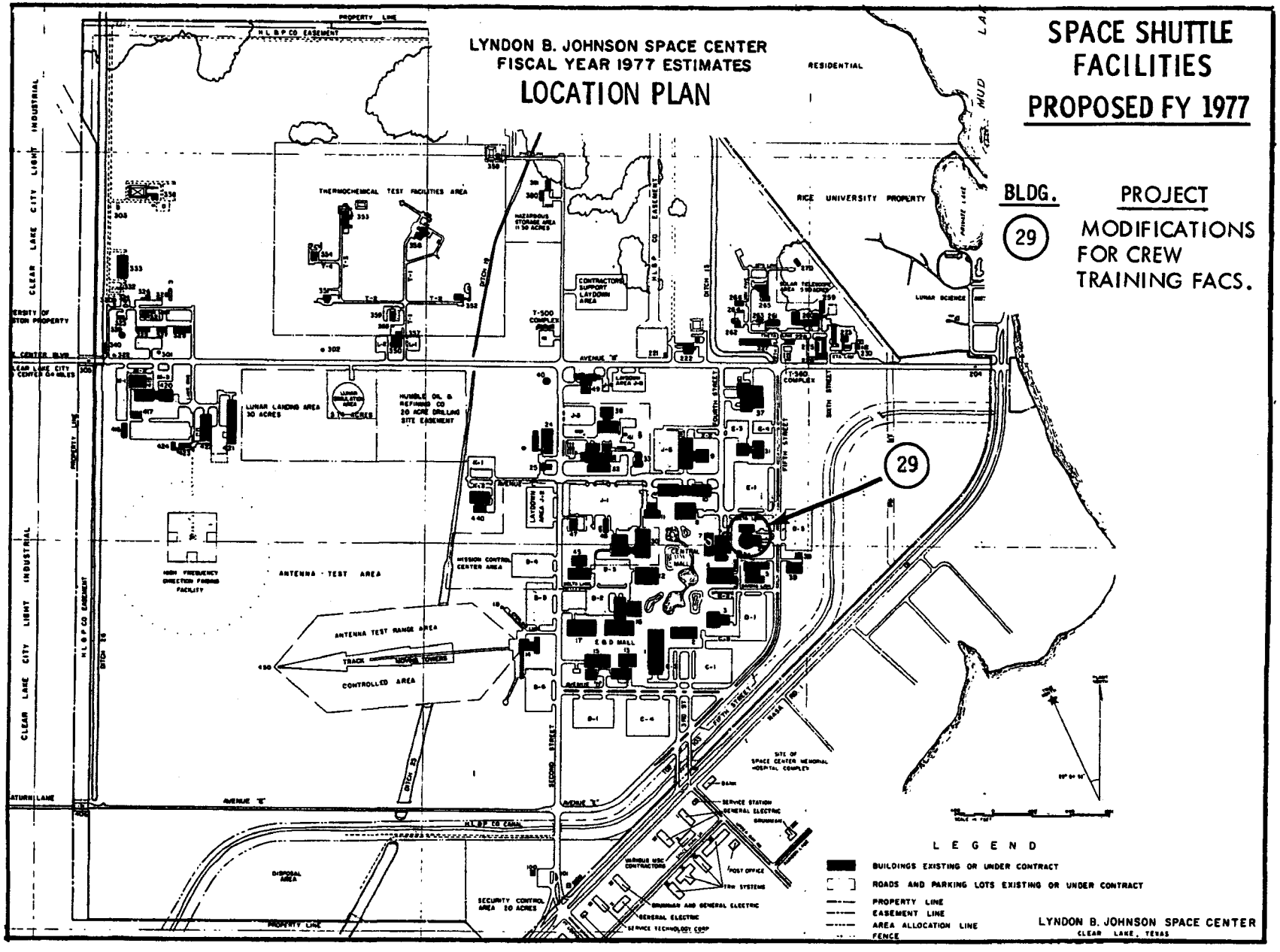
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

For presently planned usage, there are no currently foreseen future CoF funding requirements necessary to complete this project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

CONSTRUCTION OF SHUTTLE/CARRIER AIRCRAFT MATING FACILITIES




LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
LOCATION PLAN
SPACE SHUTTLE FACILITIES
PROPOSED FY 1977
BLDG.
PROJECT
29
MODIFICATIONS FOR CREW TRAINING FACS.
RESIDENTIAL
RICE UNIVERSITY PROPERTY
THERMOCHEMICAL TEST FACILITIES AREA
CONTRACTORS SUPPORT LAYDOWN AREA
T-500 COMPLEX
T-300 COMPLEX
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 & D MALL
SITE OF SPACE CENTER MEMORIAL HOSPITAL COMPLEX
SERVICE STATION
GENERAL ELECTRIC
GRUMMAN
POST OFFICE
IBM SYSTEMS
GRUMMAN AND GENERAL ELECTRIC
GENERAL ELECTRIC
SERVICE TECHNOLOGY CORP
DISPOSAL AREA
SECURITY CONTROL AREA 20 ACRES
H.L.&P.CO. CANAL
PROPERTY LINE
CLEAR LAKE CITY LIGHT INDUSTRIAL
AVENUE "E"
AVENUE "G"
FIFTH STREET
SECOND STREET
SIXTH STREET
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
CLEAR LAKE, TEXAS

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modifications for Crew Training Facilities
INSTALLATION:	Lyndon B. Johnson Space Center
FY 1977 CoF ESTIMATE:	$780,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	171,000	1,250,000	1,421,000
Other affiliated funding	---	10,206,000	10,206,000
Total	171,000	11,456,000	11,627,000

NOTE: Specific funding data applies to Bldgs. 5 & 29. Affiliated funding data applies to Bldg. 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. 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 1977 project provides modifications to Building 29, Flight Acceleration Facility, for a water immersion facility. This FY 1977 facility is required to provide the capability necessary for the adequate training of shuttle crews and mission specialists 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 extra-vehicular activities in a weightless environment. Flight crews must be trained to perform certain activities outside the spacecraft during a mission. 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. In this instance, that training, to a large extent, proved most important to the successful completion of the Skylab program.

Experience has shown that training crews for these activities in water 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 better 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 duration of the shuttle program, must be large enough to accommodate shuttle test training articles such as the payload bay, airlock and the 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 modifications 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 - 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 in two to three years of space shuttle operations. In addition, fragmenting crew training activities at two sites would tend to degrade the quality and effectiveness of implementing integrated crew training plans and would most likely have an adverse effect on the flight schedules.

The water immersion facility must be operational at least one year before the first manned orbital flight which is currently scheduled for the second quarter of CY 1979. The full-scale orbiter payload trainer is scheduled to be delivered in early CY 1978. Construction and activation will require approximately 15 to 18 months and must begin in late CY 1976, thus necessitating FY 1977 funding.

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. The Flight Acceleration Facility is primarily a centrifuge rotunda with two attached support wings. A concrete and steel 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 concrete portion of the tank will be recessed 15 feet (4.6 m) below the ground floor level. The upper 10 feet (3.0 m) will be of steel construction. A series of lighting portholes with associated 1,500-watt lamps, viewing portholes, and a ladder will be installed in the tank walls. A new 560-gallon per minute (35.3 liter per second) water treatment plant with associated filters and 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. Drainage of the tank will be through the existing storm drains.

A partition will be constructed across the rotunda to separate the tank from the existing centrifuge, which will remain in place. The steel walls and platforms of the tank will be removable to permit operation of the centrifuge if this becomes necessary.

Maximum use will be made of existing facilities and equipment at the Johnson Space Center to provide an operable crew training 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 that are located in the support wings of Building 29. The existing equipment includes a five ton 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.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				649,000
Demolition, excavation, piling and foundations	LS	---	---	253,000
Tank, concrete and steel with portholes	GAL	420,000	0.42	176,000
Platforms, ladders, rails and ramp	LS	---	---	75,000
Partitions	SF	5,000	5.00	25,000
Electrical and mechanical utilities	LS	---	---	120,000
Equipment				131,000
Water heat and treatment plant	GAL	400,000	0.22	88,000
Installation of existing equipment	LS	---	---	43,000
Fallout Shelter (not feasible)	---	---	---	---
Total				780,000

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 estimated to cost $3.7 million and to be acquired from space shuttle R&D resources will be required for the initial operation.

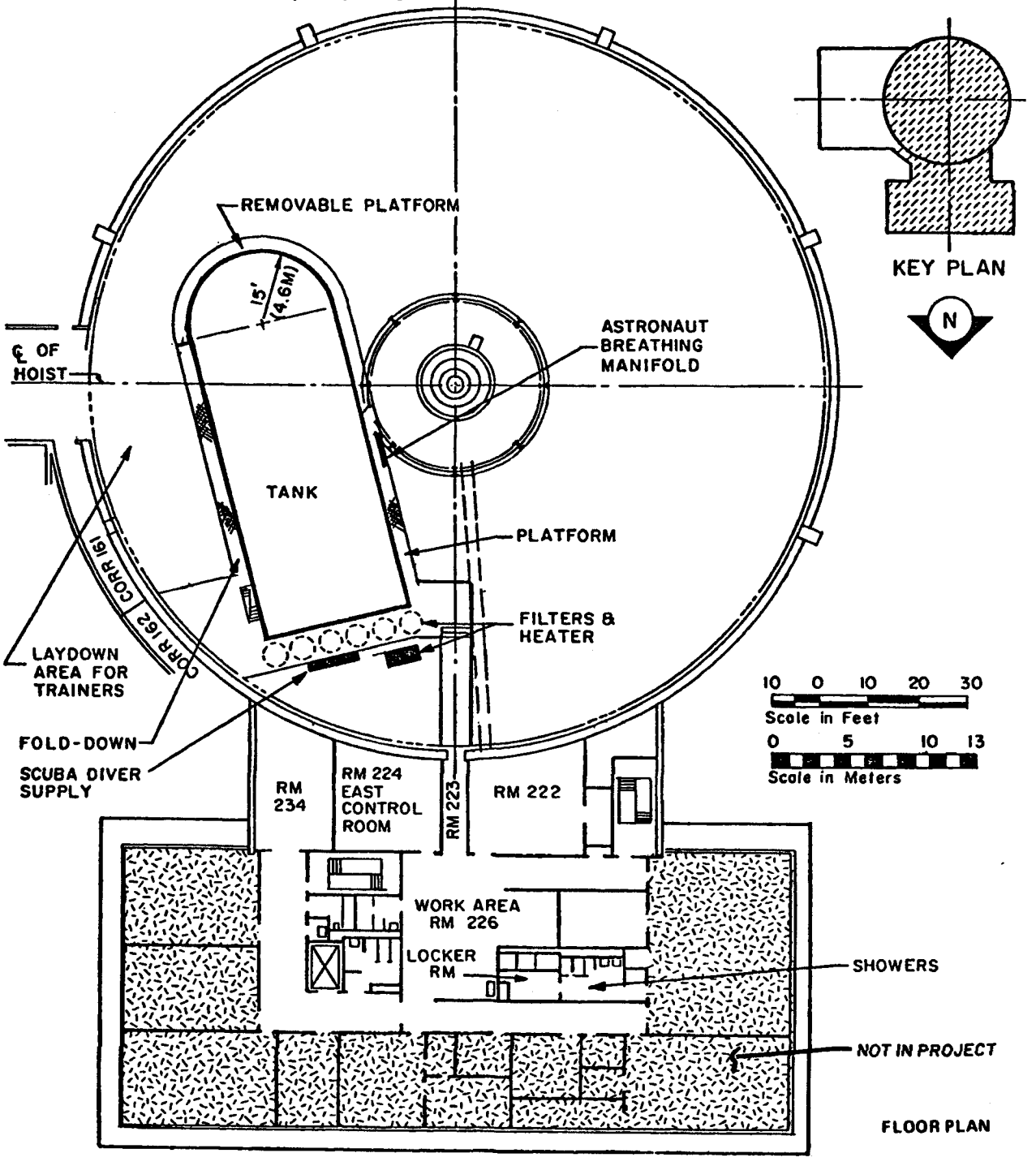
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

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

CF 8-42



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of Shuttle Facilities
INSTALLATION:	Various Locations
FY 1977 CoF ESTIMATE:	$1,760,000

LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 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	138,000	210,000	348,000
Other affiliated funding	---	---	---
Total	138,000	210,000	348,000

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 and Government-owned industrial plants. 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; to meet program milestones or "need dates"; or to ensure compliance with pollution, safety, or health regulations or standards at facilities the implication of which will directly relate to shuttle operations.

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 have been presented in past fiscal years as discrete line items within an integrated space shuttle facilities project. In many instances, the existing facilities either have the necessary capability or require only limited rehabilitation or relatively minor modifications to achieve the capability for the desired tests in support of shuttle. 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 program.

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.

The work covered in this project is of such a nature and magnitude that it is considered best to include these requirements 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 "run-out" costs previously estimated at $300 million (1971 dollars). This total remains a valid maximum cost for the facilities required by the shuttle program.

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	660,000
1. Modifications for Flash Evaporator Testing, Building 7	220,000

This project provides for modifying the existing vacuum system associated with the 11-foot (3.4 m) chamber in Building 7. The work is required to support the orbiter's flash evaporator test to be carried out in an adjacent 8-foot (2.4 m) chamber. The flash evaporator is a flight component of the Environmental Control and Life Support System contained in the shuttle crew module. It provides for the necessary cooling to the orbiter systems at altitudes

above 100,000 feet (30,480 m) when the radiators are not operative. Verification and acceptance testing of this hardware item, scheduled to start in the second quarter of CY 1977, is essential for the safety and success of the mission. The modifications include procuring and installing two 12-inch (30.5 cm) cold traps for water vapor removal, relocating the 8-foot (2.4 m) chamber, and interconnecting this chamber with the modified vacuum system. The work also includes the installation of a vapor ventilator into the roof, and a water drain line from the cold traps into the floor of Building 7. Automatic controls to operate the valves of the vacuum system are also included.

2. Modifications of Mission Control Center, Building 30 — 150,000

This project provides for various modifications to the mission operations wing of Building 30 to prepare for the establishment of the shuttle data processing complex. The shuttle data complex will use a new generation computer that will replace most of the functions now being carried out by the existing real time data processing system. The data complex and related facility modifications are required to provide real time flight data evaluation and mission control during the approach and landing test and orbital flight test phases of the shuttle program. To accommodate the new equipment, modifications to the electrical power system, reconfiguration of raised flooring, and modification of overhead and underfloor air conditioning will be required. The first computer for the new data processing complex is planned for installation in mid-1977; modifications to accommodate this computer must, therefore, be completed before that date.

3. Rehabilitation and Modification of Test Facilities, Thermochemical Test Area — 290,000

It is necessary that these test facilities be rehabilitated and upgraded at this time to support a range of essential test activities currently being conducted for components of the orbiter vehicle. These activities include developing and test firing of the vernier thrusters, a subsystem of the reaction control system (RCS) required to provide precision in the attitude control of the orbiter vehicle. Also included is testing of pyrotechnic devices essential in separating the solid rocket boosters and the external tank, battery systems for providing power, and testing the RCS components. The work includes installing an emergency propellant tank to retain and safely dispose of hazardous fuels at the component test facility, modifying the ventilation system to safely dispose of hydrogen gas in the battery testing facility, rehabilitating the altitude chamber system in the RCS test facility, and interconnecting by data cables the Electro-Explosives Device Building with an existing computer located within the Thermochemical Test Complex.

B. NASA Industrial Plant, Downey - Dual Fuel System Conversions 210,000

This project provides for modification of several systems at the NASA Industrial Plant to accommodate alternate energy sources to back up the existing natural gas fueled systems. Past mid-winter natural gas curtailment and interruptions dictate the need to install redundant systems to preclude resultant work stoppages that could effect space shuttle manufacturing milestones. For example, during 1974 and 1975, this plant experienced five days of interrupted natural gas service each year. It is anticipated that the frequency and duration of such outages may well continue to increase in the future. This project will permit continuation of operations at Downey in the event of significant natural gas curtailment or interruption.

The project includes: the addition of a fuel oil capability for one oven and two autoclaves in Building 287; addition of a steam heat capability to augment gas-fired temperature and humidity control in the paint spray booth in Building 041; and the addition of approximately 90 electric space heaters in several buildings at the NASA Industrial Plant to augment the existing gas-fired space heaters to assure minimum personnel comfort levels in the event of natural gas curtailment. These alternate heat sources must be installed before frequent curtailments of natural gas service occur.

C. Michoud Assembly Facility (MAF) 430,000

1. Rehabilitation of Chemical Waste Pond 75,000

This project consists of rehabilitating surface lift pumps, replacing deteriorated filters, cleaning, and resurfacing the 1,500,000-gallon (5,677,950 liter) chemical waste holding pond. This pond is the only means of disposing of chemical waste from manufacturing operations at MAF. This holding pond has been used for 12 years, its pumps and filters for almost 10. The bottom has deteriorated to the extent that chemical wastes can seep into the ground water. Temporary measures are now being taken to preclude contamination. However, the pond must be rehabilitated and upgraded before external tank production begins. The pond rehabilitation will alleviate the existing adverse effects on MAF's environment.

2. Rehabilitation of Road for Movement of External Tanks 170,000

This project consists of repairing 14,165 square yards (11,843 m^2) of concrete aprons west of Building 103, resurfacing 12,555 square yards (10,497 m^2) of asphalt roads and aprons to Building 420, and providing an asphalt ramp into Building 420. The existing road and apron

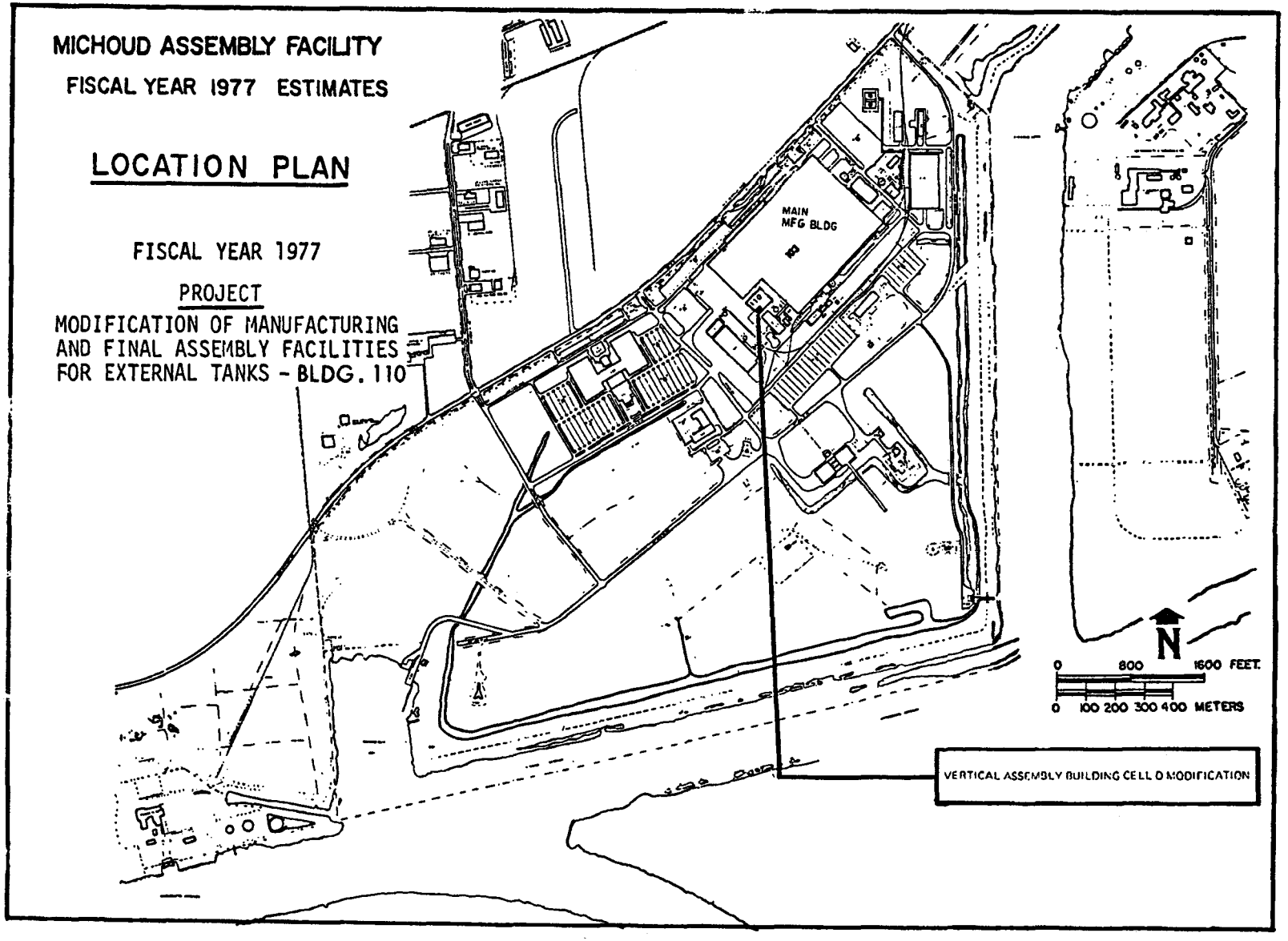
surfaces have deteriorated and could, therefore, damage the shuttle external tanks during transportation from one area to another. The rehabilitated ramp will provide smooth transport from grade level to the floor level of Building 420, which is now approximately 8 inches (20.3 cm) above grade. This work must be accomplished by early CY 1977 to support production of the external tank structural test article.

3. Modifications of Fuel Oil Supply System 185,000

This project provides for the installation of 1,200 feet (365.8 m) of 4-inch (10.2 cm) pipe and attendant supports to transfer oil from a 500,000-gallon (1,892,650 liter) storage tank to two day tanks outside the boiler house. The project also provides for installing a transfer pipe from a fill station at a railroad siding to the 500,000 gallon (1,892,650 liter) tank. The work is necessary to provide a back-up system of generating steam for MAF, which presently uses natural gas as the primary heating fuel. If the supply of natural gas is interrupted, the entire production program would be shut down. This project provides the necessary oil distribution system to ensure uninterrupted production operations in the event the natural gas supply is temporarily stopped. In light of the current energy crisis, it is prudent to accomplish this work in this time frame.

D. Flight Research Center (FRC) - Modification of Approach and Landing Test (ALT) Hangar 460,000

This project includes installing an air handling system in the ALT hangar to provide a clean and partially controlled environment during payload handling operations following the return of the space shuttle orbiter from space missions. The clean environment is required to prevent contamination of sensitive payloads returned from a space mission. At least four of the first six orbital missions of the space shuttle are scheduled for landing at FRC. Thereafter, FRC will become the secondary landing site for the orbiter. During the operational phase, two to three secondary landing site missions per year may have to land at FRC. After landing, the orbiter's environmental support system will no longer provide the necessary environment to the payload bay. For this reason, payloads must be removed from the orbiter and prepared for shipment. These payload handling operations must be conducted in an acceptably clean environment to protect the components and experiments in which significant investments have been made. The air handling system will include blowers of up to 250,000 CFM (7,080 m^3/min) capacity, with associated particulate air filters, limited cooling to offset heat rise of the recirculated air, a 1,000-foot (304.8 meters) ducting system and related switches and controls. These modifications, to be implemented before the first manned orbital flight, must be phased in such a way as to preclude interference with the orbiter approach and landing test program.


MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1977 ESTIMATES
LOCATION PLAN
FISCAL YEAR 1977
PROJECT
MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES FOR EXTERNAL TANKS - BLDG. 110
MAIN MFG BLDG
N
0 800 1600 FEET
0 100 200 300 400 METERS
VERTICAL ASSEMBLY BUILDING CELL D MODIFICATION

PROJECT TITLE:	Modification of Manufacturing and Final Assembly Facilities for External Tanks
INSTALLATION:	Michoud Assembly Facility
FY 1977 CoF ESTIMATE:	$1,930,000

LOCATION OF PROJECT: New Orleans, Orleans Parish, Louisiana

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

COGNIZANT INSTALLATION: Marshall Space Flight Center

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,788,000	14,522,000	16,310,000
Other affiliated funding	---	158,241,000	158,241,000
Total	1,788,000	172,763,000	174,551,000

SUMMARY PURPOSE AND SCOPE:

This project continues the work begun with FY 1973 and FY 1974 resources to modify manufacturing and final assembly facilities for shuttle external tanks at Michoud Assembly Facility. These prior year resources provided modifications to the Main Manufacturing Building (Building 103) for welding, mechanical subassembly, and final assembly facilities to produce the liquid hydrogen tank, the liquid oxygen tank, and the intertank which comprise the external tank. They also provide a new facility for the pneumatic testing of the liquid hydrogen tank. In the Vertical Assembly Building (VAB), prior resources provided for modifying five cells -- one for hydrostatic testing, one for cleaning tank components, one for stacking

the three major components into a complete external tank, and two for applying the thermal protection system (TPS) to the surface of the tanks.

These projects were intended to meet the requirements for external tank development and for initial production capability of up to 24 to 28 tanks per year. The results of a recent analysis have shown, however, that this capability cannot be met in the TPS application area. This year's project provides modifications for an additional cell in the VAB to apply the TPS to the external tanks. This work includes constructing a concrete silo and foundation, and installing various mechanical and utility systems.

PROJECT JUSTIFICATION:

The external tank, which supplies propellants to the orbiter main engines, is approximately 27.5 feet in diameter by 153.7 feet long (8.4 m by 46.8 m). It is composed of a liquid oxygen tank and a liquid hydrogen tank connected by an intertank. Two kinds of TPS are needed to cover the tank -- one (the foam insulation) because of the extremely cold temperatures of the propellants and one (the ablator) because of the extremely high temperatures encountered during launch and ascent of the shuttle. It was initially estimated that FY 1973 and FY 1974 resources would provide the capability to produce 24 to 28 of these tanks per year at MAF. The thermal protection system was to be applied in two modified cells in the VAB.

Since this original planning, three major problems -- icing, aerodynamic heat, and base heat -- have emerged, requiring changes in the TPS configuration. Tests have shown that ice or frost may develop on the exterior surface of the tank, chip off, and damage the orbiter. Spraying the tank with foam insulation will eliminate this problem. Wind tunnel tests have also shown that the problem of aerodynamic heat encountered during launch is much more severe than had been expected. Ablator application will correct this problem. A combination of ablator and spray-on foam insulation will protect the tank from both extreme cold and extreme heat. The portion of the external tank adjacent to the solid rocket boosters is subject to extremely high temperature during ascent firing of the orbiter. Therefore, an ablator is also needed to protect the base of the external tank.

There are thus two kinds of TPS to be applied to the external tank; some areas require either foam or ablator and others require both. The two materials cannot physically be applied at the same time; furthermore, they are chemically incompatible in the liquid form. Therefore, the same cell cannot be used for applying both kinds of thermal protection. The two materials must be segregated during application to ensure proper adhesion of the foam on areas which otherwise would require an elaborate intermediate cleaning and priming process.

Because of these problems, the TPS area is now the only phase of external tank production that cannot support a production rate of at least 24 to 28 tanks per year. The two existing TPS cells can be used for the application of foam insulation, but modification of a third cell for the application of ablator is needed. This additional cell will support the dual TPS application needed to produce 10 to 14 tanks per year by 1981.

This cell is needed by early 1978 to support the initiation of the work of applying ablator to components of the external tank needed for the first manned orbital flight, currently scheduled for the second quarter of CY 1979. The tanks for the shuttle test program are not a factor in this requirement because they only need foam insulation and do not need the dual TPS application. Construction and checkout of this work will require approximately 13 months, beginning late in CY 1976. This project thus requires FY 1977 funding.

PROJECT DESCRIPTION:

This project, to support the production of 10 to 14 external tanks per year, provides modifications to cell D in the Vertical Assembly Building for TPS application. A 45-foot-inside diameter by 119-foot-high (13.7-m by 36.3-m) concrete silo with a mechanically operated lid will be constructed. A pile-and-concrete foundation to support the silo will be provided. Work platforms, stairways, and doors will be installed, and various mechanical systems such as air conditioning, fume abatement, fire detection, sprinkler and vacuum as well as utility systems will be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				1,909,000
Concrete silo structure	CF	189,238	2.90	549,000
Foundation	LS	---	---	140,000
Work platforms, stairways, doors	LS	---	---	313,000
Air conditioning, fume abatement, fire detection and sprinkler, vacuum systems	LS	---	---	697,000
Utility systems	LS	---	---	210,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment.....				21,000
Transformers.....	EA	3	7,000	21,000
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				1,930,000

LIST OF RELATED GRAPHICS:

Location Plan
Site Plan and Section Plan

OTHER EQUIPMENT SUMMARY:

An estimated $100,000 in R&D funds will be needed for new noncollateral plant equipment. In addition, certain special noncollateral tooling (such as spray tooling, assembly tooling, unique work platforms, and special dollies) estimated to cost $2.3 million will be needed. It is planned to use existing Apollo tooling, with modifications as required, to the maximum possible extent to offset this estimated amount. The balance will be R&D funded.

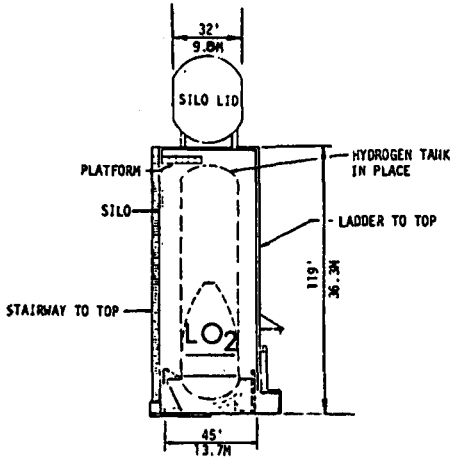
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that $12 million to $15 million will be required in a future CoF program to support a production rate of up to 60 external tanks per year. These CoF resources would be used to provide a high-bay building with additional TPS application cells, additional production cells for horizontal installation of the mechanical and electrical systems of the external tank in Building 103, an existing cell for final acceptance of the external tanks in Building 420, installation of an additional crane in Building 110, additional deionized water storage for cleaning the tanks, and a new chemical waste system for disposing of the increased quantities of chemicals during the manufacturing operations of the external tank. Additional storage space for the completed tanks may also be required. This upward revision of estimated future year CoF resources reflects the recently expanded requirements for TPS application as outlined in this project justification.

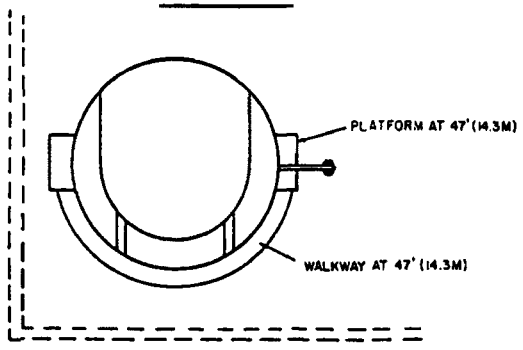
MICHOUD ASSEMBLY FACILITY

FISCAL YEAR 1977 ESTIMATES

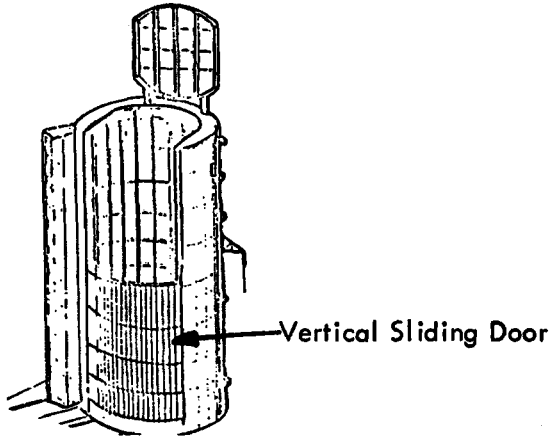
MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES FOR EXTERNAL TANKS



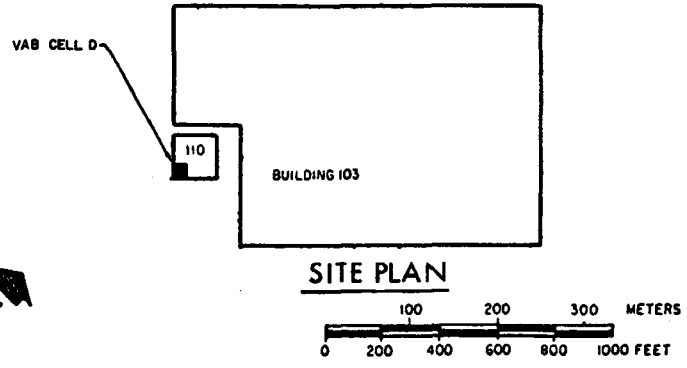
SECTION



PLAN



PERSPECTIVE - CELL D



SITE PLAN

SPACE SHUTTLE
PAYLOAD
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

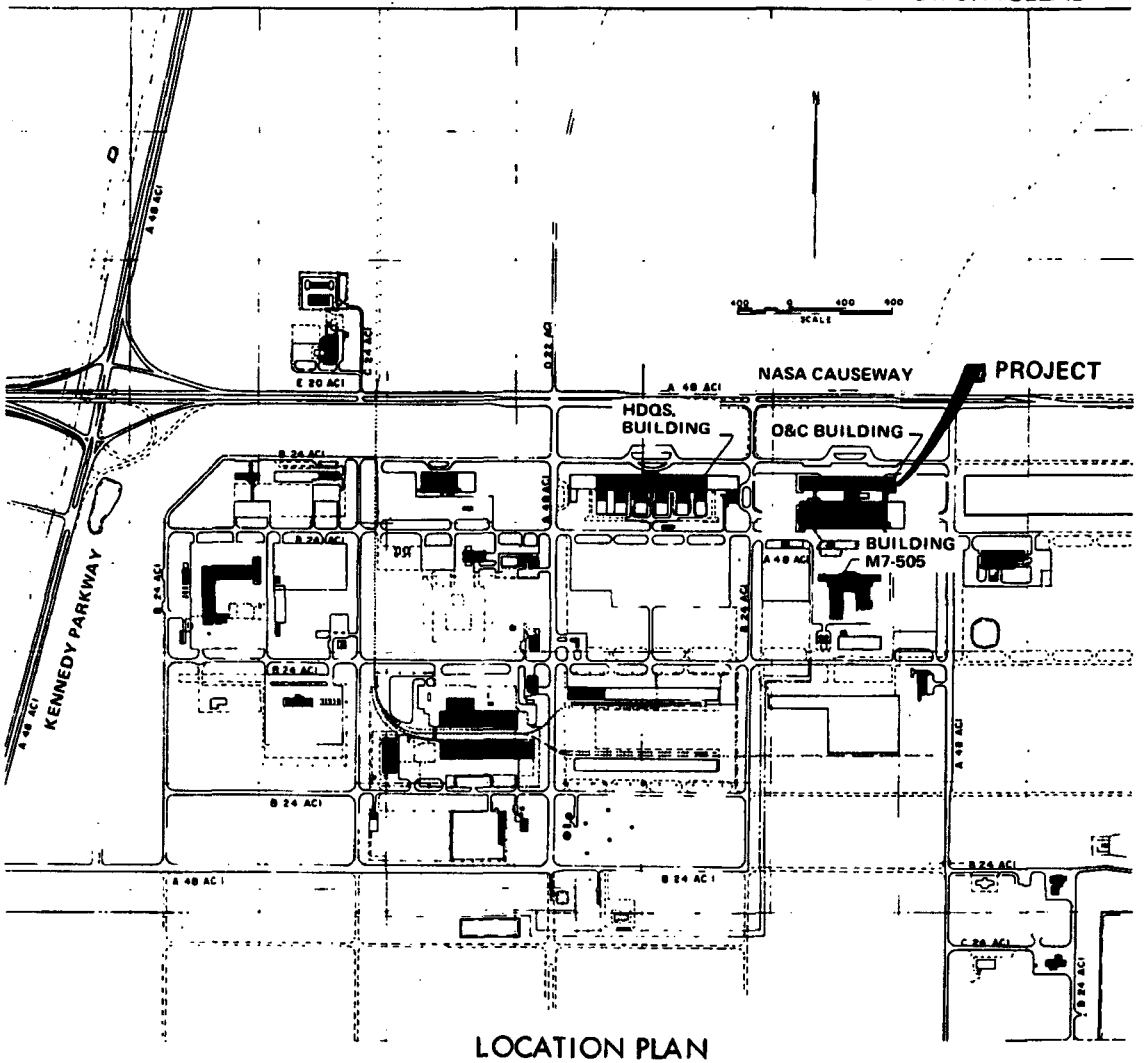
FISCAL YEAR 1977 ESTIMATES

SPACE SHUTTLE PAYLOAD FACILITIES

	Amount	Page No.
Office of Space Flight:		
Modifications to operations and checkout building for spacelab (KSC).....	3,570,000	CF 9-1
Office of Space Science:		
Modifications and addition for shuttle payload development (GSFC).....	770,000	CF 9-7
Total.....	4,340,000	

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATION TO OPERATIONS AND CHECKOUT BUILDING FOR SPACELAB



LOCATION PLAN

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modifications to Operations and Checkout Building for Spacelab
INSTALLATION:	John F. Kennedy Space Center
	FY 1977 CoF ESTIMATE: $3,570,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	231,000	---	231,000
Other affiliated funding	---	42,691,000	42,691,000
Total	231,000	42,691,000	42,922,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to modify the existing Operations and Checkout (O&C) Building at Kennedy Space Center to accomplish pre-flight and post-flight processing of Spacelab and Spacelab payloads. The project includes modifying portions of the high and low bays of the building and providing work stands. These modified high and low bays, several rooms in the O&C Building, and the monitor and test control area will be used to receive, store, inspect, assemble, checkout, integrate, and refurbish the Spacelab hardware.

PROJECT JUSTIFICATION:

The space shuttle is only one part of the total space transportation system, which also includes Spacelab and the Tug. Spacelab is an experiment carrier being developed and paid for by the European Space Agency. It will provide crew accommodations, mounts for experiments, and support systems. Individual experiments will use the Spacelab as a platform to perform missions in space while still attached to the orbiter cargo bay. The orbiter will thus move through space with its payload bay doors open. Approximately one third of the payload missions planned for space shuttle operations will use Spacelab.

Spacelab payloads will be developed by various NASA centers as well as by private industry, universities, and government laboratories, both foreign and domestic, and then shipped to the launch site. In most cases, experiments will be mounted on pallets or racks before shipment to the launch site for final integration. Upon arrival at the O&C Building, individual experiments mounted on a single pallet segment or in a single rack will be received, inspected for damage and then integrated with other pallet segments and racks. These pallets and racks will then be integrated with a simulator of the Spacelab subsystems for initial checkout. Then the complete pallet train and the combined experiment racks will be integrated with the operational subsystems of the Spacelab and tested using simulated Shuttle subsystems. These integration operations will be accomplished in specially constructed workstands. The proposed facility modifications are necessary to provide for these essential operations.

After the Spacelab operational elements and the payload bay are assembled, integrated checkout operations follow. Pressure and leak checks are performed, and all interfaces are verified to ensure compatibility with each other and with the orbiter payload bay. Electrical integrity tests are accomplished with support equipment. The weight and balance of the Spacelab will be determined before it is loaded onto the transporter for delivery to the Orbiter Processing Facility (OPF), where only final Spacelab-to-Orbiter integration occurs. This project provides the needed modifications to achieve these vital Spacelab checkout operations before launch.

When the orbiter returns from a mission, the O&C Building will be used to disassemble and process Spacelab after it has been removed from the orbiter in the OPF. Spacelab payloads will be disassembled and returned to the center of origin. The operational Spacelab elements will remain in the O&C Building for refurbishment for the next Spacelab mission. To accomplish the disassembly and refurbishment functions, modifications to the existing O&C Building are required.

The first Spacelab orbital flight is currently scheduled in late CY 1980. To achieve this goal, program schedules call for the O&C Building to be operationally ready to support delivery of Spacelab engineering model hardware in mid-CY 1978. Facility modifications and activation lead times, estimated at 18 to 21 months, require that construction be started no later than the fourth quarter of CY 1976, thus necessitating FY 1977 programming.

PROJECT DESCRIPTION:

This project provides for modifying the existing O&C Building to process Spacelab and Spacelab payloads. In so doing, certain Apollo stands and equipment will be removed from the low bay. The cleaning area in the high bay will require exhaust fans for dissipating fumes accumulated during cleaning operations. Modifications in the assembly and test area include providing three assembly and checkout workstands and subsidiary stands for pallets, racks, end cones and cable refurbishment. Foundation reinforcement for these stands, reinforcement of an existing tunnel, and construction of new utility serviceways are also required. Additional interfaces for fluids and gases, new AC and DC power distribution, and cableways will be provided. Modification of crew compartment air and avionics cooling, and additions to the operational-voice intercom systems are necessary. Demolition and construction activities in this area will require refurbishment of the floor.

Existing doors and the laminar-flow clean room in the shipping, receiving and storage area of the low bay must be enlarged, and the existing monorail relocated. Modification work in the monitor and test control area consists of removing equipment and cables, modifying and repairing floors, modifying the air ducts, and installing partitions.

Fire protection and safety modifications consist of adding suppression systems in the shipping and storage area south of the low bay and in the tunnel that runs parallel with the low bay. Additional detection systems are required in the high and low bays. A fire suppression system will be added in the monitor and test control area.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				3,570,000
Modify assembly and test area				2,916,000
Structural	LS	---	---	(670,000)
Mechanical	LS	---	---	(269,000)
Electrical/communication	LS	---	---	(760,000)
Fire protection	LS	---	---	(247,000)
Assembly and checkout stands	EA	3	290,000	(870,000)
Rack and pallet assembly stands	LS	---	---	(100,000)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Modify shipping, receiving, and storage areas				590,000
Remove existing equipment	LS	---	---	(180,000)
Structural	LS	---	---	(260,000)
Mechanical	LS	---	---	(40,000)
Fire protection	LS	---	---	(110,000)
Modify laboratories and support areas				64,000
Electrical	LS	---	---	(64,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,570,000

LIST OF RELATED GRAPHICS:

Location Plan
O&C Building Perspective

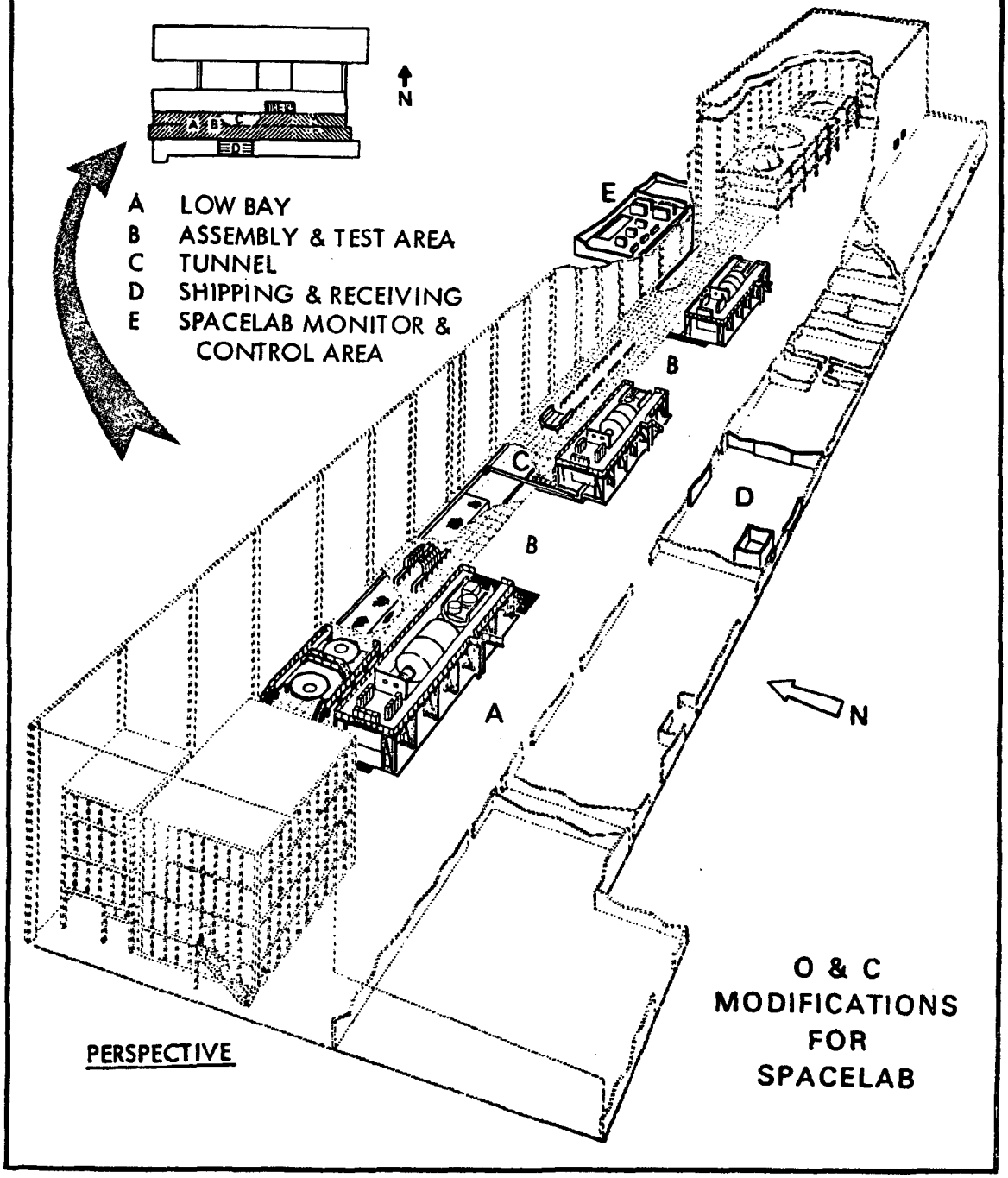
OTHER EQUIPMENT SUMMARY:

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 determined.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

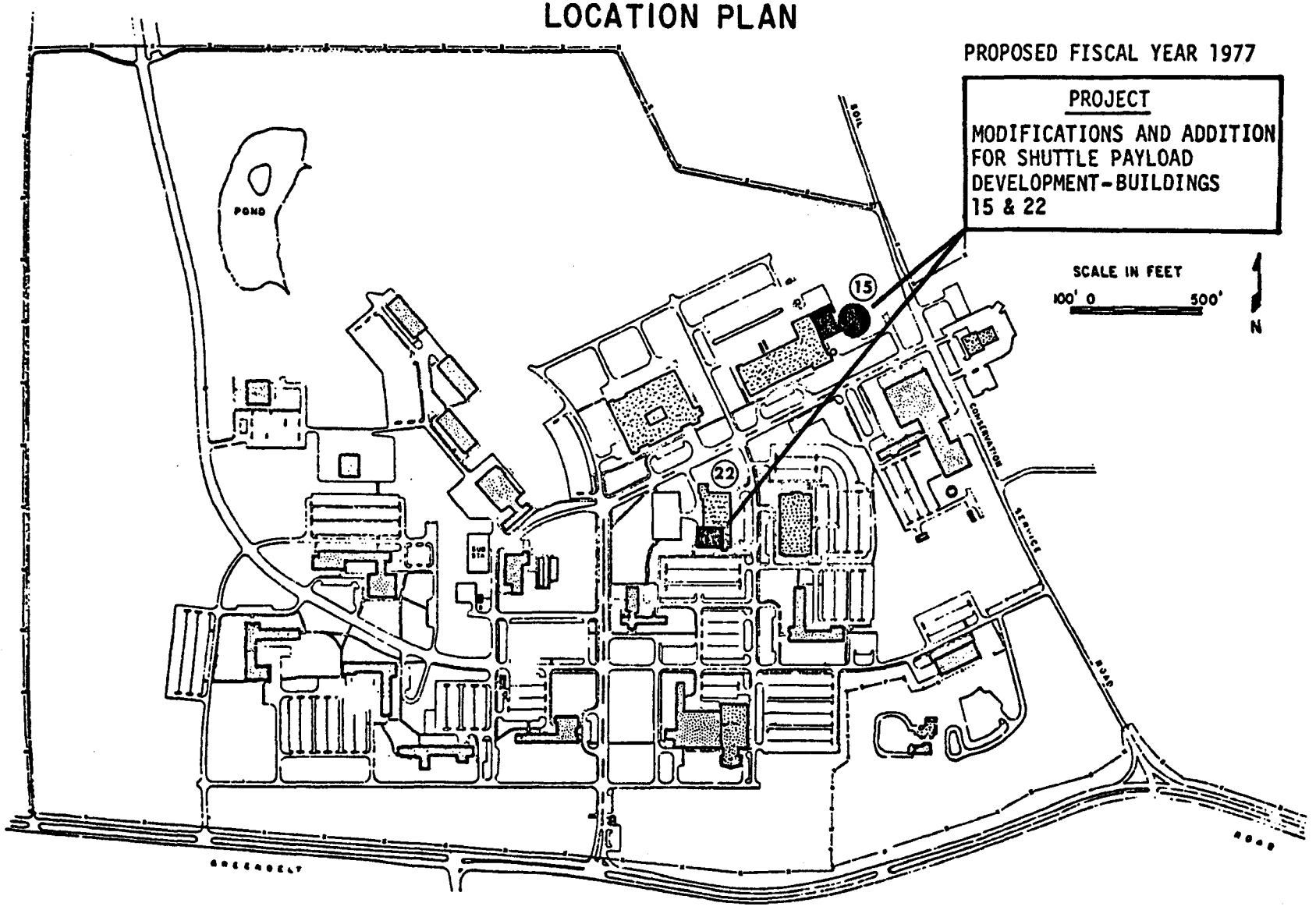
An additional work area may be required to support higher shuttle flight rates and/or any additional processing tasks which may later be required at KSC. The scope of such work and its requirement cannot be validated at this time.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1977 ESTIMATES
MODIFICATION TO OPERATIONS AND CHECKOUT BUILDING FOR SPACELAB



GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1977 ESTIMATES

LOCATION PLAN



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE:	Modifications and Addition for Shuttle Payload Development
INSTALLATION:	Goddard Space Flight Center
FY 1977 CoF ESTIMATE:	$770,000

LOCATION OF PROJECT: Greenbelt, Prince Georges County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science

FY 1976 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	71,000	---	71,000
Other affiliated funding.....	---	9,666,000	9,666,000
Total.....	71,000	9,666,000	9,737,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide the space for developing, assembling, integrating, and testing GSFC-managed "free-flyer" shuttle payloads, using a multimission modular spacecraft. Approximately 6,300 square feet (585 m^2) of space in two buildings will be modified. New construction includes a 1,050-square foot (98 m^2) truck airlock. Another 4,100 square feet (381 m^2) of existing space will be used but does not require modification.

PROJECT JUSTIFICATION:

Goddard Space Flight Center (GSFC) is one of the leading NASA Centers in the development of earth applications, communications, and astronomical satellites. The development of about 40% of NASA

scientific satellites to date has been managed by GSFC. This project will adapt existing facilities to permit continuation of this work to support payloads flown during the shuttle era. The work performed in these facilities is essential to the achievement of NASA overall payload objectives.

The payload baseline calls for development of a multimission modular spacecraft (MMS). Development of this spacecraft is baselined to be accomplished in-house at GSFC and will be used for a number of currently planned earth orbital missions. The schedule for the design and development of this "free-flyer" spacecraft dictates that facilities be available in mid-CY 1978, thus requiring FY 1977 funding.

An engineering study has shown that existing facilities at GSFC, with certain modifications and additions, will be capable of meeting the payload development and validation requirements during the space shuttle era. The facility modifications planned are primarily required to accommodate the larger payloads and be responsive to the impact of the space shuttle flight environment. Based on this engineering study, which focuses on making maximum use of existing capabilities, the following specific facilities will be used to accomplish the development, integration, and validation functions for the GSFC scientific and technological payloads.

Building 22 will be used to develop and test the flight structure of "free-flyer" multimission spacecraft. It will also be used to assemble and check out flight support systems for the resupply and reservice of "free-flyers". The modifications are required to accommodate the larger size "free-flyer" spacecraft which has a basic support structure and four subsystem modules. These modules are equivalent in size to four smaller spacecraft.

Building 15 will be used to carry out dynamic and acoustic tests to verify the structural integrity of the payloads and their ability to withstand the dynamic forces encountered throughout the flight mission. For the qualification of the spacecraft structure, no suitable acoustic test facilities are available at GSFC to test the complete multimission spacecraft configuration in the shuttle acoustic environment. The proposed modifications to Building 15 will provide this capability at GSFC.

Building 11 will be used to integrate the mission experiments to the multimission spacecraft and accomplish the necessary system level testing. This facility requires no modifications to carry out the planned functions.

These facilities must be operational approximately 12 to 18 months before the payloads are flown to permit time for development, testing, and integration. The first such payload planned to use the MMS is the Solar Maximum Mission (SMM) which is composed of a coordinated set of experiments designed to investigate solar flare emissions and their effects at various wavelengths, as well as solar terrestrial relations. This mission is scheduled to fly in late CY 1979. To support this milestone, the facilities must be completed by mid-CY 1978. Construction and activation lead times are estimated at 18 to 20 months, thus requiring a construction start in FY 1977.

PROJECT DESCRIPTION:

In order to provide these payload facilities at GSFC, modifications to Buildings 22 and 15 will be required. Appropriate extensions to and modifications of utility, nitrogen, compressed air, and hydraulic systems will be provided as needed.

Building 22. Approximately 3,600 square feet (334 m^2) of space in Building 22 will be modified. An existing 12-foot x 12-foot x 60-foot long (3.7 m x 3.7 m x 18.3 m) solar array illuminator currently located in Building 22 will be dismantled and relocated, and a class 100,000 clean environment with controlled variable lighting will be provided in the facility. A truck airlock to prevent area contamination and to maintain positive pressure will be provided. Handling capability will be improved by replacing the existing crane with two 7.5 ton (6,804 kg) bridge cranes.

Building 15. Approximately 2,700 square feet (251 m^2) of the rotunda area of Building 15 will be modified. A reverberant chamber providing for shuttle acoustic spectrum test levels of 150 dB (qualification level) will be installed. It will be constructed of demountable reinforced concrete panels. An existing horn and horn support structure will be used in the chamber. An existing low-frequency vibrator will be relocated from the high bay of Building 15 to below grade within the reverberant chamber area. A 7.5 ton (6,804 kg) bridge crane will also be provided.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				510,000
Building 22:.....				130,000
Relocation of solar array illuminator.....	LS	---	---	(5,000)
Modifications.....	SF	3,600	20.00	(72,000)
Truck airlock addition.....	SF	1,050	50.00	(53,000)

	Unit of Measure	Quantity	Unit Cost	Total Cost
Building 15:				380,000
Modifications	SF	2,700	20.00	(54,000)
Reverberant chamber	LS	---	---	(326,000)
Equipment				260,000
7½ ton bridge cranes	EA	3	80,000	240,000
Relocation and installation of existing vibrator and horn	LS	---	---	20,000
Fallout Shelter (not feasible)	---	---	---	---
TOTAL				770,000

LIST OF RELATED GRAPHICS:

Location Plan
Plan Building 22
Plan Building 15

OTHER EQUIPMENT SUMMARY:

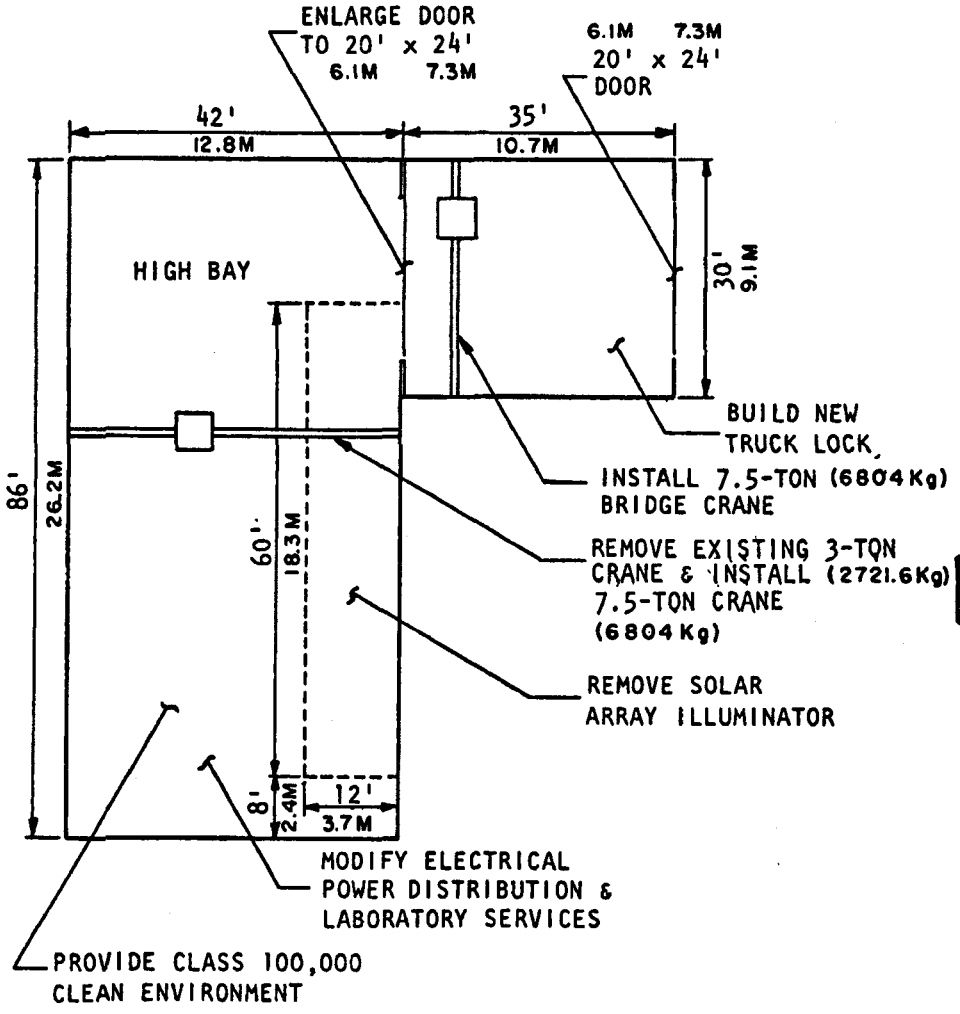
No new noncollateral mechanical and electrical equipment is planned to make the facilities operational. Existing noncollateral equipment, valued at approximately $2,300,000, will be used in these facilities.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

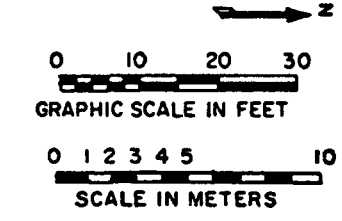
Additional facility area will be required for shuttle payload integration, development, and verification. The need and scope of work required will be submitted in a follow-on program (FY 1978).

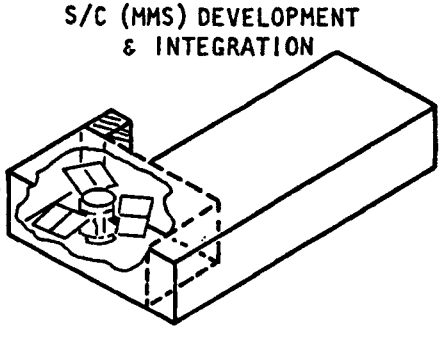
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS AND ADDITION FOR SHUTTLE PAYLOAD DEVELOPMENT



MODIFICATIONS TO BUILDING 22

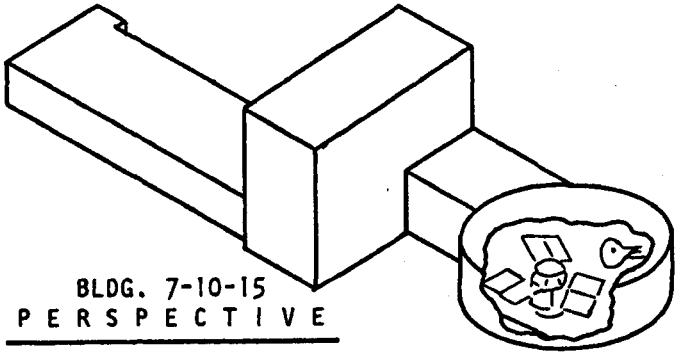


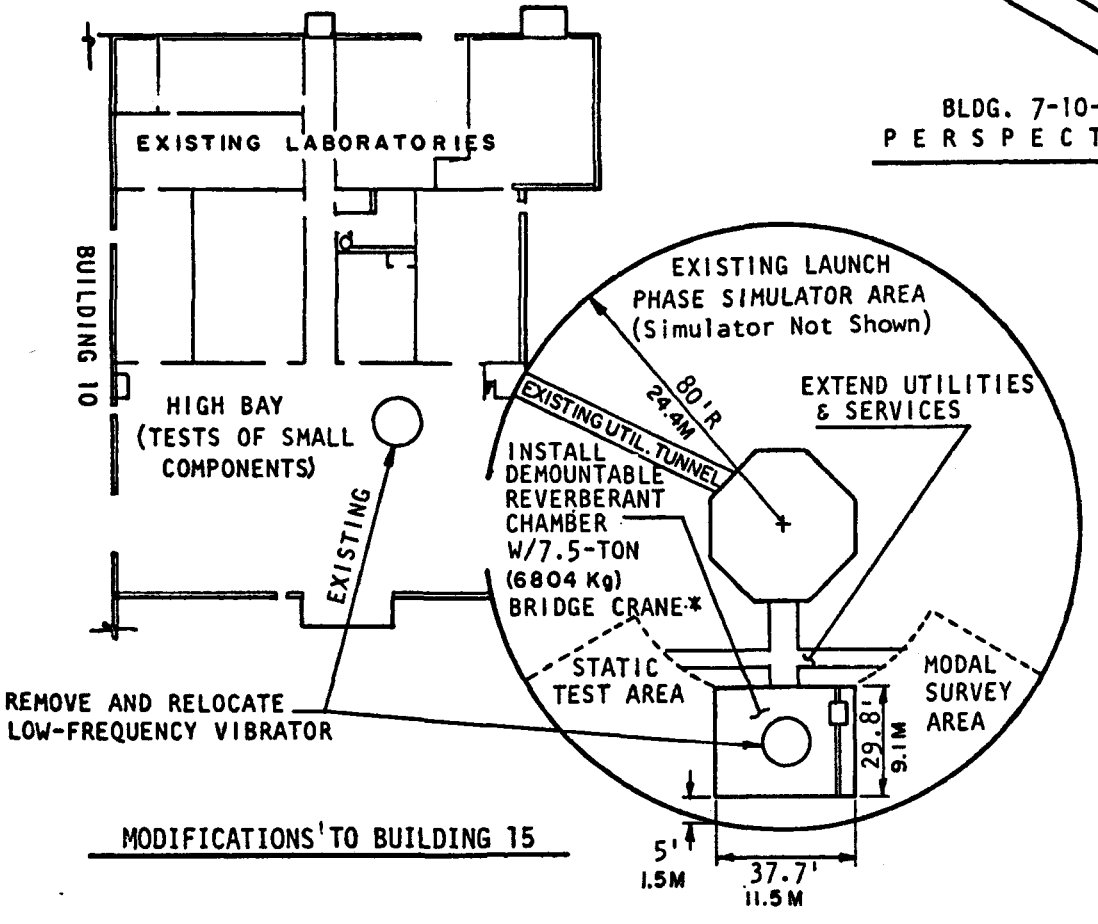


BLDG. 22
PERSPECTIVE

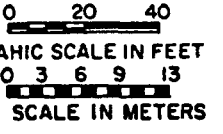
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1977 ESTIMATES

MODIFICATIONS AND ADDITION FOR SHUTTLE PAYLOAD DEVELOPMENT





MODIFICATIONS TO BUILDING 15



* (STRUCTURAL DYNAMIC TESTS)

REHABILITATION
AND MODIFICATION
OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

REHABILITATION AND MODIFICATION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	1,410,000	CF 10-3
Flight Research Center	265,000	CF 10-5
Goddard Space Flight Center	1,345,000	CF 10-5
Jet Propulsion Laboratory	1,670,000	CF 10-8
Johnson Space Center	1,200,000	CF 10-10
Kennedy Space Center	1,190,000	CF 10-12
Langley Research Center	1,840,000	CF 10-14
Lewis Research Center	1,275,000	CF 10-16
Marshall Space Flight Center	1,515,000	CF 10-17
Michoud Assembly Facility	525,000	CF 10-20
National Space Technology Laboratories	905,000	CF 10-20
Wallops Flight Center	1,315,000	CF 10-22
Various Locations	1,820,000	CF 10-23
Miscellaneous Projects Less than $100,000 Each	1,600,000	CF 10-25
Total	17,875,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE: Rehabilitation and Modification of Facilities Not in Excess of $500,000 Per Project		
LOCATION: Various Locations		
	FY 1977 CoF ESTIMATE: $17,875,000	
FY 1975: $14,900,000	FY 1976: $16,000,000	TQ: $7,000,000

COGNIZANT INSTALLATION: Various Locations

COGNIZANT PROGRAM 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 1977 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. This year in addition to the usual rehabilitation and modification requirements to the physical plant, the agency has initiated specific procedures which place increased emphasis on the identification of projects which relate directly to the conservation of energy at the various field installations. These projects along with the installation of automatic utility control systems, account for a greater portion of this total program than in prior years. Current projections indicate that such projects will ensure significant and rapid "payback" in energy consumption and that the utility control system efforts will permit reductions in operating personnel. 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 $5.9 billion (June 30, 1975). 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 1977. 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 rehabilitaiton and modification items for FY 1977 are outlined under "PROJECT COST ESTIMATE" and total $17,875,000. Of this total, $16,275,000 represents discrete work packages at designated NASA installations. The remaining $1,600,000 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 $54 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 as a phased program 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 $16,275,000 of discrete projects relates to the following broad categories of facilities:

a.	Utility Systems	4,740,000
b.	Fire Detection/Protection Systems	1,010,000
c.	General Purpose Buildings	4,940,000
d.	Technical Buildings/Structures	3,915,000
e.	Pavements and Drainage	990,000
f.	Building Exteriors and Roofs	680,000

In addition, there is the "Lump Sum" estimate of $1,600,000 for smaller project work, thus making a total of $17,875,000. The FY 1977 requests for facility rehabilitation and modification work, which is essentially at recent prior year levels, 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	1,410,000
1.	Rehabilitation and Modification of 12-Foot Wind Tunnel, Building N-206	415,000

This project provides for certain rehabilitation and modification of the model support system in the 12-foot Wind Tunnel, Building N-206, and its associated systems. The upstream model support system will be replaced by a new turntable which provides increased load capacity and eliminates the need for a large fairing presently used in conjunction with a high angle of attack model support device. The test chamber lighting will be improved. The tunnel column supports will be modified to meet established seismic

design requirements. An existing 3,000 psi (207 x $10^7 n/m^2$) air supply system will be extended 700 feet (213 m) using 4-inch (10.2 cm) diameter underground pipe to furnish up to 20 pounds/second (9 kg/sec) of air to the models. This facility is presently utilized over 12 hours per day in support of NASA, DOD, government and industry research programs relating to highly maneuverable aircraft and missiles, advanced aircraft and other aerospace projects. New test requirements will involve the use of high pressure air system for testing the powered nacelles, blowing flaps, powered rotors, control jets, or exhaust gas simulation.

2. Rehabilitation and Modification of the Storm Sewer System 195,000

This project provides for the rehabilitation and modification of the existing storm system. This rehabilitation work includes the replacement of the existing open storm water ditches in the northern section of the center by the installation of 2,400 linear feet (732 m) of corrugated metal pipe and the installation of manholes, catch basins, and culverts as required. These existing open ditches have been a continuous problem with sloughing of the banks, filling with debris, and are too shallow with consequent flooding of adjacent areas. In addition, the open drainage ditches must be continuously maintained to prevent the collection of stagnant water and the resulting breeding areas for mosquitoes. This work is needed now to eliminate further erosion and to improve the existing conditions in the area.

3. Rehabilitation of Research Support Building, N-213 405,000

This project provides for the rehabilitation of 33,300 square feet (3,094 sq. m) of interior space in the 25-year old west wing of the Research Support Building, N-213. The work will include the demolition of the existing partitions and the rehabilitation of the area for office space, electronic instrument assembly and repair, an instrument machine shop and computer areas. These interior modifications will include the installation of new partitions, floor coverings, ceilings, lighting systems, and enclose a stairway. The heating, ventilation, and air conditioning equipment will be rehabilitated including the addition of approximately 45 tons of air conditioning equipment. The roof of the east wing penthouse has deteriorated such that it leaks and disrupts activities on the second floor. Approximately 2,300 sq. ft. (214 sq. m) of this roof will be rehabilitated. This rehabilitation work is required to prevent further deterioration of this facility. This modification work will provide for the accommodation of personnel now located in five different locations. This consolidation will improve personnel efficiency and will accommodate the changing responsibilities and requirements of the center.

4. Modification of Water Supply Systems 395,000

This project provides for the modification of the water supply system as necessary to deliver 12,000 gpm (45.4 klpm) at 75 psi (5.2 x $10^5 n/m^2$) for fire water demand at the aircraft hangers. The water supply system will be modified by the installation of a new 18-inch (46 cm) diameter water main of

1,400 linear feet (427 m) from 750,000 gallon (2,839 kl) low level storage tank at the 40 x 80-Foot Wind Tunnel to the Flight Support Facility, Building N-211. This work will include a pumping station with multiple electric driven water pumps to provide the necessary flow and pressure. In addition a new 10-inch (25.4 cm) diameter water supply line of approximately 500 linear feet (152 m) will be installed from Building N-211 to the Aircraft Servicing Facility, Building N-248. This project is required to provide an adequate quantity and pressure of water to meet the fire water demand of these aircraft hangers.

B. Flight Research Center 265,000

1. Rehabilitation of Paving and Roadways 145,000

This project provides for the general rehabilitation of the paving and roadways at the Flight Research Center in anticipation of the added traffic occasioned by additional research support personnel involved in the flight aeronautical test programs such as Space Shuttle. This work will include the associated rehabilitation of the existing inadequate storm drainage systems and related problems. Also involved in this project will be the general rehabilitation including regrading and paving around Maintenance Dock, Building No. 4826, paving near Radar Building No. 4830, and regrading and paving at several additional locations at the Center. These paved areas have deteriorated to a level where without rehabilitation, major replacement will soon be needed.

2. Rehabilitation of Utility Systems 120,000

This project provides for the rehabilitation of the underground utility systems at the Flight Research Center. This work will include the rehabilitation by replacement of 33 existing 20-inch (50.8 cm) diameter deteriorated fire water system valves. The valves were installed in 1952 and the seats are badly corroded and will not operate effectively. This work also includes the rehabilitation by replacement of approximately 3,000 linear feet (194 m) of 4 inch (10.2 cm) diameter natural gas pipe which serves Boiler House No. 1 and the Center. Cathodic protection of this piping installation will be provided. The existing natural gas pipeline is badly corroded and failure would cause a disruption of service to the Center. These two work elements represent the most pressing area of the utility system that now need rehabilitation.

C. Goddard Space Flight Center 1,345,000

1. Modification to Mission Operations Facilities in Buildings 3, 14 and 23 270,000

This project modifies 19,000 sq. ft. (1,766 sq. m) of existing space in three buildings, the Central Flight Control and Range Operations Facility (Building 3), Spacecraft Operations Facility (Building 14), and the Interpretation Laboratory (Building 23), for the following functions: the Image

Processing Facility, Operations Control Centers, Information Processing Facility and Mission Computing Operations Facility. The modifications for the Image Processing Facility are required to accommodate new equipment to supporting image processing requirements stemming from on-going and approved projects such as LANDSAT, Heat Capacity Mapping Mission (HCMM), Stratospheric Aerosol Gas Experiment (SAGE) and NIMBUS-G. The modifications to the Operations Control Centers are necessary to meet changing spacecraft activities for follow-on spacecraft models which require new equipment and different personnel space configurations. The Information Processing Facility modifications are required to meet the changing needs within the Data Processing Facility. The Mission Computing Operations Facility requirements are for operational support. The modifications to these three buildings include partition changes, heating, ventilation, air conditioning and power changes.

2. Rehabilitation of Power Distribution System 110,000

This project provides for the rehabilitation of the power distribution system at Goddard Space Flight Center's Network Test and Training Facility (NTTF). This work involves the extension of a two-way ductbank and second high voltage feeder cable from the NTTF, Building 25, to an outlying distribution point and the extension of a four-way ductbank and feeder cable from the distribution point to the Frequency Standard and Test Facility. Additionally, an extension of a redundant low voltage feeder cable from the two-way ductbank to the 40-ft. (12 m) antenna will also be a part of this project. At present, the Frequency Standard and Test facility is supplied electrical service through buried cable. This method imposes limitations on system reliability, ease of maintenance and growth. This cable has reached its design lifespan and deterioration has occurred. With the attendant increase in use, the risk of failure of this cable is high. The Frequency Standard Test Facility supports a GSFC program to develop advanced atomic hydrogen time standards. These standards will support such programs as the San Andreas Fault Experiment (SAFE), the Earth and Ocean Physics Applications Program (EOPAP) and the Space Shuttle Program. A second feeder cable and ductbank will provide a redundant power supply to ensure the reliability of the system. The 40-ft. (12 m) antenna at the NTTF is also supplied power via a cable trench. This facility has been assigned a prime role in support of the International Ultraviolet Explorer (IUE) Satellite Program, and a redundant feeder cable will assure a reliable power supply.

3. Modification of Fire Protection Systems in Various Buildings 490,000

This project consists of a number of modifications for Fire Protection and Safety. There are five parts of this project to be completed. They are: the upgrading of the computer facilities; rezoning for heat and smoke detection for office/laboratory buildings 3, 14, and 23, sprinkler systems for office/laboratory buildings 15, 18, 21, 23 and 26; extension of fire protection systems in buildings 308, 309, 310 and 311 at the Magnetic Test Facility; the smoke detection and sprinkler systems in buildings 201, 205, 206 and 208 at the Optical Research Facility. These modifications are those items that are most essential

and necessary for the safety of personnel and high value equipment. Prior year funding at Goddard for these general types of fire protection and safety items totaled $3,406,000. Future funding of this type work is now estimated at approximately $2,600,000 to be progressively accomplished on a priority basis over several years.

4. Modifications for an Applications Support Facility, Building 16 475,000

This project is a phase of an anticipated three/four phase effort to adjust space utilization at the Goddard Space Flight Center (GSFC) so that an area will result which can be dedicated to use as an Applications Support Area. This phase proposes the modification of approximately 6,000 sq. ft. (560 sq. m) of existing space in Building 16. Office, laboratory and special purpose spaces in the existing building will be modified to house the laboratory space to be utilized as discussed below. Modifications will be made to partitions, heating, ventilating and air conditioning systems, fire detection and protection systems and the power distribution system. Raised floor area will be provided for use as automatic data processing space and will house the first increment of the Application Information Processing System (AIPS) computing equipment. To provide this area in contiguous space and collocated with the Applications Directorate engineers and scientists, other existing activities will be relocated to other areas on-Center to be made available for this purpose by a series of related consolidations and space reallocations. The GSFC has continuing responsibility for the development and conduct of space flight experiments and investigations in the Applications area. The Application Program furthermore is designed to apply scientific data gathered through NASA satellite missions to users on both a scientific and layman level. To continue to meet this objective in the future, new laboratory capability is required for applications data processing and information transfer to users. This is true since information extraction is a bottleneck in deriving maximum benefits from satellite data. Additional laboratory capability for applications information processing is needed for the following Applications disciplines:

Weather and Climate Observation and Forecasting
Environmental Quality Monitoring
Ocean Condition Monitoring and Forecasting
Materials Processing in Space
Earth Resources Detection and Monitoring
Earth Dynamics Monitoring
Space Communications

This resultant area will provide computational capabilities which do not now exist at the GSFC. These include on-line, interactive image analysis; "real-time" image analysis; access to discipline oriented, on-line data bases; and the networking of computers with other NASA Centers and outside users for the exchange and sharing of mission data and information. These capabilities are essential for greater utilization by a larger number of users. It is estimated that the remaining phases will cost between $800,000

to $1,000,000 to be programmed over succeeding years. This work is being done within the context of an overall utilization plan which can only be implemented on a progressive basis.

D. Jet Propulsion Laboratory 1,670,000

1. Rehabilitation of Heating, Ventilating and Air Conditioning System in the Space Flight Operations Facility (SFOF), Building 230 400,000

This project provides for the rehabilitation of major elements of the heating, ventilating and air conditioning (HVAC) system of the Space Flight Operations Facility (SFOF), Building 230. Included is the replacement of five separate roof mounted cooling towers with two new units (900 tons ea.), replacement of two roof mounted air handlers, piping system revisions, replacement of worn out boilers (70 HP) and centrifugal chillers (250 tons). Related modifications to ducting, roofing, controls, electrical power and painting are also included. Building 230 is the nerve center for world-wide control and operations of the Deep Space Network (DSN). It contains several major computer systems, Teletype Writer Exchange (TWX), telephone, and radio links to all remote DSN tracking stations. Installed value of equipment is well over $30,000,000 and operation has resulted in failure of some HVAC equipment elements, others show signs of incipient failure. Frequent alteration and expansion of the computer complex to handle mission requirements places new loads on the HVAC system that cannot be reliably supported without system rehabilitation. HVAC system failures could result in all flight control and data handling computers shutting off due to over temperature. Maintenance costs are increasing, some equipment elements are now out of production, and the age of most equipment is approaching 15 years. It is felt that further delay in the HVAC system rehabilitation creates an excessive risk to all flight project data handling capabilities.

2. Rehabilitation of Heating, Ventilation and Air Conditioning System in the Facility Engineering Office, Building 200 140,000

This project provides for the rehabilitation of a 60-ton air conditioning system serving the first and second floors of the Facility Engineering Office Building. The work involves partition relocation, installation of piping and ductwork systems, new control systems, removal of worn out heat pumps, roof repairs around penetrations and lower floor arrangements. No major changes have been made to the 15-year old original heating, ventilating and air conditioning equipment in Building 200. System performance is inadequate, maintenance is excessive, and the system is under capacity for support of the newly assigned personnel and data system loads.

3. Modifications of Utility Control System 245,000

The Utility Control System (UCS) provides a means of remotely controlling, measuring values, and determining the status of temperatures, pressures, humidities, and electrical load consumption in various

mechanical rooms. This is Phase II of a III-Phase project. Phase II consists of multiplex equipment, building control panels and system control and monitoring points for the buildings with a total of 490 individual addressable points. This system when completed will give operation personnel the opportunity to monitor and optimize the control of all buildings on a continuous basis. This project is necessary because each building has its own heating, ventilating and air conditioning system. Consequently, roving patrols are necessary to monitor and repair approximately 150 buildings on the Laboratory. When equipment malfunctions, immediate notification minimizes unscheduled shutdowns thereby preventing potential damage to equipment requiring close environmental control. This phase of the total project will have a "payback" period of 2.3 to 2.5 years. Prior year funding was in the amount of about $400,000.

4. Modification of 16.5 KV Feeders from Substation G to Transformer Banks 63, 65, and 69 — 415,000

This project proposes to modify the old existing overhead 17 kv distribution system, covering the east portion of the laboratory, with a new underground dual radial distribution system. The work consists of adding switchgear at Substation G, utilizing existing and adding some underground conduit and pulling two feeders in conduits from Substation G to Surveyor Road, then north to Explorer Road and east to Mariner Road. Banks 63, 69 and a new bank in the General Offices Building, Building 111, are to be connected to the new feeders. The existing overhead distribution system was installed about 30 years ago and has been modified and relocated as JPL expanded. It is now a loop circuit with sectionalizing air switches that are not interlocked for safety. The proposed selective radial system will provide modern distribution in the area now served by the overhead system. The proposed system is similar to the underground selective radial system in the newer areas at JPL. This project will be the first phase of work on the overhead system. The remaining portion will cost approximately $400,000.

5. Modification to Space Flight Operations Building, Building 230, Central Transformer and Switchgear Installation — 470,000

This project will modify the electrical system for the Space Flight Operations Facility (SFOF), Building 230 including the relocation and replacement of electrical transformers, motor controls, switches, and other electrical equipment items. This building was built in four increments with four separate electrical substations and systems. Two of the main transformers have failed a number of times and require replacement. Cross feed back-up circuits and uninterruptible power systems are required to prevent the loss of power to the critical computers used for spacecraft mission control and data handling and to ensure 100 percent reliability. The entire electrical system of this building has been reviewed to ensure that the planned modification will be matched to the programmatic requirements of the facility. This proposed work includes the relocation and/or replacement of equipment, replacement of portions of the distribution system and modification of the ground fault system to prevent arcing ground failures. This project is independent from the heating, ventilating and air conditioning work to be done also in Building 230.

E. Johnson Space Center 1,200,000

1. Modifications to Oxygen and Altitude Vacuum Systems Life Sciences Laboratory, Building 7 155,000

This project provides for modifications to the altitude chamber vacuum system and provides a stainless steel gaseous oxygen distribution system for the test facilities in the Life Sciences Laboratory, Building 7 at JSC. Upgrading of the gaseous oxygen distribution system consists of replacing existing copper tubing headers and branch lines with a more reliable and maintainable stainless steel system. The stainless steel oxygen system is required to eliminate particulate contamination from oxidation which occurs in the interior of the existing copper lines. Modification to the altitude chamber vacuum system consists of installing two existing liquid nitrogen cold traps to improve the vacuum capability by removing water vapor from the system.

2. Rehabilitation of Heating, Ventilating and Air Conditioning Systems in Various Buildings 350,000

This project provides for rehabilitation of deteriorated heating and cooling system equipment in 25 buildings at JSC. The work includes rehabilitating or replacing valves, pumps, fan and coil assemblies, air-handler casings and structures, and other associated equipment. This specific effort is part of a continuing program to rehabilitate the heating and cooling systems at JSC. The deterioration of the equipment has been accelerated by the high humidity and salt/chemical content of the air in this region. The energy consumption will be decreased because of the improved efficiency of the heating and air conditioning systems, and the frequency of breakdown and repair will diminish.

There have been several malfunctions of steam and chilled water valves. Also, various components of the heating and cooling systems have deteriorated to a point where collapse is imminent. If corrective action is not taken, the testing of mission essential equipment will be placed in jeopardy.

This is Phase IV of this work. Phases I, II and III were accomplished in FY 1974, 1975, and 1976 at an approximate cost of $750,000. Future work to complete this type of rehabilitation will cost $1,120,000 (FY 1977 dollars).

3. Rehabilitation of the Chilled Water and Steam System 120,000

This project provides for rehabilitating a portion of the steam and chilled water generating and distribution systems in the Central Heating and Cooling Plant, building 24, and in the utility tunnel. The work includes the rehabilitation of one steam boiler, instrumentation, and auxiliary equipment; the replacement of condensate and steam valves and expansion joints; the rehabilitation of the chiller system,

instrumentation, and auxiliary equipment; the repair and/or replacement of chilled water valves; the rehabilitation of the cooling tower structure and systems; and the replacement of insulation and covering on the chilled water and steam piping systems.

This is part four of a five-year program of rehabilitation of the Central Heating and Cooling Plant and distribution systems. Phases I, II, and III were included in the FY 1974, 1975, and 1976 programs and cost $830,000. Phase V will cost approximately $400,000 (FY 1977 dollars). The systems have been in continuous operation since 1963. A recent survey disclosed that 75 percent of the valves in the chilled water system failed to close completely. There have been several system failures in the steam system. Boiler rehabilitation of the tubes and firebox is necessary at this time to prevent further deterioration, which would necessitate complete boiler replacement. A failure of the heating and cooling system would impair the Center operation and impact the NASA program.

4. Rehabilitation of the Sanitary Sewer System 150,000

This project provides for the rehabilitation of approximately 2,800 linear feet (853 m) of the gravity sewer lines at JSC. The segments of the existing JSC sewer lines which require single point repairs and slip lining, are based upon a television inspection of the sewer system. The pipe sizes vary from 6 inches (15 cm) to 15 inches (38 cm) in diameter. Pipe segments which are broken will be replaced and manholes will be repaired as required. This work is required because of line settlement caused by the swelling and shrinkage characteristics of the soil and, to a certain extent, by land subsidence in the area. It is anticipated that nearly 16 percent of all lines will need either repair of slip lining to prevent the recurrence of blockages from either breaks or soil infiltration.

This is Phase II of a III-Phase project. The first phase was accomplished in prior years using R&PM funds at a cost of $160,000. Phase III will cost approximately $150,000 (FY 1977 dollars).

5. Modifications of Fire Detection Systems in Various Buildings 125,000

This project provides for various modifications to upgrade the fire and intrusion alarm systems in 52 JSC buildings. The upgraded system will include panels with lightning arresters, transmitters, central receiving equipment, and voice recording equipment for recording and verifying time, locations, and nature of emergencies from incoming calls. These modifications are required because the present equipment is obsolete, unreliable, and outdated to the extent that it does not provide adequate records. In addition, since most JSC facilities do not have fixed automatic fire suppression systems, reliability of detector and alarm systems is vital so backup power supplies are necessary.

Prior year fire protection work was done at a cost of $900,000. Future funds for similar work will cost $150,000 per year for the next 5 years.

6. Rehabilitation of the Electrical Distribution System 185,000

This project provides for rehabilitation of the primary electrical power cables which serve the Thermochemical Test Area (TTA) and the utility tunnel. The work includes replacing the existing 15-kv underground cable from oil switch 300 to the switchgear in each of the buildings in the TTA, from the JSC main substation to buildings fed from the utility tunnel at a point near the Technical Services Shop, Building 10, and from the JSC main substation to Vibration and Acoustic Facility, Building 49. The replacement of these cables is needed to remove the potential of power failures and possible impact on tests or other activities at JSC.

7. Rehabilitation and Modification of Various Buildings and Structures, WSTF 115,000

This project provides for rehabilitation and modification of various buildings and structures at the White Sands Test Facility (WSTF), New Mexico. Seven buildings in the Project Control Area 100, and the Laboratory Area 200, representing approximately 66,400 sq. ft. (6,168 sq. m) of floor area will be refurbished and improved. Approximately 1,250 sq. yds. (1,045 sq. m) of concrete slab liner and 1,400 ft. (427 m) of propellant inert construction joints in the Propulsion Test Area 400, propellant disposal ponds will be repaired and recoated. Modification and rehabilitation will also include the sewage lagoon aeration system. Other modifications include installation of an air conditioning system of approximately 10-ton capacity for use in the Preparation Building 200, clean room and chemistry laboratory areas. This rehabilitation and modification work is necessary to reduce maintenance and to restore the buildings to a condition suitable for use in supporting future program and project requirements. Some of the work is required to eliminate unsafe conditions, to eliminate a potential pollution problem, and to minimize an odor producing condition. The installation of the 10-ton air conditioning system will conserve energy by allowing limited utilization of two 50-ton units when only the clean room and chemistry laboratory areas are in use.

F. Kennedy Space Center 1,190,000

1. Rehabilitation of the Vehicle Assembly Building Room, Building K6-848 265,000

This project provides for the removal of the present gravel, resaturation of felts and the application of new gravel to an area of approximately 160,200 sq. ft. (14,888 sq. m) of roof surface. The work includes resealing 325 lineal feet (99 m) of gravel stops and flashings, and refilling 18 pitch pans. The Vehicles Assembly Building (VAB) has been in use since 1966 and has recently developed many leaks which cannot be effectively patched. The age of the roof and the effects of "ponding" after heavy rains have

caused loosening of the gravel and cracking of the roof seal. Resaturation and gravel replacement are necessary to prevent accelerated deterioration of the roof and possible water damage to equipment and materials in the low bay.

2. Rehabilitation of the High Temperature Hot Water System, KSC Industrial Area 410,000

This project provides for the rehabilitation of deteriorated portions of the existing underground high temperature hot water distribution system with an above-ground system. Approximately 2,800 linear feet (853 m) will be replaced with new insulation and protective jackets. In addition, associated valves and sleeves will be rehabilitated. At present, surface run-off water enters the sleeves and soaks the insulation on the underground pipes causing deterioration and resulting in further corrosion of the pipes. This rehabilitation will eliminate the growing heat loss for the systems and result in some energy savings (fuel oil). This project currently consists of the most critical portions remaining of the program started in FY 1974 for the rehabilitation to the high temperature hot water system in the KSC Industrial Area. Approximately $1.1 million of rehabilitation effort will be required in future years to complete the program. Approximately $700,000 has already been spent to rehabilitate this system.

3. Rehabilitation of the Space Launch Complex 2W (SLC-2W) Mobile Service Tower, Western Test Range (WTR) 190,000

This project provides for the rehabilitation of the Space Launch Complex 2W Mobile Service Tower at the Western Test Range (WTR). This work includes sandblasting and providing corrosion protection to the tower framing and decking, and replacing those structural members that have corroded beyond repair. This project is necessary to maintain the facility in operational condition and prevent accelerated corrosion resulting from exposure to salt air.

4. Rehabilitation of Launch Complexes 36A and B 325,000

This project provides for general rehabilitation of LC-36: (1) the LC-36A Mobile Service Tower (MST) bridge crane will be replaced to ensure reliability and safety during lifting operations. The hoist is exposed to a high moisure and salt content atmosphere and has deteriorated over the years to where major rehabilitation is necessary; (2) the flat roof on LC-36B will be replaced with a sloping built-up roof to assure good drainage. The present roof is approximately 12 years old. Due to deterioration and rain water pooling, spot patching has not been effective; (3) the rails and associated hold down hardware, on which the LC-36B MST is moved away from the launch vehicle during launch operations, will be removed, cleaned, regrouted, and shimmed to re-level the tracks. This work is necessary because the rails and track bed have settled over the years from frequent use; (4) the flammable fiberglass wall panels and thermal insulation on the upper levels of the LC-36B MST will be replaced with fiberglass panels and insulation meeting

a flame spread of 25. The existing panels present a potential fire hazard to personnel and flight hardware. Fiberglass is used to provide a radio frequency transparent enclosure required for checkout of radiating flight hardware; and (5) the grounding system for the LC-36B propellant servicing lines will be modified to assure personnel safety during propellant flow.

G. Langley Research Center 1,840,000

1. Rehabilitation of the Low Frequency Antenna Test Chamber, Building 1299 375,000

This project provides for the rehabilitation of the Low Frequency Antenna Test Chamber in Building 1299. This work will include the removal and replacement of 17,000 square feet (1,580 sq. m) of deteriorated anechoic foam absorbent material with a new improved material which has been treated to improve its fire resistance. In addition, since the new foam absorbent material is less fire susceptible, an existing potentially hazardous condition now requiring special security measures is eliminated. This improved material will also permit throat reshaping to modify chamber response and improve performance. Rehabilitation of the chamber is required for antenna pattern, impedance, and scattering measurements in support of the Aerostat Antenna Development. This improved facility will also be used for the calibration and measurement of radiometer antenna for the Advanced Applications Flight Experiments, Earth Energy Satellites, and Microwave Landing System test.

2. Rehabilitation of Electrical Power Distribution System - 110KV 405,000

This project provides for Phase IV of a planned rehabilitation of the electrical power system at the Langley Research Center. This work includes the rehabilitation of the 110-kv electrical power system at the Stratton Road Substation. Two existing circuit breakers will be replaced with new 1,600-ampere, 100-kv oil circuit breakers capable of safely interrupting service. The incoming 110-kv service line No. 2 bus will be extended. Sectionalizing switches will also be installed to enable substation components to be isolated for reduced cost in maintenance or repair without having loss of electrical service to the entire Center and the Air Force Base. This work will also include the rehabilitation by replacement of defective ancillary items such as insulators, structural steel, and equipment pads. Further upgrading of the substation includes the provision of a fire protection system to avoid a catastrophic failure. This system will limit the extent of damage due to fire in case of a transformer rupture which may occur under an unusual fault condition. This rehabilitation of the Center's electrical power system will improve the system's safety from short-circuit interruptions and is also needed to limit the extent of damage under failure conditions.

3. Rehabilitation of West Area Sanitary Sewer System 240,000

This project provides for the rehabilitation of the West Area Sanitary Sewer System. The existing 10 inch (24.4 cm) diameter sanitary sewer line will be replaced with 1,460 feet (445 m) of 18-inch (46 cm) diameter cast iron line along Ames Road from Freeman Road to Taylor Road. A 24-inch (61 cm) diameter cast iron line of 1,380 feet (421 m) will be installed from the intersection of Ames and Taylor Roads to Lift Station No. 4. The existing 10-inch (25.4 cm) diameter line was installed in 1952 to service the Unitary Plan Wind Tunnel, Building 1251, and is deteriorated and undersized. In addition, Buildings 1202, 1250, 1262, 1286, 1293, 1299, the Chemical Magazine Test Area, and the Hypersonic Physics Test area have been connected to the West Area Sanitary System. This presently overloaded system will be further aggrevated by the new System Engineering Building which will be completed in early 1976. Portions of the 10-inch (25.4 cm) diameter sewer line have been exposed in connection with other construction and it was noted that the joints leaked and the clay pipe is soft. Failure of this inadequate sewer system could cause a shutdown in an area which services over 1,100 employees.

4. Rehabilitation of Hangar Annex, Building 1244D 300,000

The project will provide for the rehabilitation to improve the reconstructed Hangar Annex, Building 1244D for additional storage and work areas. This project will include the installation of additional power and lightning, partitions, reinforcement of the structural frame, and roof and siding insulation. New heating, air conditioning, and a 14-foot (4.3 m) wide roll-up door is included with the project. The work will provide the space for and the installation of the rotor systems research aircraft calibration fixture and its support apparatus. This rehabilitation work will also provide a shop area of 2,400 sq. ft. (230 sq. m) and a clean room of 2,250 sq. ft. (209 sq. m) for rotor balance functions. The existing hangar addition is a pre-engineered structure which is over 16 years old, and has been moved and re-erected twice. The rehabilitation work is required at this time to provide more advantageous use of the available space in support of Aeronautics Research Programs.

5. Modification of Auxiliary 150-psi Air Supply Aircraft Noise Reduction Laboratory Building 1208 195,000

This project provides for the modification to the auxiliary air supply line in the Aircraft Noise Reduction Laboratory (ANRL), Building 1208. the existing 15-psi (1.034×10^5 n/m^2) air supply line to the anechoic chamber plemun will be upgrated to 150 psi (1.034×10^6 n/m^2) to provide quiet high pressure air to models and noise sources. A new larger quiet flow control valve will be installed parallel with the existing one to provide higher mass flows. The auxiliary 150 psi (1.034×10^6 n/m^2) will be extended to the existing 4-foot (1.2 m) duct to provide quiet air for research models and noise sources. Upgrading the system includes replacement of the existing flexible pipe with a 10-inch (25.4 cm) rigid steel pipe. Increasing the mass flow rate and pressure, and extending the air supply to other locations are required

to support high priority forward motion effects research relating to the control of forward and rearward radiated noise from inlets and exhaust jets of current and future conventional takeoff and landing, and supersonic aircraft. The auxiliary air system is also needed to operate model jet exhaust systems, suppression devices and controlled noise sources in conjunction with the existing ANRL primary air and flow duct systems.

6. Modification to 350-psi Air Supply East Area 325,000

This project will provide for the modification of the process air for all Langley Research Center facilities in the East Area by the installation of a 350 psi (2.413×10^6 n/m^2) compressed air distribution system. This work will include the installation of a new underground 8-inch (20.3 cm) diameter compressed air line approximately 2,000 feet (610 m) long from the Engineering Technology Laboratory, Building No. 646, to the Low Turbulence Pressure Tunnel, Building No. 582A. An additional 400 feet (122 m) of 3-inch (7.6 cm) diameter pipe will be connected into the 8-inch (20.3 cm) diameter main to supply the Transonic Dynamics Tunnel, Building No. 648, and the 8-foot (2.4 m) Transonic Pressures Tunnel, Building No. 640. New isolation and pressure reducing valves will be installed at each facility termination. The installation of these new compressed air lines will replace nine existing independent compressor systems of varying sizes located at these facilities. The new air supply will increase the maximum pumping rate by 3.5 times as compared to the rate for the two existing compressors. The new air supply will favorably impact operation of the Advanced Technology Airfoil Program which is supporting air transport and business jet aircraft with super critical airfoil designs and data.

H. Lewis Research Center 1,275,000

1. Modification of Flight Research Building, Building No. 4, for Fire Protection 465,000

The proposed project provides for the modification of the existing fire protection system in the Flight Research Building, Building No. 4, aircraft storage and service area. This modification will provide protection for an area of about 44,000 sq. ft. (4,088 sq. m) and will include an aqueous-film-forming-foam (AFFF) system, improved floor drainage system, and the installation of heat and smoke vents. The AFFF system will consist of eight horizontal discharge nozzles capable of spraying 3,400 gallons (12.8 kl) per minute. The concentrated foaming agent will be stored in a 2,000-gallon (7.6 kl) storage tank. The water will be provided by the domestic water supply through two 3,300-gallon (12.5 kl) per minute booster pumps. A separate drainage system with additional floor drains and pipes will discharge into holding tanks of 70,000 gallon (265 kl) capacity to prevent foam water and spilled fuel from reaching the domestic storm drainage system. Modifications will also be made to buildings, ventilation and electrical power systems. The automatic fire protection system is for personal safety and to protect the building, aircraft, and research equipment valued at approximately $23,500,000. Loss of aircraft and related research equipment would impact the Quiet Engine Development Program, and the Turbo-Jet Engine Flight Test Research Program.

2. Rehabilitation and Modification of East Wing of Engine Research Building, Building No. 5 355,000

The project provides for the rehabilitation and modification of 9,039 sq. ft. (840 sq. m) of research test facilities in the East Wing of the Engine Research Building (ERB), Building No. 5. The exterior work will include the rehabilitation of the exterior masonry walls, replacement of the roofing, waterproofing of parapets, removing obsolete support equipment on the roof, and replacing exterior doors. The building interior will be rehabilitated by installing new floor covering. Modifying the electrical power, lighting, heating, ventilating, and air conditioning systems, will be provided with this project. Acoustical ceilings will be installed in the hallways to reduce the noise levels. The East Wing of the ERB was constructed in 1943 and has been without major modification or repairs. This extensive rehabilitation and modification of both the interior and exterior of the building is required to restore the facility for future research programs. This wing contains 12 test cells and 6 control rooms and rehabilitation is needed for energy oriented automobile and aircraft engine test programs.

3. Rehabilitation and Modification of Central Portion of Utilities Building, Building No. 15 455,000

This project provides for the rehabilitation and modification of the central portion of Utilities Building, Building No. 15. This rehabilitation includes the replacement of the wood windows in the entire building with double glazed aluminum windows. The present wood windows have deteriorated and require constant maintenance. The double glazed aluminum windows will reduce maintenance cost, conserve energy, and shield out exterior noises. This project also provides for the rehabilitation and modification of 14,250 sq. ft. (1,300 sq. m) of the building. The exterior work will include tuck pointing and waterproofing of the masonry walls, repairing the roof, and replacing the exterior doors. The existing wood stairway will be replaced with front and rear stair towers and entrances. The interior work will include replacing the walls, acoustic ceilings, floor covering, plumbing, heating and air conditioning systems. The lighting, communication, fire protection, and power systems will also be improved. The building was constructed over 32 years ago and in the insuing time has evolved from a central firehouse to its present multipurpose role. In addition to the original equipment and systems being worn and requiring replacement, these changes in the function require extensive rehabilitation of the space and improvement of the interior and exterior to provide for adequate facilities to support research activities.

I. Marshall Space Flight Center 1,515,000

1. Modifications for Industrial Waste Treatment Facility, Building 4739 410,000

This project will provide the means for control of pH levels and will remove toxic components from the various industrial aqueous wastes discharged from various facilities at Marshall Space Flight Center (MSFC). The system will consist of the installation in the Industrial Waste Treatment Facility, Building 4739, of package systems for destruction of cyanides in cyanide-bearing rinse waters, removal of chromium

in chromium-bearing waste waters, neutralization of final pH adjustment and precipitation of all other heavy metal hydroxides, clarification, separation and removal of precipitated hydroxides. Various holdtanks, feedtanks, pumps, and instrumentation and controls will also be provided. The system will be designed to permit future addition of a reverse osmosis or ion exchange apparatus in order to comply with the 1983 and 1985 effluent regulations. When the current industrial waste system was put into operation in 1970, the Environmental Protection Agency's (EPA) effluent regulations were less stringent than at present. This facility is required to comply with the EPA 1977 effluent regulations.

2. Modification of Utility Control System 240,000

The Utility Control System (UCS) provides a means of remotely measuring values and determining status of temperatures, pressures, humidities, and electrical load consumption in various mechanical equipment rooms and critical installations throughout MSFC. Control functions are also included for starting and stopping entire air conditioning systems from a central remote site. The existing UCS in Buildings 4663, 4487, and 4708 will be updated and the systems expanded to include monitoring and control of functioning equipment in mechanical equipment rooms in eight MSFC office buildings, shops, and laboratories as follows: Buildings 4353, 4471, 4481, 4485, 4610, 4612, 4613, and 4619. The UCS provides a central point for control of air conditioning equipment. Through implementation of this project utilities savings will be $100,000/year, which amortizes the investment in 2-1/2 years. This estimate does not include the savings to be realized in maintenance surveillance manpower. Trend analysis will prevent costly shutdown of computer equipment by "anticipating" malfunction of mechanical equipment. The existing UCS has been in operation for eight years and has proven reliable and beneficial in trouble shooting and maintenance of air conditioning equipment in the three larger MSFC buildings being served. When equipment malfunctions, immediate notification minimizes unscheduled shutdowns thereby preventing potential damage to critical computer and electronic test equipment requiring close environmental control.

3. Rehabilitation of Office and Engineering Building, Building 4610 West 355,000

This project will provide for the rehabilitation of the west portion of the Office and Engineering Building, Building 4610, which has a floor area of approximately 62,000 sq. ft. (5,762 sq. m). The work consists of rehabilitation of the lighting and power distribution systems and the rehabilitation of the heating, ventilating and air conditioning system. This part of the building was constructed in the late 1950's utilizing very minimal standards. Continued utilization of this facility is imperative in support of the Center's missions in research and engineering work for assigned programs and activities. Accordingly, it is necessary to upgrade the building interior and utility systems to prolong its usefulness. The building systems are obsolete, inefficient, and require excessive maintenance and repair. This project will result in the reduction of both energy consumption and maintenance time.

4. Rehabilitation of Air Conditioning Systems, Missile Assembly and Inspection Hangar, Building 4708, Phase II 355,000

This project provides for rehabilitation of obsolete air conditioning systems serving approximately 60,000 sq. ft. (5,576 m^2) of building area. The work will include installation of an existing 673-ton chiller and associated piping and controls in an existing equipment building. Approximately 15 individual direct expansion type systems will be replaced utilizing the new chilled water system. In addition, deteriorated or inadequate systems or components will be upgraded or replaced as required in order for this area of the building to meet user environmental requirements. The building houses or will house numerous activities critical to the support of the Center's technical and scientific programs, including Space Shuttle, HEAO, X-Ray Telescope, and Spacelab, plus various other MSFC-assigned programs. Ongoing program activities in the building are beginning, presently, to take an intolerable overload on the existing air conditioning systems serving this area. These systems are old, substandard, fragmented and have become unreliable. This is the second phase of a three-phase plan to upgrade the entire building's air conditioning systems. Phase I provides for the rehabilitation of an initial 40,000 sq. ft. (3,717 m^2) of this building as part of the FY 1976 CoF program at an estimated $350,000 cost. The future Phase III increment in this rehabilitation task will complete this work and is estimated to cost an additional $350,000.

It is urgent that a more efficient central system to replace the numerous small systems be provided for greater reliability, better environmental control and reduced operating and maintenance costs. Systems to be modified or rehabilitated will incorporate provisions for energy conservation.

5. Rehabilitation of Guidance and Control Building, Building 4487, Phase II 155,000

This project consists of general rehabilitation of the western portion of the "A" Wing and the entire "AB" Wing in Building 4487. Work includes removal of various obsolete and overloaded air conditioning units, air handlers, and chillers; installation of an adequate centralized air conditioning system; and connection of the air conditioning system to an existing central chiller. Power distribution and lighting systems will be rehabilitated. This rehabilitation will result in energy conservation and reduce maintenance costs. It will also facilitate the consolidation of various electronic and control activities from other buildings into Building 4487. This project comprises the second phase of the five-year plan begun in FY 1975 for the general rehabilitation and upgrading of Building 4487 to meet operational requirements imposed by current R&D usage. Phase I, included in the FY 1976 budget at $460,000, provides for the rehabilitation of the East end of the "A" Wing. A subsequent increment is estimated to cost approximately $500,000.

J. Michoud Assembly Facility 525,000

1. Rehabilitation of Manufacturing Building, Building 103 270,000

This project provides for rehabilitation of ten rooftop substations and electrical systems in Manufacturing Building, Building 103, and the replacement of approximately 1,950 feet (594.4 m) of 6-inch (15.2 cm) horizontal roof drain lines and risers which have developed leaks. Rehabilitation of the substations and electrical systems includes repairing substation doors, replacing open cable feeders from the substations to the circuit panels and replacing electrical safety devices to include overload protection of equipment. This project is necessary to improve safety conditions and operations of the electrical system in the building. This project will also prevent leakage from the horizontal drains and risers which could result in damage to the equipment and external tank components located below these drains and risers.

2. Modifications of Utility Control System (UCS), Phase II 255,000

This project provides for expanding the existing Utility Control System to monitor electrical loads at the 2 master and 18 distribution substations at the Michoud Assembly Facility. Automated start/stop control functions and monitoring sensors will be added to optimize power loads by allowing decentralized control of all principal electrical equipment used to support plant operations. Monitoring the status of circuit breakers and electrical loads at these substations will allow real-time recording and evaluation of power used throughout the manufacturing areas for temperature, humidity, pressure, light, and power so that heavy loads can be automatically rescheduled during nonpeak hours. This rescheduling will in turn reduce electrical demand costs, aid in conservation of electricity, and allow personnel to react faster to power outages. With proper monitoring and control, costs for electricity could be reduced by at least 10 percent. When manufacturing external tanks begins, yearly electrical bills are estimated to be about $2,650,000; the proposed modifications will allow savings of approximately $265,000 per year. Thus, the cost of this project would be amortized in less than one year. Phase I of this project was funded in FY 1976 at $315,000. This second phase will complete all known control and monitoring requirements at this time.

K. National Space Technology Laboratories 905,000

1. Rehabilitation of Roofs at 20 Buildings 255,000

This project provides for the rehabilitation of approximately 482,000 square feet (44,780 square meters) of roof area on 20 buildings at this location. This rehabilitation work will include the replacement of selected sections of the deteriorated roofs, and the reworking of expansion and contraction cracks and adjoining openings through the roofs at parapets. The work also includes the installation of roof vents to dry out trapped moisture. Despite patches and repairs, the roofs on some buildings have numerous leaks, soft spots where the insulation has been saturated, and blisters from trapped moisture. These roofs

are over ten years old and detailed radioisotopic inspection surveys during the past year have indicated the need for this rehabilitation work. Delay of the rehabilitation of these roofs will result in further deterioration of the roof surfaces, underlayments, insulation, and decking to a point which would require major reworking of the roofs of many of the buildings.

2. Rehabilitation of Roads in Buffer Zone 240,000

This project provides for the rehabilitation of approximately 4.4 miles (7.1 KM) of 24-foot (7.3 m) pavement of the south access road into the Center. The work will include removal and replacement of sections of pavement and or base materials, in-place rehabilitation of existing flexible payment, laying a leveling coat, binder coat, and wearing surface, buildup of the shoulders, and restriping of finished pavements. With the acquisition of the NSTL, a portion of the Mississippi Road System, now State Road 607, was absorbed into the Fee area and closed to the public, thereby becoming the responsibility of NASA for rehabilitation. During the construction in the area this road received far more traffic than anticipated. This increased traffic and wheel loading, coupled with long heavy wet seasons has caused this access road to deteriorate. Conditions of the road are such that unless the proposed rehabilitation is accomplished it could become necessary to do major replacement of the roadway.

3. Modification of Sewage Waste Treatment System 410,000

This project provides for the modification of the existing sewage waste treatment systems at NSTL to meet present water control regulations established by the Environmental Protection Agency (EPA). The existing three sewage lagoons will be replaced with two extended aeration package treatment plants. The first waste treatment plant will be located in the vicinity of the existing Sewage Lagoon No. 1 and will provide treatment for the Engineering/Administration, and Maintenance (Industrial) areas. This new system will consist of approximately 5,770 feet (1759 m) of 4-inch (10.2 cm), 6-inch (15.2 cm), and 8-inch (20.3 cm) diameter cast iron force mains. A new lift station will be provided in the vicinity of Sewage Lagoon No. 2 and connected by a force main to Manhole II. Sewage Lagoon No. 2 will be maintained as an experimental lagoon for performing research on the use of vascular aquatic plants in the treatment of raw sewage. The modifications to the existing waste water treatment system are required so that the effluent will meet secondary treatment standards as set forth by the EPA and the State of Mississippi Air and Water Pollution Control Commission. Presently, they are operating under a national pollutant discharge elimination system permit from EPA which expires July 1, 1977. By combining the waste water systems, and the installation of the packaged treatment plants, not only will the effluent meet regulations, it will also reduce operations and maintenance costs.

L. Wallops Flight Center 1,315,000

1. Rehabilitation of Airfield Facilities 410,000

This project provides for a 2,000-ft. (610 m) drainage system parallel to runway 10/28, pavement improvements to the south end of runway 4/22, repair of joints and spalling areas on aircraft ramps at hangar area D-1 and N-159, including the repair of drainage catch basin. The drainage system of runway 10/28 will allow entrapped surface water to drain from the runway. Pavement improvements to the south end of runway 4/22 will make this portion compatible with the test section of this runway. All concrete joints on aircraft ramps are in need of repair and this work will also improve the drainage of this area.

2. Rehabilitation of the High Bay Assembly Shop, Building Z-41 390,000

This project provides for rehabilitation and/or replacement of 6,440 sq. ft. (598 sq. m) of the concrete floor, rehabilitation of damaged partitions in the office area, replacement of damaged electrical conduit and cable ducts and replacement of the cooling tower for the High Bay Assembly Shop, Building Z-41. The floor in the facility has settled due to unstable subgrade and has become uneven over large areas. This rehabilitation is required to prevent further damage to utilities and to correct safety and reliability problems in the assembly of launch vehicles on an uneven floor. The cooling tower needs replacement due to deterioration with age and use in the saline atmosphere.

3. Rehabilitation of Various Buildings 160,000

This project provides for the rehabilitation of two buildings as follows:

a. Rehabilitation of Radar Building, Building U-25. This project provides for exterior waterproofing, roof rehabilitation, replacement of ceiling and floor tile in the shop area, rehabilitation of the heating system and replacement of the hot water boiler. This work is required to prevent further deterioration and to maintain the environmental standards required for the precise instrumentation housed in this facility.

b. Rehabilitation of Conference and Morale Activities Building, Building F-3. This project provides for rehabilitation of the roof, painting of the exterior, rehabilitation of the conference and toilet facilities, installation of new lighting and the relocation of the heating, ventilation and air conditioning cooling equipment to the roof. This work is required to prevent further deterioration of this 30-year old building.

4. Rehabilitation of the Aircraft Maintenance Hangar, Building D-1 355,000

This project provides for rehabilitation of the exterior of this hangar through the replacement of 25,700 sq. ft. (2,388 sq. m) of built-up roofing, replacement of windows on the south wing and upper bay, and for the installation of a central air conditioning system to serve the second floor of the south wing. This project will complete the exterior rehabilitation of the building and prevent further damage to the interior from window and roof leakage. The new air conditioning system will provide more efficient operation than the existing 19 window units. Prior funding (FY 1971 and FY 1976) for Building D-1 was $665,000 and it is anticipated that future funding of $455,000 will be required to complete work on this facility.

M. Various Locations 1,820,000

1. Rehabilitation of Air Conditioning System at Fairbanks, Alaska 120,000

This project will rehabilitate existing air conditioning systems in the Operations Building at the Fairbanks Station. Since the installation of the original equipment, new electronic systems have been added without any corresponding increase in the cooling system. In addition, most new electronic systems introduced as replacements of old systems have greater heat loads. This project will replace worn out equipment such as condensers, fans, and motors. Ducting and controls will also be modified or replaced and zones will be rerouted to accomplish optimum heat balance to protect electronic equipment from over heating and to establish a controlled environment for stable electronic operation.

2. Rehabilitation of Operations Control and Communications Building at the Goldstone Complex (MARS/DSS-14 and ECHO/DSS-12) 295,000

This project provides for rehabilitation of buildings and existing collateral equipment at the Goldstone complex. The work includes rehabilitation of roofs, walls and ceilings, the installation of air locks, replacement of incandescent lighting with fluorescent, modernization of the heating, ventilating and air conditioning system with economizer cycles and improved distribution and balancing and installation of modern and efficient utility controls. This work is required to improve the reliability of operations while providing savings in operations, maintenance and utility costs.

3. Modification of the Power Distribution Systems (DSN) - Various Locations 360,000

This project provides for the modification of the site power distribution at Goldstone (DSS-11) and Canberra (DSS-44) Stations. The work includes replacement of the 480-volt distribution switchgear, increasing installed transformer capacity for the Operations and Power Plant buildings, increasing the underground duct bank capacity, rehabilitation of the ground fault protection system and the modification

of the power distribution switchgear at each site. Implementation of the above work will minimize short circuit problems, minimize the safety hazard to operational personnel and reduce the station down-time caused by failures of the power distribution system.

4. Modification of Internal Lighting Systems at Various Locations (STDN) 290,000

This modification will replace incandescent fixtures in the Operations Building, STDN Stations, with Electro-Magnetic Interference (EMI) free flourescent fixtures. Fixture replacements will be made at the Goldstone and Canberra Stations. Electrical wiring and the ceilings will be modified to accept the recessed flourescent fixtures.

Until recently, incandescent fixtures were stipulated for use at the Space Flight Tracking and Data Network (STDN) stations because ballast used with the flourescent fixtures created an EMI in tracking equipment. Improvement in ballast has reduced this EMI disturbance and recent additions at the stations using flourescent fixtures have caused no noticeable increase in equipment disturbance. Incandescent fixtures use between 2-3 times the energy required for flourescent fixtures for the same candle power intensity. Air conditioning requirements would also be reduced due to less heat dissipation from flourescent fixtures resulting in additional energy savings.

5. Modification of the Power Plant at Ascension Island 120,000

This modification will replace deteriorated diesel engine radiators, install air shut-offs on diesel engines to prevent damage or destruction to the engine and alternator in event of an engine runaway. Also included is the relocation of diesel engine control panels from engine mount to floor mount to reduce vibration and the possibility of an undesirable engine shut-down or failure; the installation of frequency and voltage monitoring cubicles and kilowatt recording meters to retain operational history that can be utilized in the evaluation of equipment operation; and replacement of two transformers which are presently overloaded because of increased station loads.

6. Modification of the Utility Control Systems at the Goldstone Complex 435,000

This is the first of a two-phase project to provide a utility control system for the Goldstone Complex. This system will be composed of a real time micro-processor subsystem for local monitoring and control at each of the five tracking facilities with a centralized mini-computer control system for the complex. This system will monitor and control commercial power, engine generator plants, heating, ventilating and air conditioning systems, fire protection systems, power and water distribution systems. This system will accept weather and tracking schedules to permit predictive response. Should there be a failure in the Utility Control System the equipment returns to a manual mode or to its normal operating mode. The first phase will be completed at the following stations: DSS-12 (Echo) and DSS-14 (Mars).

7. Rehabilitation of Three Buildings at the Scout Launch Facilities, East and West Sites 200,000

This project provides for the rehabilitation of three buildings at the Scout Launch Facilities. Included in this work is the replacement of the heating system, rehabilitation of the roof and modification for the pressure vessel test cell in the Ordnance Assembly Building, Building 960 (Western Site). The work in the Operations Support Building, Building 582 (Western Site), includes replacement of the heating system, shelter cover for the nitrogen servicing system and paving. This project also includes roof rehabilitation, cooling tower and boiler replacement in the Assembly Shop, Building 3 (Eastern Site). The heating systems as well as roofs, tower and boilers in these buildings are more than 15 years old and need replacement or rehabilitation. The pressure vessel and shelter cover modifications are necessary for personnel safety, while the paving will provide for fire protection access to the launch pad area.

MISCELLANEOUS PROJECT LESS THAN $100,000 EACH 1,600,000

TOTAL..... 17,875,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that between $15 and $20 million per year will be required for the continuation of this facility rehabilitation and modification program.

MINOR
CONSTRUCTION OF
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

MINOR CONSTRUCTION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	560,000	CF 11-2
Flight Research Center	170,000	CF 11-3
Goddard Space Flight Center	235,000	CF 11-4
Jet Propulsion Laboratory	570,000	CF 11-4
Johnson Space Center	185,000	CF 11-5
Langley Research Center	865,000	CF 11-6
Lewis Research Center	250,000	CF 11-7
Wallops Flight Center	420,000	CF 11-8
Various Locations	1,245,000	CF 11-8
Miscellaneous Projects Less than $50,000 Each	625,000	CF 11-10
Total	5,125,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 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 1977 CoF ESTIMATE: $5,125,000
FY 1975: $4,500,000	FY 1976: $5,000,000	TQ: $1,250,000

COGNIZANT PROGRAM 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 1977 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. Several projects are included in this year's minor construction program which relate directly to the conservation of energy.

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 1977 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 1977 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. Items of work proposed to be accomplished within this program for

FY 1977 have been carefully selected from a list totaling about $10.5 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. 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 $5,125,000. Of the $5,125,000 total, $4,500,000 represents specific discrete items of work and approximately $625,000 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	560,000
1. Construction of Addition to Utilities Along Moffett Boulevard	135,000

This project provides for an addition to the utility system along Moffett Boulevard. This work will include the installation of approximately 1,400 feet (427 m) of 6-inch (15.2 cm) diameter natural gas pipe line from Arnold Avenue to the northern portion of the Center. As a part of this work, Moffett Boulevard will be extended approximately 700 feet (213 m). New electrical ducts will be installed from manhole 133, approximately 1,300 feet (396 m), to the northern portion of the Center. This addition to the electrical system along Moffett Boulevard is required to provide a loop for the utility system and will contribute to the reliability of the electrical power to a segment of the Center. This extension of the utilities is in accordance with the master plan and will permit the location of planned improvements.

2. Construction of a New Test Leg in Fluid Dynamics Laboratory, Building N-231	245,000

This project provides for the construction of a new test leg parallel to the existing leg in the Fluid Dynamics Laboratory, Building N-231. This work will include a new settling chamber and a 4-foot (1.2 m) diameter by 20-foot (6.1 m) long pressure vessel to enclose future test sections of various geometric shapes. The test chamber will include a provision for the installation of a large porous walled test section with related piping and valving for the control of side-wall boundary layers. An addition of approximately 650 sq. ft. (60.3 sq. m) is included for the tunnel control room and data recording system. The pacing item for the development of advanced computer codes for ILLIAC IV, used in the design

of advanced high performance aircraft, is the turbulence models which account for significant viscous effects such as shock-induced separation. Such models will have to be developed and verified experimentally to take full advantage of the ILLIAC IV capabilities, since a larger computer would be required if turbulence was to be simulated by computation. The first computer codes requiring these turbulence models are ready for solution, and additional codes for predicting the lifting characteristics of airfoils will be ready for solution in FY 1977. Currently the chamber is limited to wing experiments for zero lift. This modification will allow experiments for modeling and verification for the case of lift over a practical range of Reynolds number by providing an increase in Reynolds number. An increase in test section size is necessary because of problems associated with the laminar sublayer and surface roughness effects at high Reynolds numbers.

3. Construction of Addition to Communication Ducts 180,000

This project provides for an addition to the communication ducts and manholes for communications, fire alarm, security, and other low voltage cables from the Administration Building, N-200, northward along Moffett Boulevard. Approximately 3,700 feet (1,128 m) of 6-duct bank with manholes will be installed from Building N-200 along Moffett Boulevard to Arnold Avenue. Approximately 2,400 feet (732 m) of 4-duct bank with manholes will be installed along Arnold Avenue from the corner of Moffett Boulevard and Arnold Avenue northward to the Static Test Stand, Building N-249, and south and east to the Unitary Plan Wind Tunnel, Building N-227. This work will include increasing the size of the communications distribution point in Building N-227. This installation of communications ducts is in accordance with the Master Plan and will be independent of the main electrical distribution system. This will permit the telephone company to install and maintain their cables in the proposed duct system. These ducts will provide for the existing facilities in the northern portion of the Center as well as making provision for planned future developments.

B. Flight Research Center 170,000

Construction of Addition to Radar Tracking Station, Ely, Nevada 170,000

This project provides for the construction of an 1,800-sq. ft. (167 sq. m) one-story masonry block addition to the radar tracking station on a mountain top near Ely, Nevada. This work will also include lighting and heat. Fire protection will be provided in the storage areas. This addition will provide space for the storage and shop repair functions now located in trailers adjacent to the radar tracking facility. The existing trailers are inadequate and unsafe due to the high winds, over 100 mph (161 km/hour), which are experienced frequently at this mountain top location. The wind has frequently damaged the metal roof material and sheeting of the trailers resulting in excessive maintenance costs.

C. Goddard Space Flight Center 235,000

1. Additions to Telescope Facility (Building 208) at the Goddard Optical Research Facility 120,000

This project provides for the construction of two 600-sq. ft. (56 sq. m) additions to the 48-inch (122 cm) Telescope Facility at the Goddard Optical Research Facility (GORF). These additions will be single story, prefabricated buildings with a connecting passage from the building addition to the radome telescope facility. The buildings will include a double door, heating, ventilation and air conditioning and power. One of the structures will be located north of the existing radome and the other will be on the west side.

The north building is needed to house advanced laser ranging systems for field evaluation and testing with the 48-inch (122 cm) telescope. The new building will support R&D experiments in laser ranging development for Earth and Ocean Physics Application Program (EOPAP), Sea Satellite (SEASAT) and Laser Geodynamic Satellite (LAGEOS).

The west building addition will house equipment for field evaluation and testing of advanced Optical Communications Systems. The equipment used with the 48-inch (122 cm) telescope will support the R&D effort and operations for the DOD/NASA Space Laser Communications experiments.

2. Construction of Mezzanine Addition to Shop Area, Building 5, in the Instrument Construction and Installation Laboratory 115,000

This project proposes the construction of a mezzanine in the existing tool crib serving the Machine and Sheet Metal Shops. An additional 800 sq. ft. (74 sq. m) of available area for tool custody will be constructed. Also included will be the extension of the heating, ventilating and air conditioning system. The consolidation of the Machine and Sheet Metal Shops has forced both organizations to share a tool crib formerly used by only one shop. The crib is inadequate in size and must be expanded.

D. Jet Propulsion Laboratory 570,000

1. Addition to Remote Preparation Building, Building E-44, Edwards Test Station 105,000

This project provides for the construction of a 500-sq. ft. (46 sq. m) addition to an existing propellant preparation building at Edwards Test Station. Construction is concrete slab, block walls, standard roofing, plus temperature and humidity controls. The present building, of similar construction, contains 323 sq. ft. (30 sq. m) and was built in 1963. It is not of adequate size to house the newer machine tools used to remotely prepare the cast solid propellant grains for testing. Remotely operated

mandrel pulling (from the casting) and propellant machining equipment, necessary to prepare the larger propellant grains, will be installed in the new addition. This additional area is required for research oriented activities in the development of solid motors of up to 18,000 pounds thrust. The addition is also required to provide testing capabilities for solid propellants in a remote area which is necessary to preclude a compromise of safety standards.

2. Construction of a Radiographic Inspection and Assembly Building, Edwards Test Station 225,000

This project provides for the construction of a new high bay building at Edwards Test Station for radiographic inspection of propellant grains. The building is approximately 1,000 sq. ft. (93 sq. m) with 40 ft. (12 m) head room plus an adjacent low bay control area. Construction is concrete slab on grade, block walls and an overhead three ton crane. The high bay will accommodate X-ray equipment able to penetrate a 4,000-pound propellant grain which will be operated from the adjacent control area. Access roads, utilities and fence relocation are included in the site development per the master plan. The present facility cannot handle motors over 800 pounds. Private off-site vendors have been utilized for this class work but they are all now closed, or closing, and no place is available for essential X-ray tests preparatory to firing. Without X-ray examination for voids or blow holes, dangerous explosions can occur during firing tests with resultant facility and equipment destruction as well as hazardous exposures to personnel.

3. Addition to Facility Engineering Office Building, Building 200 240,000

This project proposes a 5,250-sq. ft. (488 sq. m) two-floor addition to the Facility Engineering Office Building, Building 200. This addition will allow for needed loading and maintenance shop space on the first floor. The second floor will provide space for new offices and will consolidate those personnel in temporary and remote locations at the site. This addition will provide for better utilization of space and increase the efficiency of the engineering office.

E. Johnson Space Center 185,000

1. Construction of Storm Drainage System, Thermochemical Test Area (TTA) 185,000

This project provides for the construction of a storm drainage system in the Thermochemical Test Area (TTA). This is phase I of a two-phase project and consists of regrading three existing drainage ditches, installing storm sewers and inlets, contour grading of drainage areas, and seeding the regraded areas. The existing drainage consists of small road ditches and three secondary drainage ditches which are poorly graded and inadequate in cross section. Poor drainage exists causing the flat area to contribute to widespread ponding of rainwater and subsequent long periods of wetness. This hampers TTA operations, restricts mowing operations and encourages the breeding of mosquitoes. Silting has also caused obstructions and ponding in the secondary ditches. This project will reduce maintenance of the roads and

keep the area from flooding during storms. The future phase II will consists of similar work in an area north of the TTA area and it is estimated that the cost will be $200,000.

F. Langley Research Center 865,000

1. Construction of Addition to Flight Instrument Laboratory, Building 1202 225,000

This project provides for construction of an addition of approximatley 5,000 sq. ft. (465 sq. m) to the Flight Instrument Laboratory, Building 1202. This addition consists of enclosing the southwest corner of the building with the construction similar to the existing building. The area will be divided into three large rooms for instrumentation systems assembly, and for housing of hybrid multispectral processor and image generation equipment, and six smaller rooms for individual sensor development and calibration laboratories. Existing heating and air conditioning capabilities will be extended and no unique utilities are required.

These facilities are required for laboratory evaluation of earth resource sensors and data preprocessing concepts being developed under the Advanced Applications Flight Experiment and Space Research and Technology Progams, and for assembly of these sensors into instrumentation systems for evaluation via aircraft flight tests. During CY 1978 and subsequently, ground and flight tests on sensor instruments developed in these programs will be conducted. These instruments will be the pre-prototypes of next generation air and water quality instrumentation.

2. Construction of Logistics and Property Management Building 215,000

This project provides for the construction of a one-story masonry structure of approximately 4,000 sq. ft. (372 sq. m) to be located on Durand Road near the General Storage Building 1245. The building will include minimum partitions with large open landscaped spaces that provide maximum flexibility for approximately 30 people. This work will also include the necessary rest rooms, mechanical equipment and parking area. A study of the property management and stores functions indicated that the consolidation will improve the overall effectiveness and efficiency of this organization. The study indicates the manpower savings can amount to five manyears per calendar year with this new facility. This centralized location for this facility will provide for effective supervision of these functions, more efficient operations, and improved coordination with other Center functions.

3. Construction of Addition to Data Systems Building, Building 1152 110,000

This project provides for the construction of a single story addition of approximately 1,800 sq. ft. (167 sq. m) at the north corner of the Data Systems Building, Building 1152. The work will include acoustic tile ceiling and carpeted floor to reduce the noise level for key punch operations. Storage will be provided for computer card stock and standard forms. The addition is required to provide space

for production key punch operations and computer supplies. This addition is needed to replace three trailers which are providing an interim solution to the requirement. These trailers limit security and the effectiveness of the operation, and are inefficient to operate and maintain. The data processing systems support all programs and operations at the Center.

4. Construction of General Services Facility 245,000

This project provides for the construction of a 6,000-sq. ft. (558 sq. m) one-story masonry block structure, to be located east of the intersection of Bush and Freeman Roads. This work will include an office area and a one-story shop area. Rest room facilities and storage space will be provided in the shop area. This building is needed for the service organizations of the Plant Engineering Division. At present they are located in four trailers and in shop and office space in the Model Shop, Building 1150. The trailers are planned for disposal and Building 1150 is deteriorated, inadequate, and scheduled for demolition.

5. Construction of Aircraft Crashworthiness Preparation Building 70,000

This project provides for the construction of a one-story pre-engineered metal building of approximately 2,400 sq. ft. (223 sq. m) in the vicinity of the Impact Dynamic Research Facility, Building 1297. The building will include a 42-foot (12.9 m) wide hangar type door and an 18-foot (5.5 m) ceiling height. A hoisting mechanism will be located overhead for the suspension of aircraft. This building is required to provide environmental protection for aircraft prior to testing. This building will be used for the installation and calibration of instrumentation, and post-test evaluation of aircraft being prepared for crash testing. The building will also provide an area for weighing and balancing of aircraft. The major portion of this research support is now performed outside and is discontinued during rain or extreme cold weather.

G. Lewis Research Center 250,000

1. Construction of Storage Building for Equipment 115,000

This project provides for the construction of a pre-engineered metal building of approximately 4,800 sq. ft. (447 sq. m). in the vicinity of Substation A, Building 200. The building will be 40 feet (12.2 m) wide and 120 feet (36.6 m) long with a 16-foot (4.9 m) height erected on a reinforced concrete floor slab and foundation. The building will be insulated, heated and lighted. An overhead door will be provided at the south end. This building will be used to consolidate equipment catalogued in the agency-wide equipment storage system during the 120-day screening cycle. This equipment is presently dispersed at four locations at Lewis and at Plumbrook resulting in an inefficient and time consuming operation. The average inventory value of the items to be stored during the screening cycle is $1,500,000.

2. Construction of Coal Storage Area 135,000

This project provides for the construction of a coal storage area for 8,000 to 12,000 tons (7,257,600 to 10,886,400 kg) to be located in the vicinity of South and Substation A Roads. The site will be graded and a layer of acid neutralizing limestone will be installed over a drainage system of field tile. This tile will drain into a new retention basin which is necessary to hold the runoff from a 4-inch (10.2 cm) rainfall. The accumulated water will be treated prior to being pumped from the basin. A pre-engineered metal building of approximately 320 sq. ft. (28 sq. m) will be included to house the water pump and chemicals. A perimeter road with security lighting is included. The current and future critical shortage of natural gas combined with the economic disadvantages of using fuel oil mandates the use of coal as heating fuel. The proposed coal storage area accommodates the proper logistics of coal, delivery, storage, and consumption. The area will provide a six months supply of coal to meet anticipated delivery contingencies.

H. Wallops Flight Center 420,000

1. Construction of Storage Shed 190,000

This project provides a prefabricated metal storage shed 100' x 150' x 14' high (30.48 m x 45.72 m x 4.26 m high). The structure will be constructed using steel columns spaced at maximum possible spans with galvanized steel panels. This shelter is urgently needed to protect portable power generating systems containing sensitive electronic voltage regulators and controls from deterioration due to continuous long-term exposure to the elements.

2. Construction of Environmental Protection for Support Equipment 230,000

This project provides for construction of a 9,120-sq. ft. (847 sq. m) metal building consisting of five bays, including a high bay with a 26-foot high (7.92 m) door. This facility will provide protection from the salt environment for the mobilized equipment used to support launch range operations.

I. Various Locations 1,245,000

1. Construction of a 9-Meter Antenna at Madrid, Spain 235,000

This project will relocate a 9-meter (30 ft.) antenna to the Madrid Station. The construction includes: antenna foundation, boresight tower foundation and guy anchors, a hydro-mechanical building, power and signal trenching, necessary road accesses, and antenna service apron. The station's grounding, fire detection/protection and electrical systems will be extended as necessary.

The project will provide a simultaneous S/Ku-band capability in the post 1979 period to support S-band and Ku-band equipped satellites. This support is required for all synchronous and elliptical orbiting spacecraft.

2. Construction of a 9-Meter Antenna at Rosman, North Carolina 245,000

This project will relocate a 9-meter (30 ft.) antenna from Carnarvon to Rosman. The construction includes: antenna foundation, boresight tower foundation and guy anchors, a hydro-mechanical building, power and signal cable trenching, neccessary road accesses, and antenna service apron. The station's grounding, fire detection/protection and electrical systems will be extended as necessary.

The requirement exists to provide the Rosman Station with a full Unified S-Band capability and a simultaneous S/Ku-band operational capability. It will also permit removal and disposal of the obsolescent dual 14-foot (4.5 m) system which currently provides S-Band command and ranging at the Rosman Station.

3. Construction of a 9-Meter Antenna at Merritt Island (MILA), Florida 140,000

This project will relocate an existing 9-meter (30 ft.) antenna at the Merritt Island (MILA) Station. The construction includes; antenna foundation, boresight tower foundation and guy anchors, a hydro-mechanical building, power and signal cable trenches, necessary road accesses, and antenna service apron. The stations grounding, fire detection/ protection and electrical systems will be extended as necessary.

The two existing 9-meter antennas at MILA are located south of the Operations Building and have their key-holes aligned in a north-south direction. To provide the versatility necessary to support missions in the shuttle era, it is proposed to move one antenna east of the Operations Building and to align its key-hole in a east-west direction. This flexibility was not necessary in the pre-shuttle era.

4. Construction of Support Facilities for Mobile Lasers, Various Locations 355,000

This project will provide for the construction of two laser sites at various sites around the world. The construction includes land clearing as necessary, road construction, erection of temporary shelters, and pouring of concrete pads for the laser tracking systems. Sanitation facilities will be included.

Each site will be managed as a separate project because of the different locations involved. The estimated cost to construct these facilities at these locations ranges from $150,000 to $200,000. This is the third increment of Laser Tracking Sites for the Laser Geodynamic Satellite (LAGEOS) projects. The first two increments were funded in FY 1975 and FY 1976.

These Laser Tracking Systems will be used in conjunction with the LAGEOS and other operational application spacecraft. They will comprise part of a global network of highly accurate tracking stations in tectonically unstable areas. By precisely tracking these spacecraft and discerning very small changes in the ranging measurements over a period, these stations will participate in the observing and analyzing of tectonic plate motions. This will contribute to man's knowledge and understanding of the earth's surface motion. The objective of this undertaking is to contribute to earthquake prediction and possible geological exploration. These sites will be occupied periodically for short periods over several years while the tracking observations are made. In this manner, a minimum of laser tracking systems will be required.

5. Construction of Antenna Service Tower at Fairbanks, Alaska 210,000

This project will provide an enclosed telescoping tower to elevate service personnel and equipment approximately 15.2 meters (50 ft.) for maintenance work on the 26-meter (85 ft.) antenna.

Maintenance work on the antenna feed box must be performed during the winter months when temperatures range as low as -51°C. Work is presently performed from a cherry picker and workers are exposed to the elements of this severe climate. The cherry picker tends to drift and is hard to control. Efficiency under these conditions is low and sometimes counter productive. A similar tower at the nearby National Oceanographic and Atmospheric Administration antenna has proven most beneficial with respect to improved efficiency and minimum down-time for repairs.

6. Construction of Flammable Storage Facility, Kauai, Hawaii 60,000

This project will provide approximately 1200 square feet (111.5 sq. m) single story masonry building and loading dock at the Hawaii Station. The station's fire detection/protection, grounding electrical systems and road access will be extended as necessary.

Space previously utilized for storage is being displaced to make room for electronic equipment and other operational functions due to the recent small antenna additions. This project is considered necessary to restore adequate space for the storage of bulk items and equipment, to centralize staging of logistics and handling of supplies and equipment now scattered throughout the station and to provide a storage area for flammable materials.

MISCELLANEOUS PROJECTS LESS THAN $50,000 EACH 625,000

TOTAL..... 5,125,000

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 1977 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

	Amount	Page No.
Regular Requirements:	5,155,000	
Master planning	200,000	CF 12-2
Engineering support	995,000	CF 12-3
Preliminary engineering reports and related engineering studies	1,110,000	CF 12-4
Final design	2,850,000	CF 12-5
Other Requirements:	7,500,000	
Shuttle facility planning and design	2,900,000	CF 12-6
Spacelab/payloads planning and design	800,000	CF 12-7
Large aeronautical facilities	3,800,000	CF 12-8
Total	12,655,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1977 ESTIMATES

PROJECT TITLE: Facility Planning and Design		
	FY 1977 CoF ESTIMATE: $12,655,000	
FY 1975: $10,900,000	FY 1976: $9,275,000	TQ: $2,500,000

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 updating of record drawings and the provision of engineering 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 $12,655,000 requested for facility planning and design for FY 1977 is composed of two major segments:

a. Regular requirements - $5,155,000

b. Other requirements - $7,500,000

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 — 5,155,000

A. Master Planning — 200,000

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 1977 are:

(1) Jet Propulsion Laboratory

A major update of the existing master plan to include facility modifications, the recent land acquisition, and the post-VIKING utilization of facilities.

(2) Kennedy Space Center

A major update to include new space-shuttle and shuttle-related facilities, revisions in utilization, and the general updating of the existing plan.

(3) Johnson Space Center

A scheduled update to include orientation to space shuttle needs and revised utilizations of facilities.

(4) Wallops Flight Center

A major update to involve consolidation of facilities and the attainment of the posture of a more efficient utilization of facilities.

B. Engineering Support 995,000

Provisions for facility studies and specific engineering support have taken on an added importance in recent years, and must continue to be given high priority throughout FY 1977. These efforts are of upmost importance due to the more unpredictable cost situation which currently exists, and cost trends in construction materials, fuels, 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 1977 requirements.

(1) Building Research and Advisory Board Support

This covers annual support to the Federal Construction Counsil (FCC) operations and provides for special studies that this Council will perform throughout FY 1977 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 functioning of the Agency-wide construction specification system which combines a catalog of preapproved standard construction specifications on magnetic tape and a computer software program for selective retrieval and taped printouts of bid specifications.

(4) Engineering Handbook Update

The Facilities Engineering Handbook is a document prepared by Headquarters to guide the field installations on a standardized approach to facilities engineering. These handbooks are used as a source of basic policy and criteria for all in-house engineering as well as work done by architectural-engineering firms. Since new criteria is constantly being developed and/or revised, the handbook must accordingly be modified on a progressive basis.

(5) 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.

(6) Energy Reduction Analysis and Support

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, coincident with the validation of an energy computer modeling program. This project will provide instrumentation and computer modeling at selected Centers and expand the types of structures being validated. 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.

C. Preliminary Engineering Reports and Related Engineering Studies — 1,110,000

(1) Preliminary Engineering Reports (PER's) — (740,000)

Preparation of PER's, investigations, and project studies related to proposed facility projects to be included in the FY 1979 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

non-space shuttle construction involving an estimated cost of $25 million to $30 million of construction for which updated PER's will be needed and with new projects estimated to cost $25 million to $30 million for which completed new PER's will be required.

(2) Related Engineering Studies (370,000)

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 2,850,000

The amount requested will provide for the preparation of designs, plans, drawings and specifications necessary for the accomplishment of non-space shuttle facility projects, primarily those which are planned for inclusion in the FY 1978 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 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 7,500,000

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 2,900,000

(1) Shuttle Facilities Studies and Preliminary Design (390,000)

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 1979 Construction of Facilities program. This preliminary work is predominantly associated with future construction for that year now estimated to cost approximately $50-55 million and which is to be carried out in relation to Space Shuttle unique projects such as:

(a) Launch and Landing Facilities

Additional studies will be conducted and PER's will be implemented involving modification of existing facilities, to satisfy launch control and mission control requirements at the Kennedy Space Center and Johnson Space Center, respectively, and the construction and modification of facilities at the launch site to support the increased flight rates planned for the operational phase. These higher rates will place demands on ground support equipment which was, in many cases, designed to support the less frequent launches of the Apollo program. In order to understand the extent and impact of this increased demand, additional studies must be undertaken. In addition, several projects which were provided for in previous years require additional study to investigate and resolve problems which have emerged as programmatic testing and design have been completed. Examples of emerging problems are those connected with higher sound levels at the launch pad, total integration and insertion of the payload, and emergency egress from the launch pad and Orbiter.

(b) Solid Rocket Booster and External Tank Facilities

Studies and PER's will be continued toward modifying existing facilities or providing added capabilities for Solid Rocket Booster production as they relate to satisfying increased production requirements. As in the launch facilities, additional requirements may be emerging in relation to production of the external tank. The requirements must be studied to determine appropriate facility solutions which may have an impact on projects previously provided for. An example of an emerging problem is the need for additional facilities to support increased thermal protection being applied to the external tank.

The cost of these related studies is estimated at $150,000 and the estimated cost of preparing preliminary engineering reports (PER's) is $240,000.

(2) Shuttle Facilities Final Design (2,510,000)

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 $60-65 million and which may be included in an FY 1978 Construction of Facilities request. The final design costs relating to the proposed FY 1978 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 second phase of the launch and landing facilities at Kennedy Space Center required to support the higher launch rates of the operational phase. Facilities for which projects are forecast during 1978 include modification to the second launch pad, mating integration and checkout facilities, and development of logistics support facilities. Also included is design for enlargement of external tank production facilities at Michoud Assembly Facility (MAF) required to support the greater production rates.

B. Spacelab Payloads Planning and Design 800,000

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 specialized or functionalized activities. In addition, requirements for facilities to support ground control of payload missions must be assessed. The facilities considered for construction are now estimated to cost $10 million to $15 million and will be needed in the FY 1978 and subsequent Construction of Facilities programs. The cost of these studies and preliminary engineering effort required in FY 1977 is estimated at $250,000 and the final design is estimated at $550,000.

C. Large Aeronautical Facilities Planning and Design — 3,800,000

(1) Final Design for National Transonic Facility — (3,400,000)

This planning is required for obtaining final facility design relating to the construction of a National Transonic Facility (NTF) with 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 number 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 requirement. It will also permit separation of Reynolds number effects from aeroelastic effects, a capability unattainable in any known existing wind tunnels.

An initial $2,100,000 has been funded for engineering studies to more fully define operating conditions and cost parameters and to initiate final design. Included in NASA's Construction of Facilities request for FY 1977 is a project for $25 million to initiate procurement of the long-lead time items for the NTF. It is planned that NASA will request some $40 million to complete the construction of this National Transonic Facility in following future years programs. It is anticipated that this request will complete all the facility planning and design work for the NTF.

(2) Final Design for Modification of the 40 x 80-Foot Subsonic Wind Tunnel (Phase II - Addition of 80 x 120-Foot Test Section Leg) — (400,000)

This project has been divided into two phases: (a) Repowering; and (b) Addition of 80 x 120-Foot Test Section Leg. The final design of the repowering phase has been funded and a major portion of the design is complete. A total of $1,810,000 has been funded for engineering studies, final design of the repowering phase, and for preliminary design of the new test section addition.

This request is for $400,000 and will provide for acoustic studies to determine the most cost-effective approach to be used in the design of the acoustic baffle system for the new test section addition and to continue with some final design of the new test section addition.

It is planned that NASA will request some $44 million for the repowering phase and approximately $50 million for the addition of the new test section leg in future year's programs. It is anticipated that an additional $1.2 million of Facility Planning and Design funds will be required in a future year to complete all the facility planning and final design work for the addition of the new test leg.

Total.....	12,655,000