National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR 1981

Volume II

Construction of Facilities

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CONTENTS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL, YEAR 1981 ESTIMATES

TABLE OF CONTENTS

VOLUME II

	Page No.
General Statement	SUM 1
Appropriation language (proposed)	SUM 2
Program and financing schedule	SUM 3
Summary of budget plan by location	SUM 4
Summary of budget plan by cognizant office	SUM 5
Summary of budget plan by subfunction	SUM 5
Summary of budget plan by location and project	SUM 6
Geographic location of NASA installations	SUM 10
Capitalized value of NASA facilities	SUM 11
Justification by Location:	
Ames Research Center. Moffett Field. California	CF 1
Jet Propulsion Laboratory. Pasadena. California	CF 2
John F. Kennedy Space Center. Kennedy Space Center. Florida	CF 3
Langley Research Center. Hampton. Virginia	CF 4
Lewis Research Center. Cleveland. Ohio	CF 5
Michoud Assembly Facility. New Orleans. Louisiana	CF 6
Various Locations	CF 7

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	Page No.
Space Shuttle Facilities	CF 8
Space Shuttle Payload Facilities	CF 9
Repair	CF 10
Rehabilitation and Modification	CF 11
Minor Construction	CF 12
Facility Planning and Design	CF 13

SUMMARY
INFORMATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

The Construction of Facilities (CoF) appropriation provides for contractual services for repair, rehabilitation and modification of existing facilities; the construction of new facilities; the acquisition of related facility equipment; the design of facilities projects and advance planning related to future facilities needs.

The funds requested for 1981 provide for: the continuation of prior years' endeavors in meeting the facilities requirements for the Space Shuttle and Space Shuttle payloads; construction and modification of aeronautical research and development facilities; repair, rehabilitation, and modification of other facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; minor construction of new facilities; and facility planning and design activities.

The projects and amounts reflected in this budget estimate for Space Shuttle and Space Shuttle payloads are time sensitive to meet specific milestones. In addition, the program for 1981 includes the construction of a Man-Vehicle System Research Facility at the Ames Research Center and modification to the Aircraft Landing Dynamics Facility at the Langley Research Center.

The FY 1981 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and to ensure safe economical and efficient use of the NASA physical plant. This request continues the necessary Rehabilitation and Modification Program as in prior years and continues a Repair program. The purpose of the Repair program is to restore facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. This program also includes projects which continue NASA efforts to reduce the consumption of energy.

Funds requested for facility planning and design cover advance planning and design requirements for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

The request for FY 1981 is $120,000,000, a decrease of $36,100,000 below the appropriation for FY 1980. Outlays are estimated to be $163,000,000 in FY 1981, an increase of $7,800,000 over the estimate for FY 1980.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION LANGUAGE

CONSTRUCTION OF FACILITIES

For construction, repair, 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, [$156,100,000] *$120,000,000*, to remain available until September 30, [1982] *1983: 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 repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and facility planning and design. *(42 U.S.C. 2451, et. seq.; Department of Housing and Urban Development—Independent Agencies Appropriation Act, 1980; additional authorizing legislation to be proposed.)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars)

Identification code 80-0107-0-1-999	Budget plan (amounts for construction cl facilities actions programed)			Costs and obligations		
	1979 actual	1980 ut	1981 est	1979 actual	1980 est	1981 est
Program by activities:						
Direct program:						
1. Space transportation systems	31,070	27,750	10,100	41,029	43,600	29,700
2. Scientific investigations in space		4,250	1,617	5,215	2.800	3,400
3. Space and terrestrial applications				2,225	800	500
4. Space research and technology				116		
5. Aeronautical research and technology	76,530	62,500	45,291	43,047	69,800	61,300
7. Supporting activity	39,900	61,600	62,992	45,366	48,800	58,400
Total direct program	147,500	156,100	120,000	136.998	165,800	153,300
Reimbursable program:						
1. Space transportation systems	251	12,000	2,000	251	3,636	7.700
5. Aeronautical research and technology	1,550	1,600	4,000	5	2,030	2,000
7. Supporting activity	923	3,400	5,000	5,034	4,934	3,500
Total reimbursable program	2,724	17.000	11.000	5,290	10.600	13,200
Total program costs, funded				142.288	176,400	166,500
Change in selected resources (undelivered orders)				4,658	2,000	−10,600
10.00 Total	150,224	173,100	131,000	146.946	178.400	155,900
Financing:						
11.00 Offsetting collections from Federal funds	−2,724	−17,000	−11,000	−2,724	−17,000	−11,000
21.40 Unobligated balance available, start of year: For completion of prior year budget plans:						
Direct				−93,356	−95,501	−88,601
Reimbursable				−823	−2,676	−4,276
22.40 Unobligated balance transferred from other accounts				−680		
24.40 Unobligated balance available, end of year: For completion of prior year budget plans:						
Direct				95,501	88.601	65,201
Reimbursable				2,676	4,276	2,776
25.00 Unobligated balance lapsing				63		
Unobligated balance restored				−103		
40.00 Budget authority (appropriation)	147,500	156,100	120,000	147,500	156,100	120,000
Relation of obligations to outlays:						
71.00 Obligations incurred, net				144,222	161,400	144,900
72.40 Obligated balance, start of year				128,061	139,535	146,035
74.40 Obligated balance, end of year				−139,535	−146,035	−127,935
77.00 Adjustments in expired accounts				−32		
90.00 outlays				132,716	154.900	163,000

Note.—Reconciliation of budget plan to obligations:

	1979 actual	1980 estimate	1981 estimate
Total budget plan	150.224	173.100	131.000
Deduct portion of budget plan to be obligated in subsequent years	62.885	54.200	32.600
Add obligations of prior year budget plans	59.607	59.500	51.500
Total obligations	146 946	178 400	155900

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY OF BUDGET PLAN BY LOCATION

Location	FY 1979	FY 1980 (In Dollars)	FY 1981
Ames Research Center	9,770,000	2,9[illegible]0,000	13,189,000
Goddard Space Flight Center	5,640,000	---	---
Jet Propulsion Laboratory	4,630,000	---	3,500,000
Lyndon B. Johnson Space Center	---	1,7[illegible]6,000	---
John F. Kennedy Space Center	---	2,8[illegible]1,000	760,000
Langley Research Center	6,500,000	7,9[illegible]8,000	22,756,000
Lewis Research Center	6,140,000	5,7[illegible]2,000	12,355,000
George C. Marshall Space Flight Center	---	3,5[illegible]4,000	---
Michoud Assembly Facility	---	3,1[illegible]0,000	4,5[illegible]2,000
Wallops Flight Center	---	1,1[illegible]0,000	---
Large Aeronautical Facilities	56,100,000	45,9[illegible]0,000	---
Various Locations	---	---	2,150,000
Space Shuttle Facilities	31,070,000	27,750,000	10,100,000
Space Shuttle Payload Facilities	---	4,250,000	1,617,000
Repair	---	12,000,000	15,000,000
Rehabilitation and Modification	12,800,000	19,790,000	20,000,000
Minor Construction	4,200,000	3,500,000	4,000,000
Facility Planning and Design	10,650,000	14,000,000	10,000,000
Total Plan	147,500,000	156,100,000	20,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

	FY 1979	FY 1980 (In Dollars)	FY 1981
SUMMARY OF BUDGET PLAN BY COGNIZANT OFFICE			
Office of Space Transportation Systems	31,070,000	27,750,000	10,100,000
Office of Space Science	---	4,250,000	1,617,000
Office of Aeronautics and Space Technology	76,830,000	92,500,000	45,291,000
Office of Space Tracking and Data Systems	---	---	2,150,000
Office of Management Operations	7 920 000	---	---
Office of the Comptroller	32,280,000	91,600,000	60,842,000
Total	147,500,000	156,100,000	120,000,000

SUMMARY OF BUDGET PLAN BY SUBFUNCTION

Code No.	Title	FY 1979	FY 1980	FY 1981
253	Space Flight	31,070,000	27,750,000	10,100,000
254	Space Science, Applications and Technology	---	4,250,000	1,617,000
255	Support Space Activities	39,900,000	61,600,000	62,992,000
(250)	Subtotal, General Science, Space and Technology	70,970,000	93,600,000	74,709,000
402	Air Transportation	76,530,000	62,500,000	45,291,000
	Total	147,500,000	156,100,000	120,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

BUDGET PLAN BY LOCATION AND PROJECT

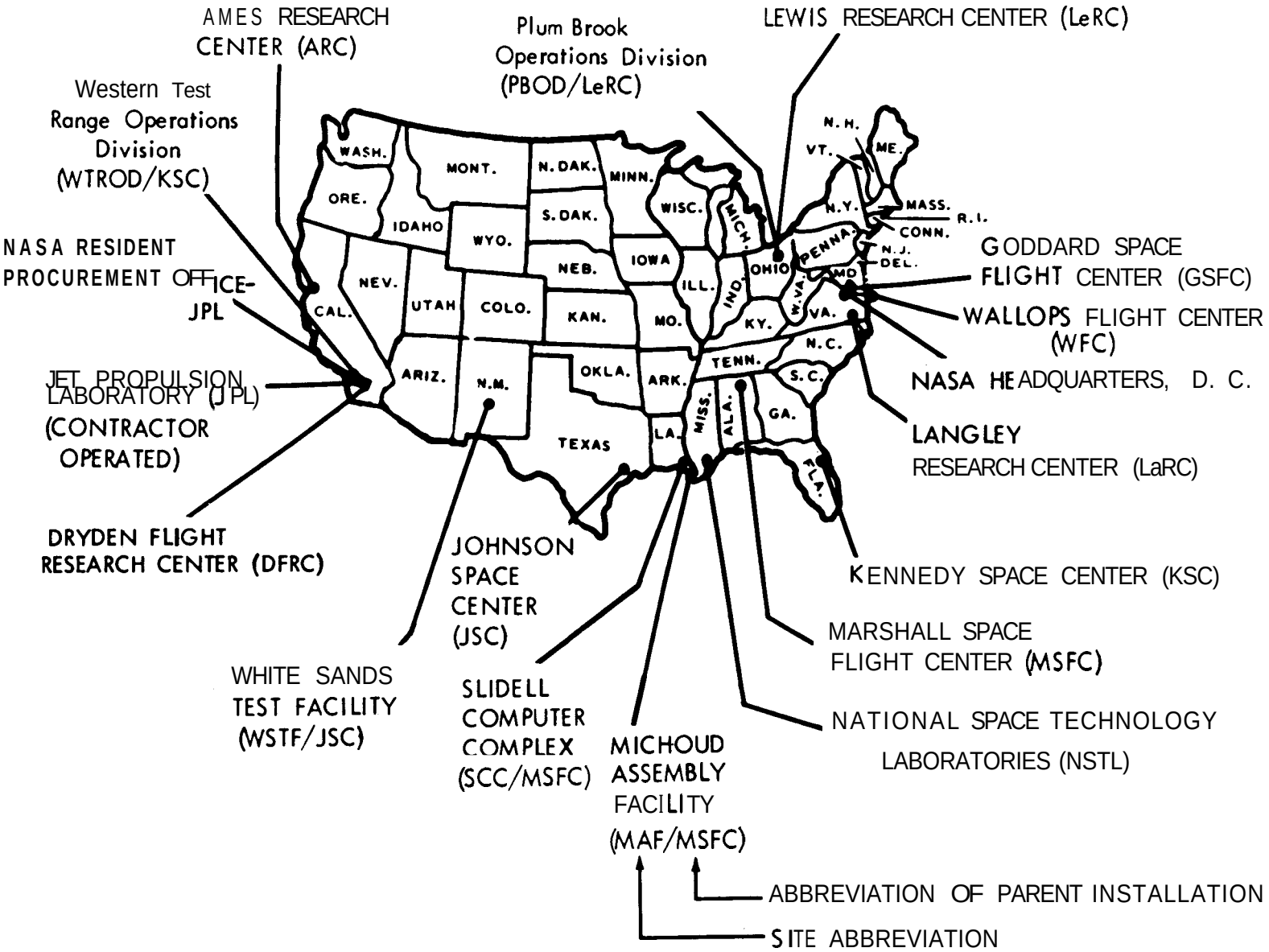
Cognizant Office	Budget Activity	Subfunction Code	Installation and Proiect	FY 1979	FY 1980	FY 1981	Page No.
				(In thousands of dollars)			
			Ames Research Center	9,770	2,900	13,180	
AST	5	402	Construction of Man-Vehicle Systems Research Facility	---	---	7,480	CF 1-1
AST	5	402	Modification of Steam Ejector System and Thermal Protection Laboratory (N-234).....	---	---	2,300	CF 1-9
AST	5	402	Modification of the Unitary Plan Wind Tunnel (N-227).	5,390	---	3,400	CF 1-17
AST	5	402	Modification of Static Test Facility (N-249).....	---	2,900	---	
AST	5	402	Modification of 3.5-Foot Wind Tunnel.....	1,870	---	---	
AST	5	402	Modification of 12-Foot Pressure Wind Tunnel.	2,510	---	---	
			Goddard Space Flight Center	5,640	---	---	
MGMT OPS	7	255	Modifications and Additions for Logistic and Supply Facilities	5,640	---	---	
			Jet Propulsion Laboratory	4,630	---	3,500	
COMP	7	255	Modifications to Various Buildings for Energy Conservation.....	---	---	1,500	CF 2-1
COMP	7	255	Modifications to Various Buildings for Seismic Protection.....	1,570	---	2,000	CF 2-6
COMP	7	255	Modifications and Addition to the Space Flight Operations Facility.....	3,060	---	---	
			Lyndon B. Johnson Space Center	---	1,760	---	
COMP	7	255	Rehabilitation and Modification of Flight Operations Facilities, Ellington AFB.....	---	1,760	---	

Cognizant Office	Budget Activity	Subfunction Code	Installation and Project	FY 1979	FY 1980	FY 1981	Page No.
				(In thousands of dollars)			
			John F. Kennedy Space Center	---	2,810	760	
COMP	7	255	Rehabilitation of High Temperature Hot Water System, Zone 2, Industrial Area	---	---	760	CF 3-1
COMP	7	255	Modifications to the Central Instrumentation Facility	---	1,260	---	
COMP	7	255	Modifications to the Operations and Checkout Building	---	950	---	
COMP	7	255	Rehabilitation of Roof, Launch Control Complex	---	600	---	
			Langley Research Center	6,500	7,980	22,756	
AST	5	402	Modifications for Avionics Integration Research Laboratory (1220)	---	---	5,756	CF 4-1
AST	5	402	Modifications to Aircraft Landing Dynamics Facility (1257)	---	---	15,000	CF 4-8
AST	5	402	Rehabilitation and Modification of Gas Dynamics Laboratory (1247)	---	3,600	2,000	CF 4-17
AST	5	402	Modifications of Model Support System 8-Foot High Temperature Structures Tunnel (1265)	---	1,410	---	
AST	5	402	Modification of Transonic Dynamics Tunnel	---	970	---	
AST	5	402	Modifications to 8-Foot Transonic Pressure Tunnel (640)	---	2,000	---	
MGMT OPS	7	255	Modifications for Utility Control System	1,980	---	---	
AST	5	402	Rehabilitation of Unitary Plan Wind Tunnel	4,520	---	---	
			Lewis Research Center	6,140	5,720	12,355	
COMP	7	255	Decommissioning of Plum Brook Station Reactor Facility	---	---	3,000	CF 5-1
AST	5	402	Modifications to Central Air System, Various Buildings	---	5,720	7,655	CF 5-10
AST	5	402	Rehabilitation of Electrical Switchgear, Engine Research Building (5)	---	---	1,700	CF 5-21
AST	5	402	Construction of Research Analysis Center	6,140	---	---	

Cognizant Office	Budget Activity	Subfunction Code	Installation and Project	FY 1979	FY 1980	FY 1981	Page No.
				(In thousands of dollars)			
			George C. Marshall Space Flight Center	---	3,540	---	
COMP	7	255	Modifications to Various Buildings.....	---	2$640	---	
COMP	7	255	Rehabilitation of Roofs, Various Buildings.....	---	900	---	
			Michoud Assembly Facility	---	3,100	4,582	
COMP	7	255	Rehabilitation of Roof, Phase II, Building 103.....	---	---	3,800	CF 6-1
COMP	7	255	Rehabilitation of Chilled Water System.....	---	---	782	CF 6-6
COMP	7	255	Rehabilitation of Roof, Phase I, Building 103.....	---	3,100	---	
			Wallops Flight Center	---	1,100	---	
COMP	7	255	Construction of Facilities Operations Shop Building..	---	1,100	---	
			Various Locations	---	---	2,150	
ST&DS	7	255	Modification of 26-Meter Antenna, DSS-44, Canberra, Australia (JPL).....	---	---	1,200	CF 7-1
ST&DS	7	255	Replacement of Azimuth Radial Bearing, DSS-14, Goldstone, CA (JPL).....	---	---	950	CF 7-5
			Large Aeronautical Facilities at Various Locations as Follows:	56,100	45,900	---	
AST	5	402	Construction of National Transonic Facility (LaRC)...	24,500	12,000	---	
AST	5	402	Modification of 40- by 80-Foot Subsonic Wind Tunnel (ARC).....	31,600	33,900	---	
			Space Shuttle Facilities at Various Locations as Follows:	31,070	27,750	10,100	
STS	1	253	Modification of Manufacturing and Final Assembly Facilities for External Tanks (MAF).....	13,980	6,900	5,400	CF 8-4
STS	1	253	Modifications to Solid Rocket Motor Manufacturing and Assembly Facilities, Thiokol Plant, Wasatch, Utah.....	1,920	---	2,700	CF 8-14

Cognizant Office	Budget Activity	Subfunction Code	Installation and Project	FY 1979	FY 1980	FY 1981	Page No.
				(In thousands of dollars)			
			Space Shuttle Facilities at Various Locations as Follows: (Cont'd)				
STS	1	253	Minor Shuttle-Unique Projects (Various Locations).....	1,600	2,500	2,000	CF 8-28
STS	1	253	Modifications to Crawler Transporter Maintenance Facility (KSC).....	---	1,250	---	
STSA	1	253	Modifications to Launch Complex 39 (KSC).....	13,570	17,100	---	
			Space Shuttle Payload Facilities at Various Locations as Follows:	---	4,250	1,617	
SS	2	254	Rehabilitation and Modification for Payload Ground Support Operations (KSC).....	---	2,610	1,617	CF 9-1
SS	2	254	Modification of an Addition to Materials Sciences Laboratory (N-240) (ARC).....	---	1,640	---	
COMP	7	255	Repair of Facilities at Various Locations, Not in Excess of $500,000 per Project.....	---	12,000	15,000	CF 10-1
COMP	7	255	Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of $500,000 per Project.....	12,800	19,790	20,000	CF 11-1
COMP	7	255	Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations, Not in Excess of $250,000 per Project.....	4,200	3,500	4,000	CF 12-1
COMP	7	255	Facility Planning and Design.....	10,650	14,000	10,000	CF 13-1
			TOTAL.....	147,500	156,100	120,000	

LOCATION OF NASA MAJOR AND COMPONENT INSTALLATIONS



RECORDED VALUE OF CAPITAL TYPE PROPERTY
IN-NOUSE AND CONTRACTOR-HELD
AS OF SEPTEMBER 30, 1979
(IN THOUSANDS)

Reporting Installation	Real Property: Land	Real Property: Buildings	Real Property: Other Structures and Facilities	Real Property: Leasehold Improvements	Real Property: Total	Equipment	Fixed Assets in Progress	Grand Total
Ames Research Center	$ 2,928	$ 213.479	$ 9.374	$ -0-	$ 225.781	$ 165,781	$ 56.247	$ 447.809
ARC-Moffett Field, Ca.	2,928	213.479	9.374	-0-	225,781	160,997	56,247	443,025
Various locations (a)	-0-	-0-	-0-	-0-	-0-	4.784	-0-	4.784
Dryden Flight Research Center	-0-	14.447	6.804	-0-	21,251	63.564	3,095	87.910
DFRC - Edwards AFB, Ca.	-0-	14.447	6,804	-0-	21.251	60,059	3,095	84.405
Various Locations (a)	-0-	-0-	-0-	-0-	-0-	3,505	-0-	3,505
Goddard Space Plight Center	1.706	101.711	58.174	-0-	161.591	511.020	19.555	692.166
GSFC-Greenbelt, Md.	1,353	85.994	16.939	-0-	104.286	241,690	14.224	360,200
Tracking Stations (Networks)	353	15.716	41,190	-0-	57,259	233.344	5,331	295,934
Various Locations (a)	-0-	1	45	-0-	46	35,986	-0-	36,032
Jet Propulsion Laboratory	1.188	89.871	67.578	534	159.171	233.821	19.408	412.400
JPL - Pasadena, Ca.	1,188	78,461	11,840	534	92.023	155,360	19.408	266.791
Deep Space Network	-0-	11,410	55,738	-0-	67,148	78,461	-0-	145.609
Johnson Space Center.	9.107	195,875	61.925	-0-	266.907	442.347	24.623	733.877
JSC - Houston, Tx.	5,537	160.127	35.389	-0-	201.053	373,547	19,701	594,301
White Sands Test Facility WSTS-Las Cruces. N.M.	-0-	9,455	20,979	-0-	30,434	20,149	-0-	50.583
Various locations (a)	3,570	26,293	5,557	-0-	35,420	48,651	4.922	88,993
Kennedy Space Center	71,345	349,073	330.677	-0-	751.095	967.416	117.914	1,836,425
KSC - Cape Canaveral, Fal.	71,345	349,073	330,677	-0-	751,095	962,507	117,914	1,831,516
Western Test Range Operations Oiv. WTROD - Lompoc, Ca.	-0-	-0-	-0-	-0-	-0-	3,820	-0-	3.820
Various locations (a)	-0-	-0-	-0-	-0-	-0-	1,089	-0-	1,089
Langley Research Center	162	147.434	217.582	-0-	365.178	183.710	17.665	566.553
LARC - Hampton, Va.	156	133.034	217,506	-0-	350,696	169,476	17,665	537.837
Various locationa (a)	6	14.400	76	-0-	14.482	14,234	-0-	28.716
Lewis Research Center	2,230	209,128	76,377	136	287,871	143,194	17,971	449,036
LERC - Cleveland. Oh.	316	132.778	57,963	136	191,193	113,452	17,971	322.616
Plumbrook Operations Division PBOD - Sandusky, Oh.	1,914	76.350	18,414	-0-	96,678	15,238	-0-	111.916
Various Locations	-0-	-0-	-0-	-0-	-0-	14,504	-0-	14.504
Marshall Space Plight Center	1.157	200.979	130.147	-0-	338.283	396,707	3.522	738,512
MSFC - Huntsville, Al.	-0-	124.910	62.888	-0-	187.798	268,770	3,522	460.090
Michoud Assembly Facility MAF - New Orleans. La.	7.092	66.918	54.540	-0-	128,550	25,863	-0-	154.413
Slidell Computer Complex SCC-Slidell, La.	65	5,004	2,041	-0-	7,110	11,208	-0-	18,318
Various Locations (a)	-0-	4,147	10,678	-0-	14,825	90.866	-0-	105,691
National Space Technology Labs. NSTL - NSTL Station, Ms.	18.061	68.629	194.294	-0-	280.984	29,296	-0-	310.280
Wallops Plight Center	1.305	26.585	52.899	-0-	80.789	56.015	5.083	141,887
WFC - Wallops Inland. Vs.	1,305	26,585	52,899	-0-	80,789	53,929	5,083	139 801
Various Locations (a)	-0-	-0-	-0-	-0-	-0-	2,086	-0-	2 086
NASA Headquarters	-0-	-0-	-0-	-0-	-0-	17,807	6,644	24,451
Washington, D. C.	-0-	-0-	-0-	-0-	-0-	4,555	6,644	11.199
Various locations (a)	-0-	-0-	-0-	-0-	-0-	13,252	-0-	13.252
TOTAL	$ 115.189	$1,617,211	$ 1,205,831	$ 670	$ 2,938,901	$3,210,678	$291.727	$6,441,306

(a) Includes Property in possesion of Contractors at Various Locations

JUSTIFICATION
BY LOCATION

AMES RESEARCH
CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

AMES RESEARCH CENTER

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Construction of Man-Vehicle Systems Research Facility	7,480,000	CF 1-1
Modification of Steam Ejector System and Thermal Protection Laboratory (N-234)	2,300,000	CF 1-9
Modification of the Unitary Plan Wind Tunnel (N-227)	3,400,000	CF 1-17
Total	13,180,000	

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
CONSTRUCTION OF MAN/VEHICLE SYSTEMS RESEARCH FACILITY
LOCATION PLAN

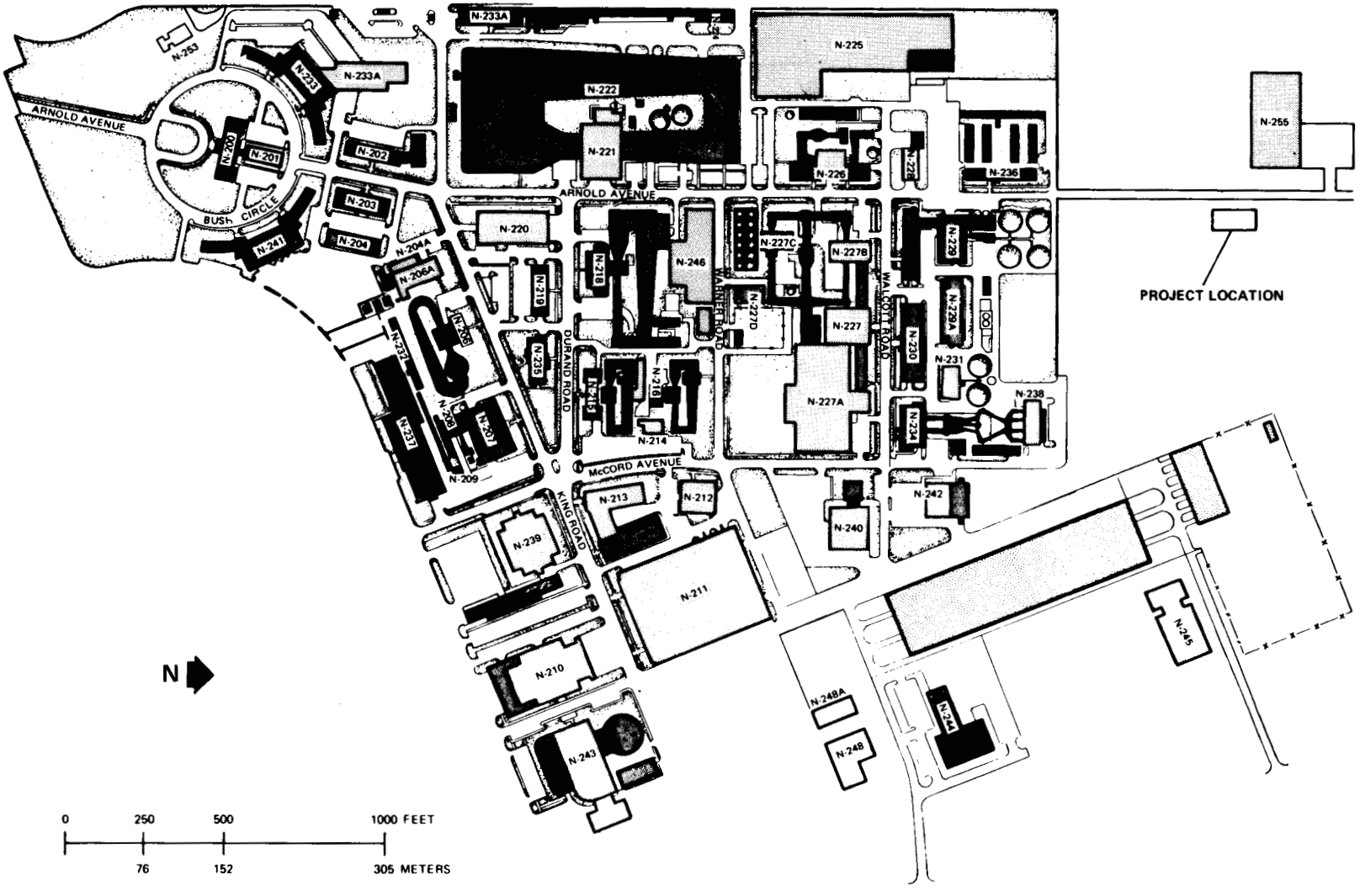


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Construction of Man- icle Systems Research Facility

INSTALLATION: Ames Research Center

FY 1981 CoF ESTIMATE: $7.480.000

LOCATION OF PROJECT: Ames Research Center

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding	700,000	---	700,000
Capitalized Investment	N/A	---	---
Total	700.000	---	700,000

SUMMARY PURPOSE AND SCOPE:

Construction of the Man-Vehicle Systems Research Facility at Ames Research Center (ARC) will provide a vital research capability which will satisfy a national requirement for aeronautical human factors research. It will be the only such facility that will provide ground test simulation of multiple aircraft (two with full crews), terminal area Air Traffic Control (ATC), air crew interactions, and advanced technology cockpit displays technology representative of future generations of aircraft and all within the full-mission context. By providing a high degree of operational fidelity, the facility will permit meaningful research on critical human factors such as fundamental analytical models for the functional and physical characteristics of both the air crew and the ground crew; the formulation of design criteria and principles, from the human factors perspective

appropriate to flight systems and operational environments of the future; the integration of new subsystems and procedures such as electronic displays, and automated avionics and controls into contemporary flight and traffic control scenarios; and, new training methodologies and principles which will be required by the introduction of increasing levels of systems automation and integration.

PROJECT:

It is estimated that human error is responsible for or a contributing factor in 60-80% of all domestic aircraft accidents. Aviation is on the verge of a revolution in air and ground operations which with adequate human factors research input has the potential for eliminating many causes of these human errors. This proposed facility will significantly contribute to the design and operational use of cockpits of future generations of domestic aircraft and to the overall aviation system.

In the near future, based on current technology trends, aircraft cockpits will be very different from those in use today. The new cockpits will have integrated electronic displays instead of the individual electromechanical displays now used. These displays will be capable of providing the air crew with much more information concerning the air traffic in the immediate vicinity than present instruments. They will be more automated and are likely to be designed for specific members of the flight crew instead of being duplicated, as at present, for the pilot and copilot. New technology will provide the air crew with more information and control for maintaining positive separation from other aircraft. Research is required to determine the potential impact of this new technology on the total aviation system from the perspective of human information processing and cockpit/ground interactions.

The Federal Aviation Administration (FAA) has, requested that NASA give special attention to the integration of advanced technology systems into the cockpit'. The Air Transport Association (ATA) also has requested that NASA undertake a major program to examine advanced cockpit displays. In addition, the Congressional Subcommittee on Transportation, Aviation and Weather, in its final report #98-796, dated November 1977, from the hearings on "The Future Needs and Opportunities in the Air Traffic Control System", recommended a ". . . joint effort between the FAA and NASA in examining the capabilities and limitations of cockpit displays of traffic information. . . (and in) examining human factors problems related to distributive management concepts." It also recommended that ". . . NASA conduct a study directed toward identifying which of the pilot functions can and should be automated."

More recently, the Secretary of Transportation and the Administrator of the Federal Aviation Administration announced a wide ranging air-safety program that includes near term implementation of new equipment and air traffic control procedures for many of the Nation's airports and air routes. Also projected were future studies of both hardware and procedural protocols that may significantly affect air-to-air and air-to-ground

interactions. Research facilities, such as the one requested here, are needed to fully develop and evaluate these concepts under demanding but controlled conditions.

The Man-Vehicle Systems Research Division at ARC has been involved in a wide variety of research activities that are related to these issues. Among these are studies of control and monitoring behavior, head-up display utilization, cockpit displays of traffic information, the Aviation Safety Reporting System, resource management training, work load measurement and full-mission simulations. A recent full-mission simulation has shown that performance of crew members may deteriorate under high work load and abnormal flight conditions in ways that are not predictable from normal operating conditions and conditions of reduced workload. This has emphasized the need for high fidelity in simulation and for the capability to conduct full-mission simulations of relevant aircraft operations. These requirements are particularly compelling for the human factors research including (1) information requirements for all-electronic advance displays, (2) interaction and distribution of responsibility between aircrew and ground controllers, and (3) the automation of pilot and aircrew functions.

IMPACT OF DELAY:

Human error is responsible for or a contributing factor in 60-80 percent of all domestic aircraft accidents. Because no facility currently exists to integrate all of the critical human factor research involved in aircraft control, it is essential that this project be started as soon as possible.

PROJECT:

Building

The building will consist of a high bay portion housing simulator, controls, shop support and mechanical equipment room; and an adjoining one-story wing containing computer rooms, support space, conference room, programming area, toilets and janitor room. The entire structure encloses an area of 11,000 square feet (1,022 square meters) plus an additional 2,300 square feet (214 square meters) at mezzanine level in the high bay portion (Figure 1). The building will be structural steel framing with first floor slab on grade (slab depressed at computer floor areas), and second floor (mezzanine) and roof to be steel decking with a concrete fill.

Advanced Technology Aircraft Cockpit

The advanced technology aircraft cockpit consists of four basic elements: cab, in-flight controls, flight displays and visual scene. The advanced technology cab will be representative of future generations of transport aircraft. The cab will be a totally enclosed shell and will accommodate a pilot, copilot, flight engineer, and an observer. This cab will also be equipped with a visual scene generator capable of depicting both day

and night scenes, other aircraft and special visual conditions representative of fog, clouds, and other meteorological conditions. This visual system will allow the experimenter to recreate and control visual as well as operational workload which is a capability of particular importance in many of the proposed research applications. The cockpit will be provided with a full complement of panels, switches and controls to provide fully outfitted positions for a crew of three.

Current Technology Cockpit

The current technology cockpit will consist of a cab, the frame and shell of which will be identicial to that of the advanced technology cockpit, but equipped to represent the current generation wide-body aircraft with a flight engineer's station and flight display and control systems virtually identical to those of a representative operational aircraft. This cab will be equipped with a visual display system.

Terminal Area Air Traffic Control Facility

A functional representation of an Air Traffic Control (ATC) facility will comprise an important element in the overall facility. An existing ATC system will be coupled with a new dedicated computer system to provide long duration, full-mission simulation studies. This project will provide a new dedicated mini-computer to perform overall functions of terminal air traffic modeling and traffic generation in support of this existing ATC system (Figure 2).

Other Equipment and Capability

The facility will include audio, video and intercommunication systems so that realistic speech and cockpit noise environments can be recreated for the flight and ground crews. These systems will also make it possible for the experimenters and simulator operators to communicate efficiently with one another and with flight and ground crews. Experimenters' stations for the control and monitoring of the simulation will be provided, as will be a computer-controlled equipment test system. This latter system, which will test and monitor all the major facility systems, is necessary to ensure a level of system reliability high enough to satisfy the requirements of full mission research.

PROJECT COST ESTIMATE:

This cost estimate is based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1,200,000
Site development and utilities (outside of 5' line)	LS	---	---	210,000
Structural/architectural	SF	13,300	43.20	575,000
Mechanical/electrical	SF	13,300	31.20	415,000
Equipment	---	---	---	6.280 ,000
Advanced technology aircraft cockpit	LS	---	---	2,825,000
Current technology cockpit	LS	---	---	1,870,000
Terminal area air traffic control station	LS	---	---	325,000
Other equipment	LS	---	---	1,260,000
Audio, video, intercommunication equipment	LS	---	---	(625,000)
Simulation test and control stations	LS	---	---	(635,000)
Fallout Shelter (not feasible)	---	---	---	---
Total				7.480.000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Equipment Layout

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE COF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Additional visual equipment and a fundamental human factors research area for part task, part mission investigations not requiring full mission simulation are under study for future year requirements.

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
CONSTRUCTION OF MAN/VEHICLE SYSTEMS RESEARCH FACILITY

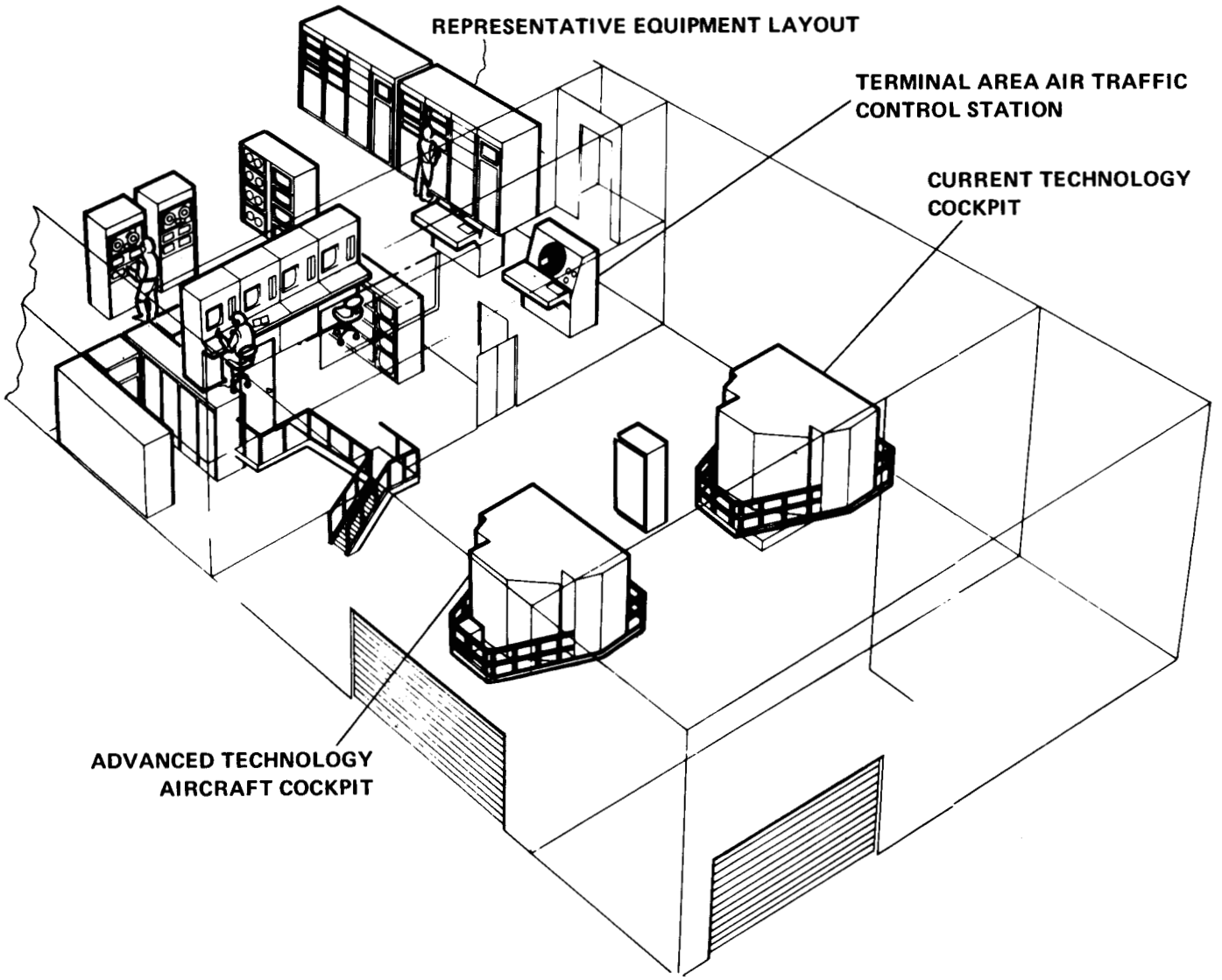


FIGURE 2

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION OF STEAM EJECTOR SYSTEM
LOCATION PLAN

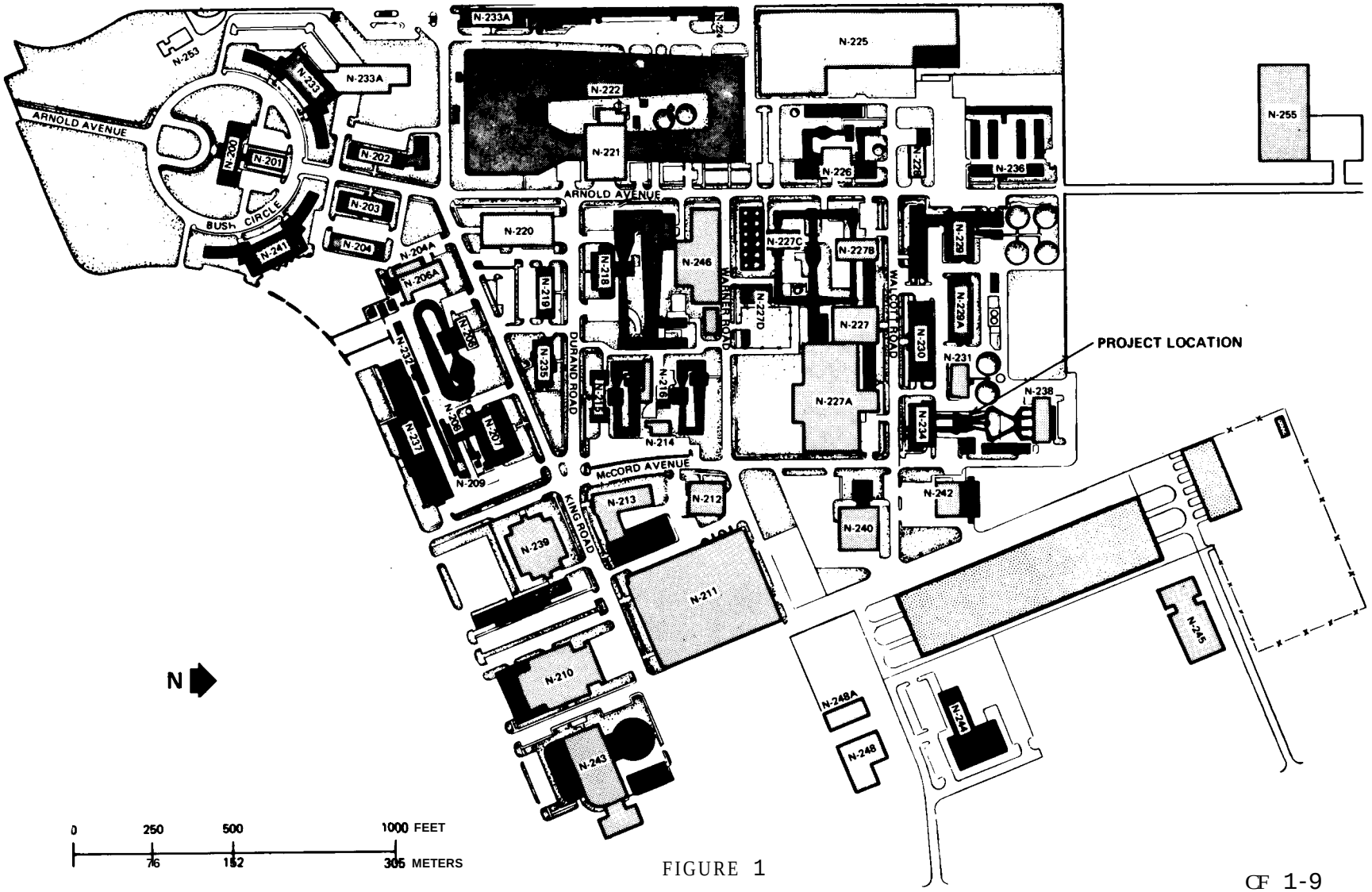


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modification of Steam Ejector System and Thermal Protection Laboratory (N-234)

INSTALLATION: Ames Research Center

FY 1981 CoF ESTIMATE: $2,300,000

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

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding.	234,000	1,040,000	1,274,000
Capitalized investment.....	N/A	*17,927,426	17.927.426
Total.....	214.000	18.967. 426	19.20 1.426

*Value for N-234 and N-238

SUMMARY PURPOSE AND SCOPE:

This project will provide modifications to the Steam Ejector System which serves the Thermal Protection Laboratory, N-234, and Arc Jet Facility, N-238, at Ames Research Center (ARC) (Figure 1). The project consists of three tasks: (1) replacement of the fifth stage steam ejector with a mechanical/electrical vacuum pump for energy conservation; (2) modifications to the steam boiler for energy conservation; and (3) repair and modification of components and support systems of the Arc Jet and Thermal Protection Laboratory facilities. The energy conservation portions of this project will enable savings of over 60,000,000 cubic feet (1,700,000

cubic meters) of natural gas annually. The related project payback for this work is approximately three years. The modification and repair portions will insure continued reliable operation of the laboratory facilities.

PROJECT:

The Steam Ejector System (Figure 2) at ARC provides the high vacuum required for aerodynamic investigation, design and qualification testing of the thermal protection systems of both the Thermal Protection Laboratory, N-234, and Arc Jet Facility, N-238. The Thermal Protection Lab began operation in 1962 and the Arc Jet Facility began operation in 1973. Both facilities have been in continous use since their initial operation. This facility complex provides testing capability for research and development activities such as for the Space Shuttle tiles, the leading edge thermal protection system testing, the materials testing of planetary entry heat shields and the aerodynamic heating investigations of vehicles in planetary atmospheres.

The Steam Ejector System consists of a natural gas-fired steam generating plant, a five-stage steam ejector vacuum pumping system, cooling towers, and high pressure water and exhaust storage equipment. This vacuum system provides the necessary discharge condition for each of the various test facilities of the complex.

The Thermal Protection Lab is comprised of the 1 x 5-inch Supersonic Turbulent Flow Duct, the Heat Transfer Wind Tunnel, the High Power Gasdynamic Laser, the 2 x 9-inch Supersonic Turbulent Flow Duct, and the Aerodynamic Heating Wind Tunnel. The Arc Jet Facility includes the 20 and 60 Megawatt Interaction Heating facilities, the High Enthalpy Entry Facility, the High Pressure Turbulent Flow Facility, and the Giant Planet Entry Facility.

The first project task replaces the fifth stage steam ejector with a mechanical vacuum pump for energy conservation. The energy savings for the first year of operation (FY 1982) is approximately 45,400,000 cubic feet (1,285,600 cubic meters) of natural gas. This savings is partially offset by the approximately 390,000 kWh required to operate the mechanical pumps. However, there will still be a net savings of approximately $250,000 per year.

The second task modifies the steam boiler which was originally designed as a ship's boiler and has been in constant operation at its present location since 1962. Over the years, its 220-tube economizer has frequently been repaired by removing or sealing tubes. Consequently, now one out of five economizer sections is inoperative which reduces the boiler efficiency. The project also provides for an exhaust gas oxygen analyzer and insulation of hot water tankage and equipment to improve efficiency. Finally, through the addition of a heat exchanger to the waste hot water side of the condenser, the boiler make-up water to the deaerator can be preheated. The combined fuel savings achieved by these modifications amounts to approximately 16,500,000 cubic feet (467,000 cubic meters) of natural gas per year valued at $95,000 per year during the first year of operation.

The third task is modifications and repairs to support systems such as the cooling water system, the gas supply system, the flow control system, the model support system, heat exchangers, the data acquisition system, and the diffuser section. This work is required to insure continued reliable and efficient operation of this research facility complex.

IMPACT OF DELAY:

If this project is delayed, significant energy will be needlessly wasted. The combined net savings of this project will result in a payback of about 3 years. In addition, the modification and repair items must be done to insure future facility reliability and needed flexibility.

PROJECT:

Replacement of Fifth Stane Elector

The last (fifth) stage of the Thermal Protection Laboratory's Steam Ejector System will be replaced with mechanical/electrical vacuum pumps. To accomplish this, two vacuum pumps and motors operating in parallel are required. The project also includes all piping, valving controls and electrical modifications necessary to install the new fifth stage. Surplus 600 horsepower (447 kilowatts) electric motors will be installed to drive the vacuum pumps.

Modifi ion to the Steam Boiler

Modifications to the boiler include the installation of new tubes in the economizer, and improvements to related equipment. This work also includes the installation of an oxygen analyzer and combustion air controls to improve the operational efficiency. Three inches (7.6 centimeters) of fiberglass insulation are to be applied to the bare steel tank saddles, supporting steel work, adjacent valves, and to the deaerator tank. Also included is the installation of a heat exchanger to preheat the boiler makeup water.

Modification and Repair of Various Components

a. Repair of Support Systems. The following support systems for the Arc Jet and Thermal Protection Lab facilities will be repaired or replaced in-kind.

- The cooling water system which consists of seven large capacity water pumps, 500 horsepower (373 kilowatt) drive motors and system valves will be overhauled.

- The Gas Supply System repairs include the replacement of a deteriorated and failing Nitrogen Storage System, replacement of a storage tank, pump valves and manifolding, and refurbishment of valves, manifolds, and other support items for helium/hydrogen gas and carbon monoxide systems.

- The Flow Control System repairs include replacement of obsolete and worn flow control drives such as differential pressure transmitters, gages and other central panel instruments.

- The Model Support System repair will replace the debilitated model support system for the Aerodynamic Heating tunnel.

- The downstream heat exchanger of the 2- x 9- Turbulent Flow Duct of the lab will be replaced.

b. Modification of Thermal Protection Lab Data Acquisition System. This modification consists of replacing the existing data acquisition system and wiring in Building N-234 with a newly acquired computer controlled Data Acquisition/Processing system and associated wiring.

c. Modifications of the Aerodynamics Heating Facility. The existing 4-foot (1.2 meter) diameter diffuser section of the Aerodynamic Heating Facility will be replaced with a 6-foot (1.8 meter) in diameter section. This diffuser pipe will pass through the north wall of Building N-234 and requires the present opening to be enlarged to accommodate the larger diameter diffuser pipe. Included in this revision will be a new 6-foot (1.8 meter) diameter vacuum valve with a valve shield mechanism. The existing diffuser entrance, diffuser pipe, water jacket and expansion joint will be replaced. Modifications will also be made to the test section box, plenum and cooling water piping.

PROJECT COST ESTIMATE:

This cost estimate is based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,300,000
Site development	---	---	---	---
Replacement of fifth stage steam ejector	---	---	---	765,000
Vacuum pump	EA	---	---	(505,000)
Piping, valves and electrical	LS	---	---	(260,000)
Modification to steam boiler	LS	---	---	400,000
Modification and repair of various components	---	---	---	1,135,000
Repairs of support systems	LS	---	---	(480,000)
Modification of thermal protection lab data acquisition system	LS	---	---	(455,000)
Modification of aerodynamic heating facility diffuser	LS	---	---	(200,000)
Fallout Shelter (not feasible)	---	---	---	---
Total				2,300,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Schematic Diagram

OTHER EQUIPMENT SUMMARY:

No additional equipment is required for this project.

FUTURE CoF ESTIMATED FUNDING TO COMPLETE THIS PROJECT:

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

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION OF STEAM EJECTOR SYSTEM
SCHEMATIC DIAGRAM

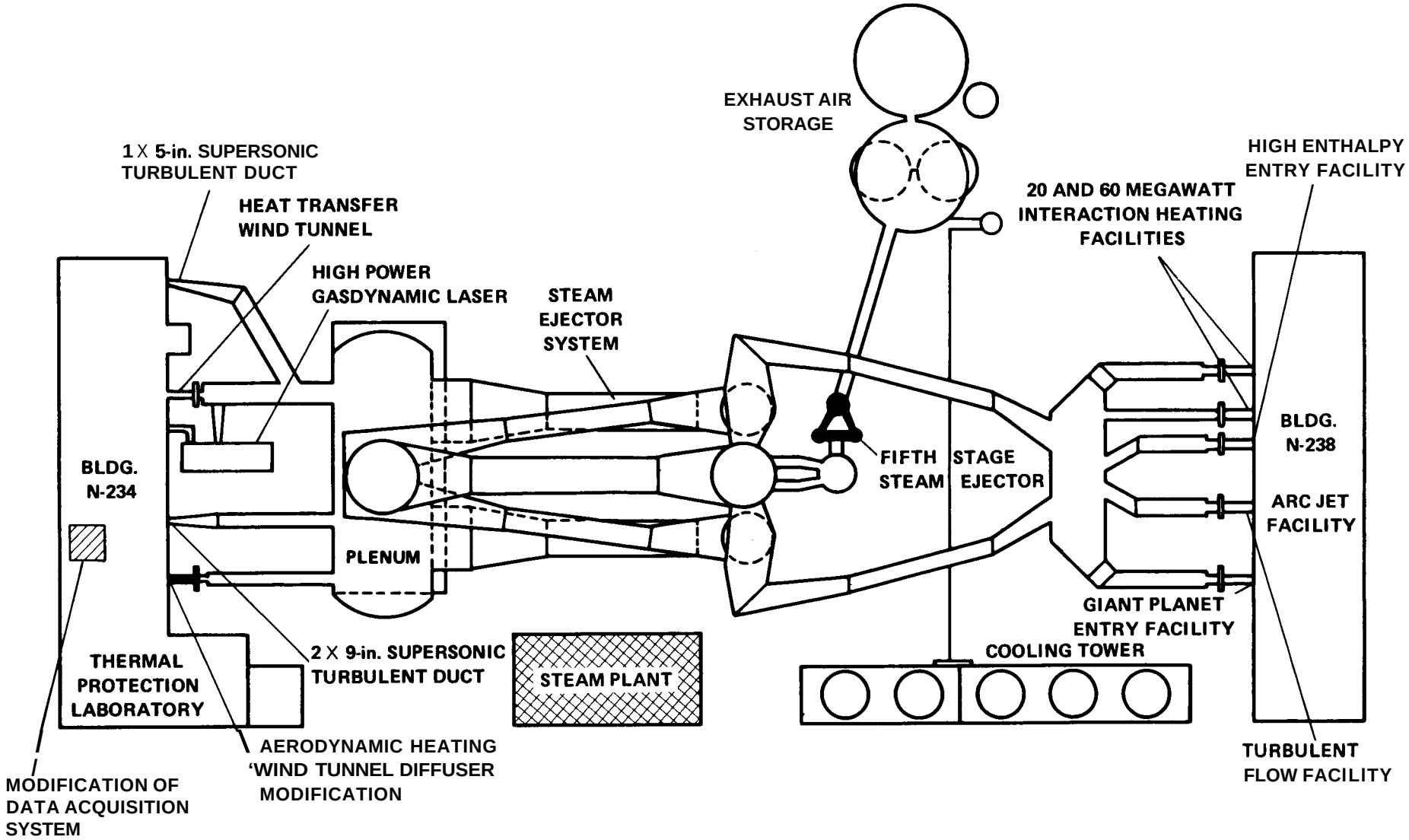


FIGURE 2

CF 1-16

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION OF THE UNITARY PLAN WIND TUNNEL
LOCATION PLAN

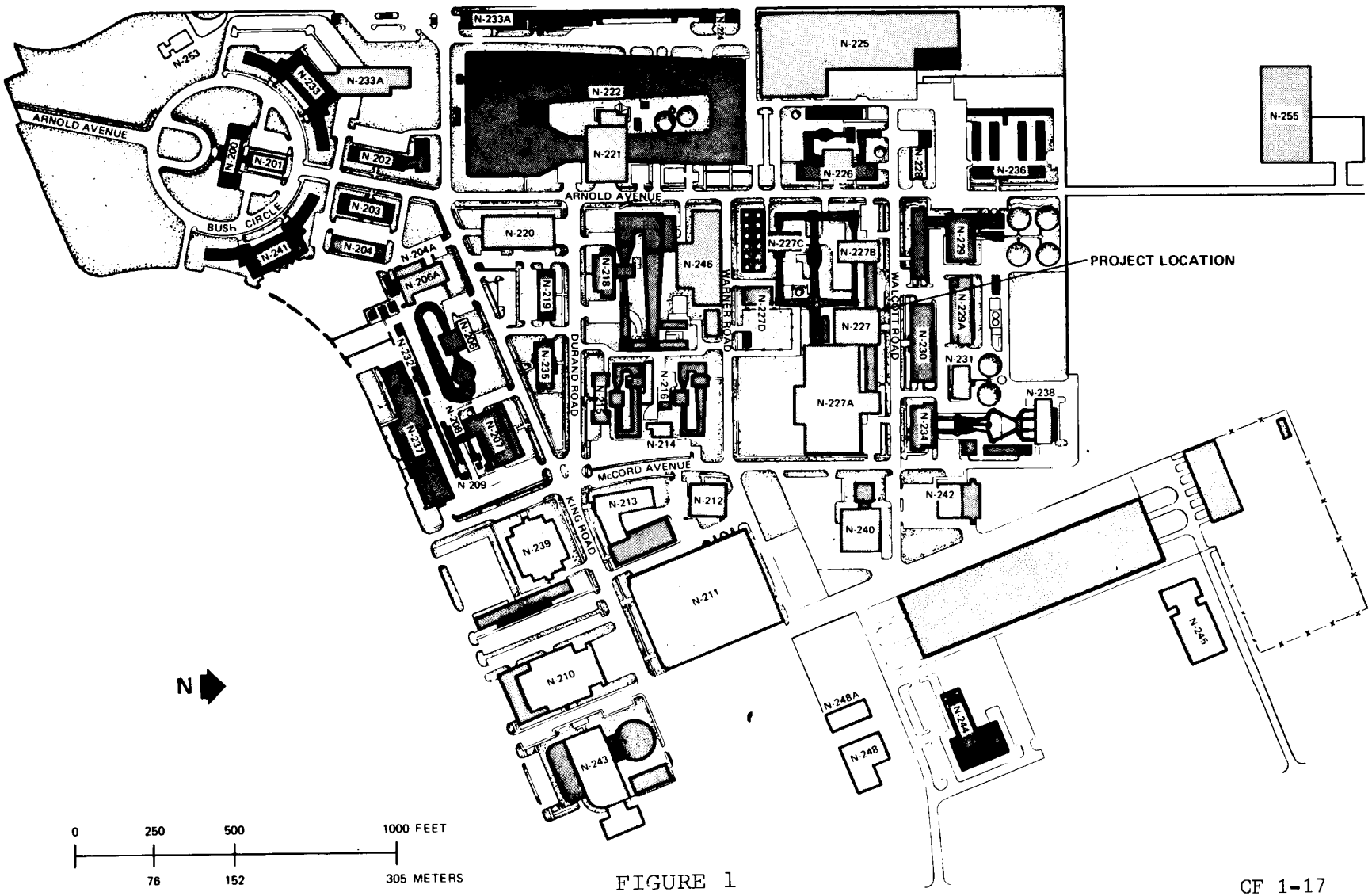


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modification of the Unitary Plan Wind Tunnel (N-227)

INSTALLATION: Ames Research Center

FY 1981 CoF ESTIMATE: $3,400,000

COGNIZANT

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	415,000	7,522,000	7,937,000
Capitalized investment	N/A	35,316,298	35,316,298
Total	415,000	42,838,298	43,253,298

SUMMARY PURPOSE AND SCOPE:

This project modifies the Unitary Plan Wind Tunnel (UPWT), Ames Research Center (ARC) (Figure 1), Moffett Field, California, for energy conservation improvements and to maintain an efficient operation of this terting complex. The energy conservation modifications will save approximately 20,000,000 kilowatt-hours of electricity annually with an estimated savings of $540,000 per year beginning in FY 1982. This project also includes modifications to the model buildup shops as well as repairs to the cooling coils, flow control valves and other equipment.

PROJECT:

The UPWT complex consists of three separate wind tunnel circuits and test sections; the 11- X 11-Foot Transonic with a Mach number range of 0.4 to 1.4, the 9- X 7-Foot Supersonic with a Mach number range of 1.5 to 2.5, and the 8- X 7-Foot Supersonic with a Mach number range of 2.5 to 3.5 (Figure 2). All three circuits are powered by a common set of drive motors. Therefore, only one wind tunnel can be operated at a time. The Unitary facility has been in continuous operation since completion of construction in 1955, and is a National Facility.

Experimental investigations conducted in the UPWT facilities include projects requested by: the Department of Defense (DOD) for advanced aircraft and missiles; the aircraft industry for commercial transports; ARC in-house researchers for advanced NASA aerodynamic programs; and other NASA centers and government organizations for a broad range of advanced aircraft and aerospace projects.

Because this facility is heavily used and plays an important role in the Nation's aeronautical research programs, it is imperative that these improvements be made. The energy conservation measures, needed modifications and repair work will assure its continued operation, at minimum cost and maximum efficiency.

Four of the five tasks comprising this project are required to reduce the operating energy consumption of the UPWT. This work includes: modifying the 11- X 11-Foot leg compressor to enable control of the wind tunnel flow speed by adjusting the inlet guide vanes instead of the drive motors; installing bypass switchgear and eliminating the rheostat losses for maximum speed operation; reducing the electrical power usage of the 11- X 11-Foot test section diffuser region; and automation of the start up, on line adjustment, and shutdown sequencies of the wind tunnel's pressurization and compressor lubrication systems. Approximately 20,000,000 kilowatt-hours per year will be saved by these modifications. The estimated amortization period for this energy investment is less than 4 1/2 years.

The other modification and repair work is required to maintain and improve the operating condition of the UPWT complex. Modifications to the model buildup shops are needed to allow complete assemblies of model-balance-sting instrumentation for checkout before installation in the wind tunnel test section. Because modern models and instrumentation are becoming more complex, buildup and checkout of these assemblies is best performed outside the tunnel test section. This will provide better tunnel utilization and a more manpower efficient checkout environment. Acoustic treatment of the 9-X 7-Foot Wind Tunnel is needed to reduce the noise level in the test chambers from 117 dba, which does not meet OSHA standards, to under 85 dba which is acceptable for continuous work areas.

The repair work is needed for continued efficient operation of the facility. The existing cooling spray canopy is corroded and cooling coils are subjected to thermal stresses from imprecise control of the cool-down

cycle during shutdown of the facility. The coils and control valves of the 11-X 11-Foot Wind Tunnel after cooler and compressor lubrication system heat exchangers are old and unreliable. These systems need frequent repair and always leak, allowing moisture to enter the wind tunnel. This problem can only be eliminated by complete replacement of these components. Both the vibration and temperature monitoring systems are worn out and outdated. Reliable, low maintenance, state-of-the-art systems will replace these existing systems. These monitoring systems are essential to the wind tunnel operation because either excessive bearing temperature or compressor rotor vibration can lead to catastrophic failures.

IMPACT OF DELAY:

If this project is delayed, significant potential energy savings will not be realized. The UPWT uses approximately 46 percent of ARC's electrical energy. This project will save approximately nine percent of the Center's utilities energy consumption as compared to 1978. Consequently, it is a critical element in ARC's program to reduce energy consumption and improve efficiency of large energy users. In addition, if the necessary modification and repair items are delayed, more frequent shutdowns for maintenance and repair could occur. This will result in an ever increasing backlog of testing in this key research and development facility.

PROJECT DESCRIPTION:

The five project tasks are described below:

Modification of Compressor 11- X 11-Foot Leg

The compressor of the 11- X 11-Foot leg of the UPWT consists of 3 stages of fixed (stator) and rotating (rotor) blades as well as fixed inlet and exit guide vanes. Modifications will replace the fixed inlet guide vanes of the compressor with motorized camber inlet guide vanes, and adjust the first, second, and third stage stator blades, and exit guide vanes to optimized fixed positions. This will permit the control of the wind tunnel flow speed by adjusting the variable camber inlet guide vanes rather than through the present method of changing the drive motors speed. Presently, the speed of the drive motors is reduced by increasing the amount of resistance in the motor secondary circuit resulting in heat energy losses. The purpose of the variable camber inlet guide vanes is to introduce the correct amount of swirl to the flow upstream of the first compressor stage.

Modification of Drive Motor Control

Presently, liquid rheostats provide the varying resistance for speed control of the four 45,000 HP (33,500 kW) compressor drive motors. At maximum speeds, these resistors introduce a loss of about 4 percent into the circuit. Unlike the 11- X 11-Foot circuit, the 8- X 7-Foot and 9- X 7-Foot circuits normally operate at maximum speed. The proposed bypass switchgear will eliminate these rheostat losses at maximum speed operation by permitting the bypass switching of the resistors out of the circuit. The switchgear will be of the outdoor, weatherproof enclosed type, rated for 5,000 volts and 6,000 amps, and will be positioned close to the Auxiliary Equipment Building.

Modification of Plenum Bleed System

This modification work involves the use of 9 boundary layer ejectors to significantly increase the efficiency of the tunnel diffuser which is the highest energy loss segment of the tunnel circuit. This ejector system consists of an array of 104 nozzles installed around the periphery of the downstream end of the test section. It will remove air around the test section and re-introduce the air further downstream from the test section, thereby increasing the flow efficiency. Piping and controls required to supply air to these nozzles from an existing compressor are also part of this project.

Automation of the Make-Up Air (MUA) System

The project will provide a system which will permit a controller, acting through electrical relays, to automatically operate the make-up air system. The controller will consist of input/output sensors to activate electric valve motors, receive valve position and pressure sensor data; a computer processor capable of storing alternate operation and sequences data and monitoring system status; operator displays and manual override equipment; and sensors for system monitoring.

Modification and Repair of Various Components and Systems

This portion of the project consists of the following:

a. Modification of Model Build-up Shops. Installation of support systems such as an overhead crane, high pressure air supply, electric power, and data system connections to provide improved model buildup capability in these shops.

b. Acoustic Treatment of 9- X 7-Foot Wind Tunnel Diffuser and Test Chamber. The wind tunnel will be enclosed with a fiberglass sound wall in the Test Chamber area. This will acoustically isolate the wind tunnel from the work area adjacent to the tunnel.

c. Cooling System Modification. The existing spray canopy will be replaced and enlarged. Control valves and a control system will be provided to allow automatic cool-down when the facility is shutdown. Cooling tower drift eliminators and fire protection sprinklers will be repaired/replaced to save water and provide proper protection.

d. Cooling Coils and Flow Control Valves. The coils and control valves of the 11- X 11-Foot Wind Tunnel after-cooler and compressor lubrication system heat exchangers will be replaced in kind with new components.

e. Vibration and Temperature Monitoring Equipment. Existing equipment will be replaced with modern components to provide adequate monitoring of both temperature and vibration of the wind tunnel compressors.

PROJECT COST ESTIMATE:

This cost estimate is based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	3,400,000
Modification of compressor	LS	---	---	730,000
Modification of drive motor control	LS	---	---	820,000
Modification of plenum bleed system	LS	---	---	300,000
Automation of make-up air system	LS	---	---	650,000
Modification & repair of various components systems	---	---	---	900,000
Modification of model buildup shops	LS	---	---	(47,000)
Acoustic treatment of 9- X 7-foot wind tunnel	LS	---	---	(162,000)
Cooling system modification	LS	---	---	(211,000)
Cooling coils and flow control valves	LS	---	---	(300,000)
Vibration and temperature monitoring equipment	LS	---	---	(180,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,400,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Isometric View

OTHER EQUIPMENT SUMMARY:

No other equipment is required for this project.

FUTURE COF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

AMES RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION OF THE UNITARY PLAN WIND TUNNEL

ISOMETRIC VIEW

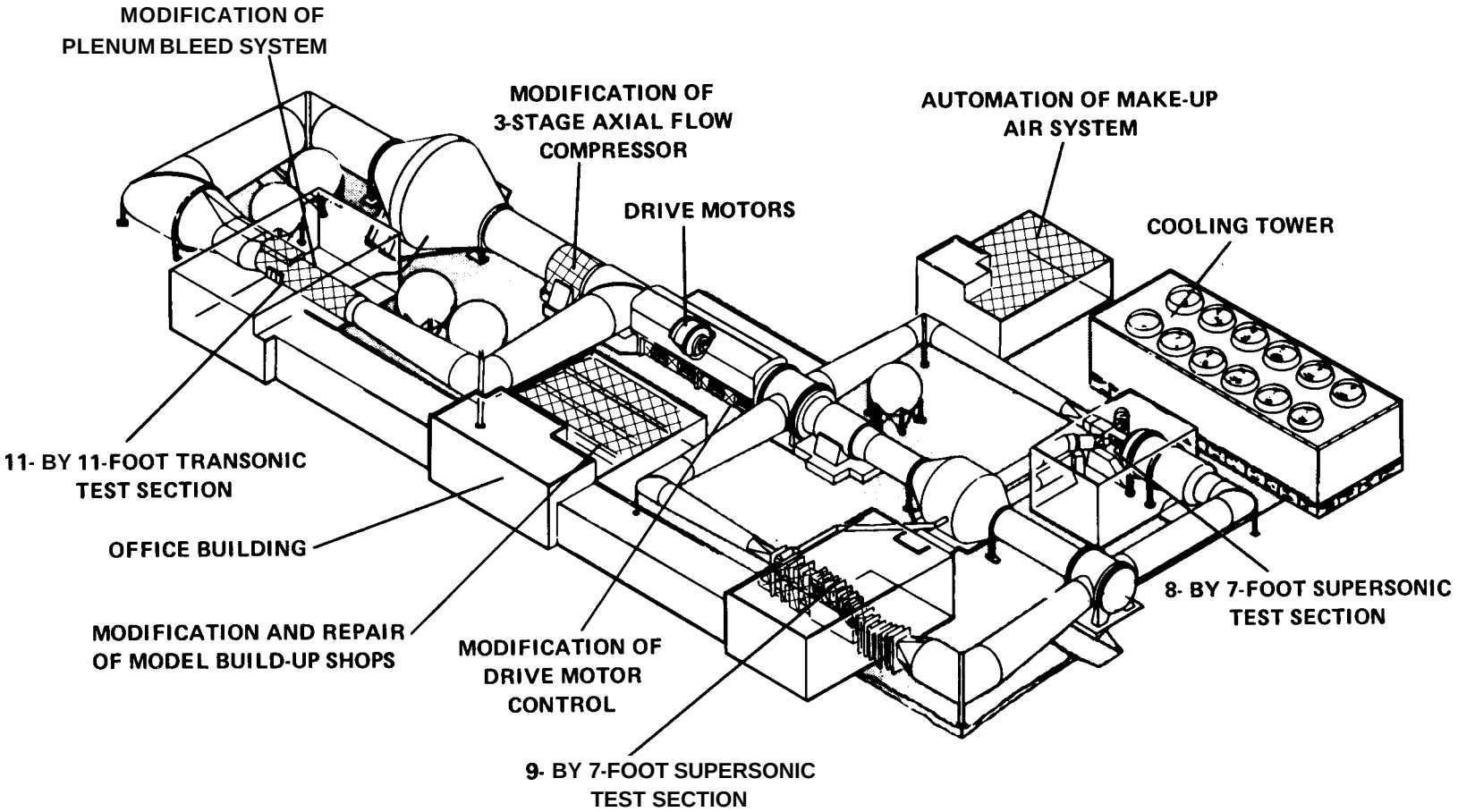


FIGURE 2

JET PROPULSION
LABORATORY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

JET PROPULSION LABORATORY

	Amount	Pane No.
Office of the Comptroller:		
Modifications to Various Buildings for Energy Conservation.....	1,500,000	CF 2-1
Modifications to Various Buildings for Seismic Protection.....	2,000,000	CF 2-6
Total.....	3,500,000	

JET PROPULSION LABORATORY
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO VARIOUS BUILDINGS FOR ENERGY CONSERVATION

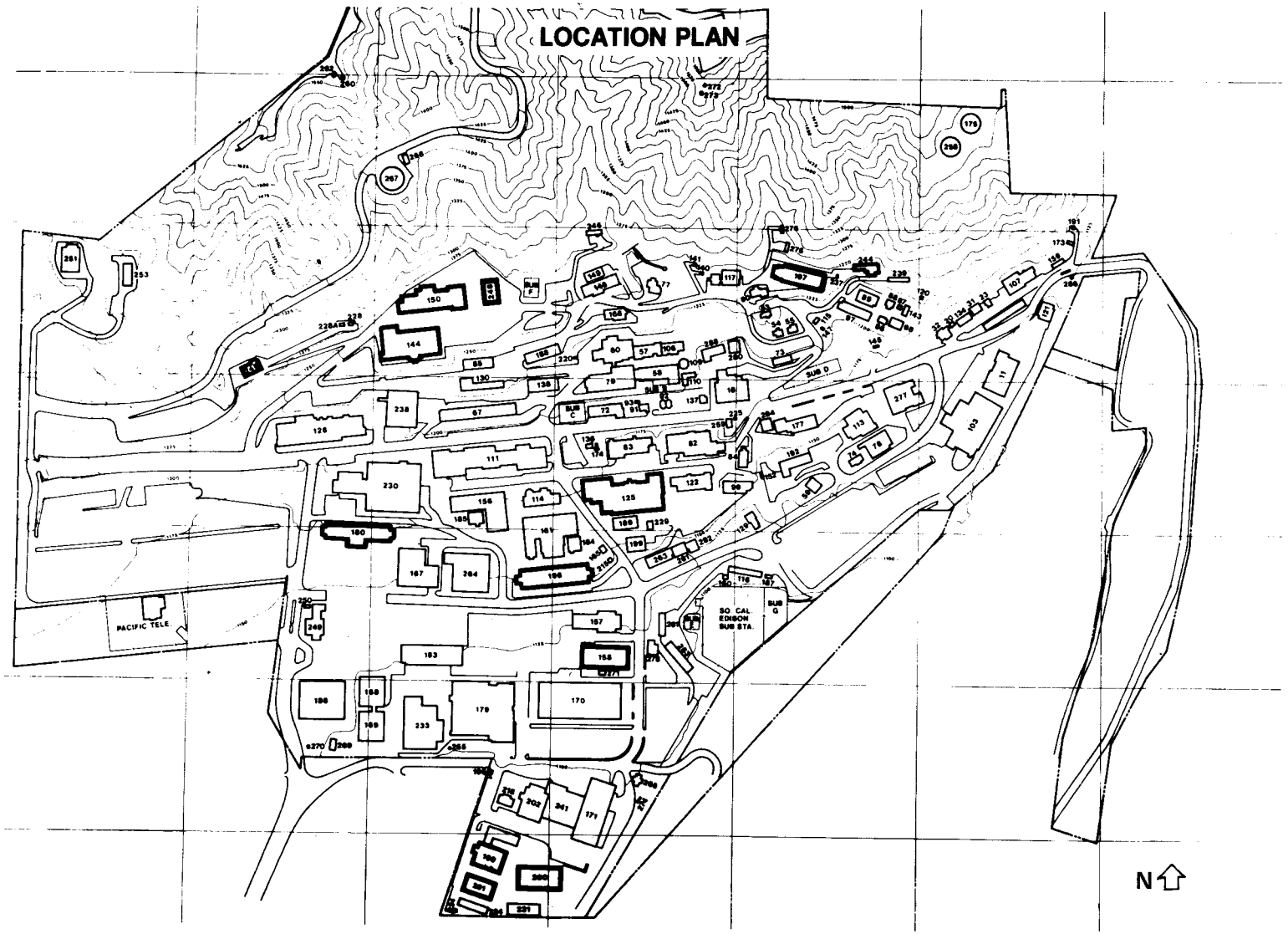


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modifications to Various Buildings for Energy Conservation

INSTALLATION: Jet Propulsion Laboratory

FY 1981 CoF ESTIMATE: $1,500,000

LOCATION OF PROJECT: La Canada-Flintridge, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	115,000	---	115,000
Capitalized investment	N/A	16,355,161	16,355,161
Total	115.004	16,355,161	16.470.161

SUMMARY PURPOSE AND SCOPE:

This project provides for modifications to mechanical and electrical systems in various Jet Propulsion Laboratory (JPL) buildings to improve efficiency of operation and reduce energy consumption. The air-conditioning systems in thirteen buildings will be modified to reduce wasteful, chilled air-reheat mechanical systems capacities to more closely match the loads in the buildings (Figure 1). This will reduce the energy needed to satisfy the space conditioning requirements. These modifications will reduce electrical consumption by approximately 6,000,000 kilowatt hours of electricity and 27,000,000 cubic feet of natural gas per year. These energy reductions will enable JPL to operate these buildings using less energy, and reduce the total

laboratory energy consumption by almost 8 percent compared to FY 1978 levels. The estimated first year's operational savings is about $380,000. This project is very cost-effective with a simple payback period of four years.

PROJECT:

The mechanical and electrical systems for these buildings were designed and installed when energy consumption was not a major consideration. At that time, a low initial cost system that satisfied the building requirements was the criterion. The existing constant air volume systems waste significant amounts of energy because of their inability to vary the energy input as loads inside the building change or outside air conditions change. The existing controls are inadequate and unreliable. The existing chilled water and hot water systems are energy inefficient. The general office lighting levels in Building 180 are much higher than needed. Conversion of constant air volume systems to variable air volume (VAV) systems (Figure 2); replacement of inefficient motors and installation of economizers; modification of the HVAC system to allow the main system to shutdown during off-hours; and decreasing the lighting levels of office areas in Building 180 will improve operating efficiencies and save energy. The chilled water and hot water systems will be rebalanced to more closely match the building loads and use outside air to the maximum extent.

IMPACT OF DELAY:

Delay in accomplishing these modifications to the mechanical and electrical systems will result in unnecessary expenditure of funds for energy, continued waste of natural gas and delay a significant increment of JPL's overall energy reductions.

PROJECT DESCRIPTION:

This project provides for the modification to the existing HVAC systems of some 370,000 square feet (34,370 square meters) of space in Buildings 125, 144, 150, 158, 180, 190, 197, 198, 200, 201, 244, 245, 248. The work includes installation of new control systems, conversion of existing constant air volume systems to variable air volume (VAV) systems, rehabilitation of chilled water and hot water systems, and rebalancing the air distribution systems in the thirteen buildings. Additionally, replacement of motors, provision of economizers, and minor duct changes will be included. It is also planned to reduce the general office lighting in Building 180 from over 5 watts per square foot to 3 watts per square foot. Provisions will be made to connect these buildings to the Utility Control System at JPL, so that night set-back and system optimization can be achieved.

PROJECT COST ESTIMATE:

The basis of this cost estimate is a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1,500,000
Demolition	LS	---	---	90,000
Structural modifications	LS	---	---	70,000
Electrical modifications	LS	---	---	290,000
Mechanical modifications	LS	---	---	1,050,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				1,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Typical HVAC Modifications

OTHER EQUIPMENT SUMMARY:

There is no other equipment required to be used with this facility project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no known future requirements to complete this project.

JET PROPULSION LABORATORY
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO VARIOUS BUILDINGS FOR ENERGY CONSERVATION

TYPICAL HVAC MODIFICATIONS

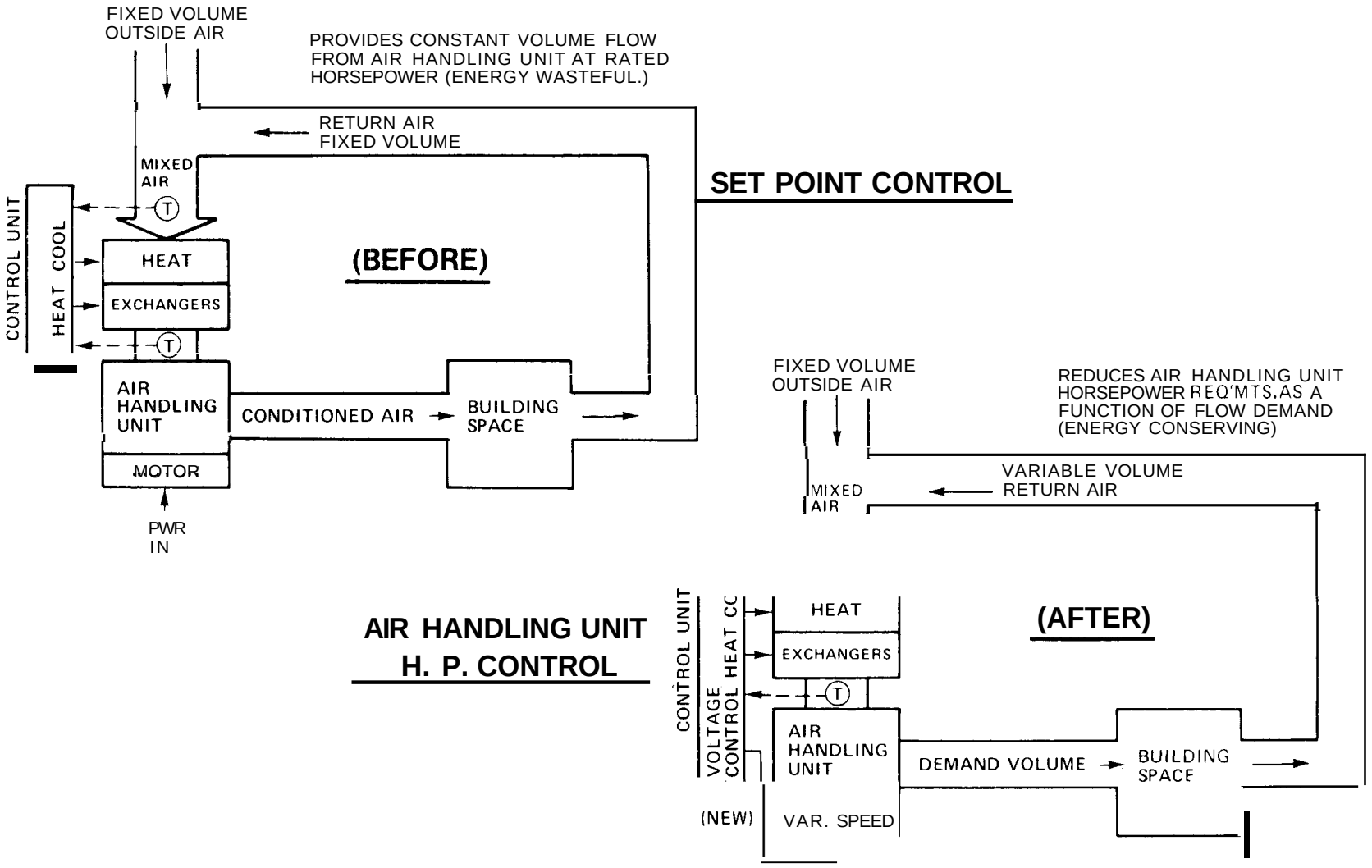


FIGURE 2

JET PROPULSION LABORATORY
FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION

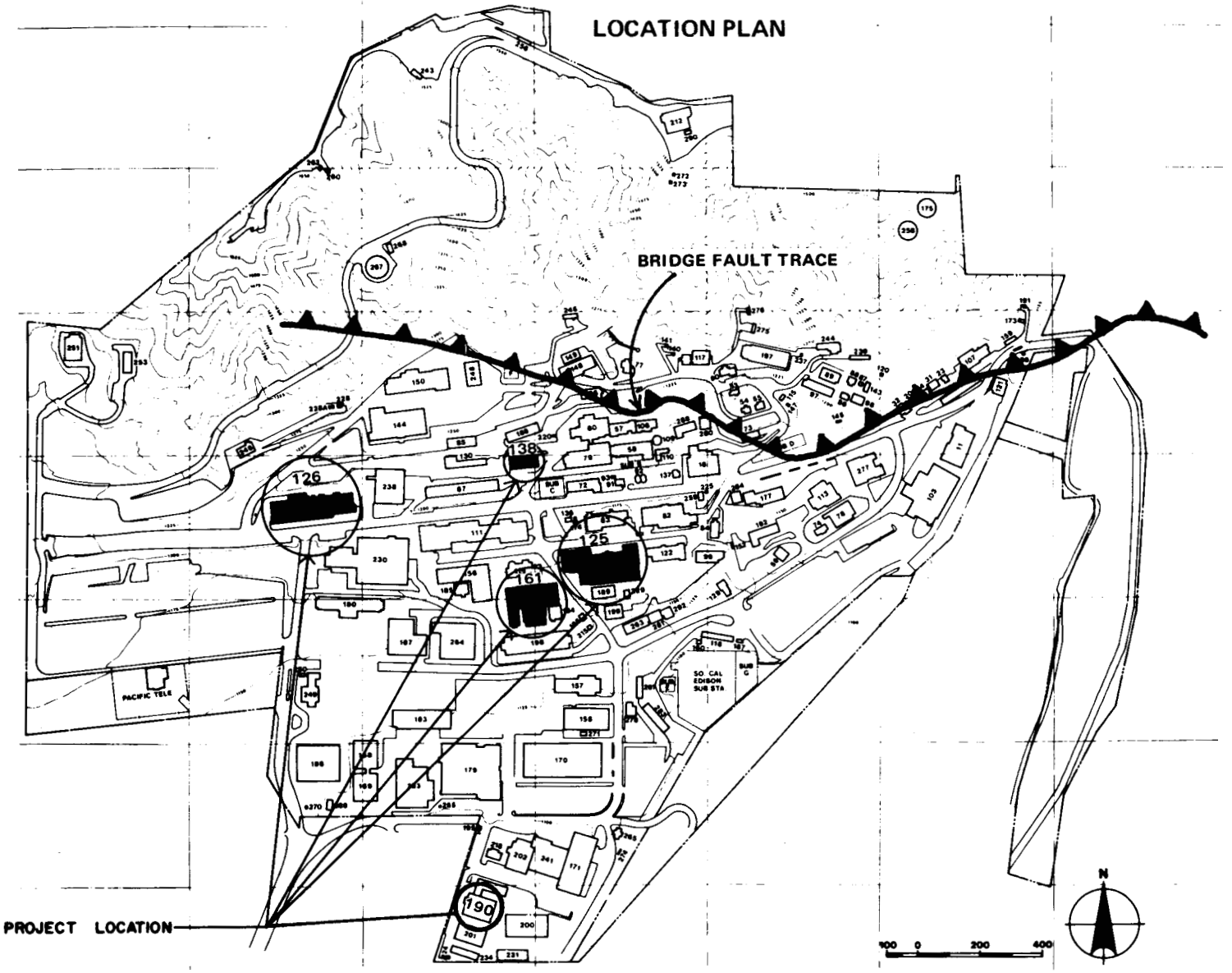


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modifications to Various Buildings for Seismic Protection

INSTALLATION: Jet Propulsion Laboratory

FY 1981 CoF ESTIMATE: $2,000,000

LOCATION OF PROJECT: La Canada-Flintridge, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	605,000	5,070,000	5,675,000
Capitalized investment	N/A	5,035,300	35,300
Total	605.000	10.105.300	10.7 10.300

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide seismic reinforcement necessary to minimize human fatalities at five Jet Propulsion Laboratory (JPL) Buildings that are susceptible to collapse in the event of a major earthquake. This reinforcement work will meet current seismic code standards. Structural, architectural, mechanical and electrical systems will be improved in accordance with the JPL Seismic Safety Plan to minimize fatalities and provide for the safe exit of personnel. FY 1978 and 1979 seismic protection projects provided for comparable efforts in some 20 major JPL buildings as well as the JPL water storage system. Further analysis of the earthquake probabilities and associated risks has identified these additional buildings which require

strengthening to upgrade resistance to seismic forces for protection of buildings' occupants during major earthquakes. This project includes improvements to buildings (125, 126, 138, 161, and 190) which have serious deficiencies. These facilities will be used through the 1980's and, therefore, these modifications are necessary and prudent.

PROJECT:

This project is necessary to minimize potential high fatality seismic risks caused by the seismic hazard at JPL. Structural modifications to the buildings will prevent collapse even in the event of irreparable structural damage. Other modifications will minimize injuries from hazards within buildings, such as falling ceilings, partitions or hardware; broken water and natural gas lines; failure of elevator hoistways; and blockage of stairways. Since the average seismic hazard for the JPL site is high, this work should be accomplished as soon as possible.

JPL is located in rugged topography at the base of the San Gabriel Mountains (Figure 1). The northern portion of the site is steep and mountainous. The lower portion is a decomposed granite alluvial fan with slopes of about 14 percent. After the 1971 San Fernando earthquake, geologic investigations located a thrust-type fault running east and west across the northern end of the site. The fault, named the "JPL Bridge Fault", is related to the San Gabriel fault zone that produced the San Fernando earthquake and is considered potentially active (Figure 2).

JPL initiated seismic studies on a priority basis soon after the 1971 San Fernando earthquake. Over the past several years, the seismic hazard and the earthquake resistance of a significant number of JPL facilities have been investigated. In summary, these studies included: (1) determination of local and regional geology and seismicity; (2) studies of foundation materials; (3) determination of earthquake probabilities and the nature of resultant earth shaking; (4) development of seismic design criteria; (5) design checks of numerous suspect facilities with the guidance of new codes; (6) dynamic analyses of several buildings; (7) identification of unsafe facilities or structural elements; (8) cost estimates for upgrading facilities; and, (9) cost estimates for replacement of facilities. Results of these studies were used to develop the JPL Seismic Safety Plan, which was the basis for the FY 1978 and FY 1979 projects as well as this funding request. Facilities at JPL were designed in accordance with codes applicable at the time of construction, but are now assessed as having inadequate earthquake resistance in view of the present seismic hazard knowledge and the latest building codes. The facilities to be rehabilitated are the remaining minor facilities at JPL considered to be high potential fatality seismic risks. The FY 1978 and FY 1979 projects addressed the major facility requirements at JPL.

IMPACT OF DELAY:

Delay in providing for these modifications will result in the continuation of unacceptable high seismic risk to the occupants of these buildings. The five buildings in this project do not conform to minimum criteria for protection against seismic hazards caused by a major earthquake and are high potential fatality risks.

PROJECT:

The project includes structural modifications to prevent the collapse of the walls and floors in five buildings, and other nonstructural modifications to minimize hazards from architectural, electrical and mechanical failures. Structural modifications include adding reinforced concrete shear walls, guniting and reinforcing existing walls and columns, and provisions for anchoring roofs and floors to masonry walls. Nonstructural modifications include elevator hoistway bracing; adding battery powered fire alarm and light systems; strengthening stairways; anchoring heating, ventilating and air-conditioning (HVAC) equipment; providing automatic shutoff valves on water and natural gas pipelines; and providing building utility pipeline and powerline flexibility.

The following facilities, with a cumulative occupancy of approximately 1,085 people, are included in this project:

Facility Number	Facility Title	Avg. No. of Occupants
125	Electronics Laboratory	311
126	Systems Division Office Building	255
138	Engineering Office	53
161	Telecommunications Laboratory	337
190	Procurement Office/Cafeteria	129

PROJECT COST ESTIMATE:

The basis of this cost estimate is a detailed Preliminary Engineering Report supported by related studies.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,000,000
Modifications to building 125	LS	---	---	495,000
Modifications to building 126	LS	---	---	470,000
Modifications to building 138	LS	---	---	320,000
Modifications to building 161	LS		---	415,000
Modifications to building 190	LS	---	---	300,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				2,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Geological Fault Map of Los Angeles County

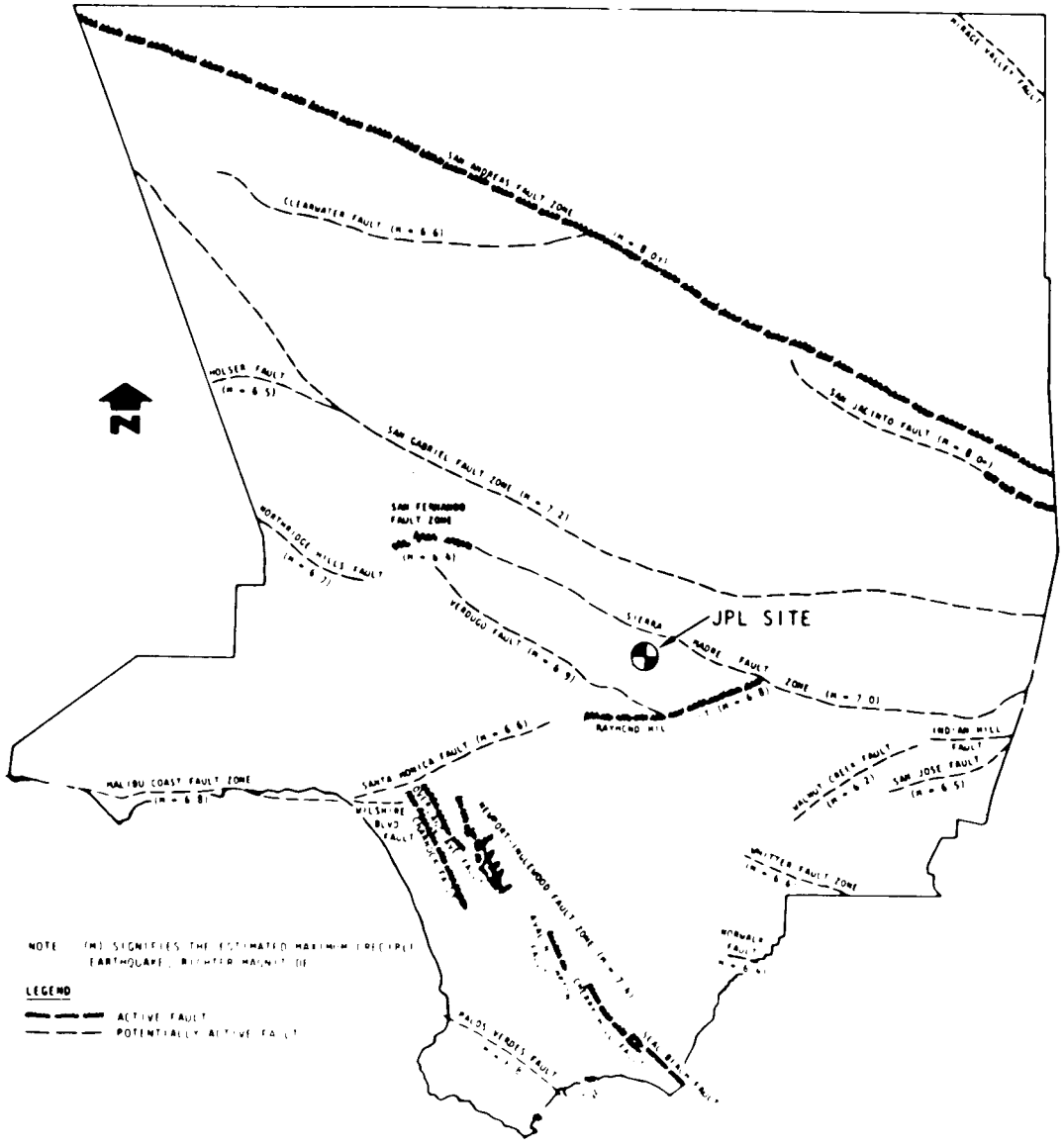
OTHER EQUIPMENT SUMMARY:

There is no known additional equipment, either collateral or noncollateral, required for this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT

No future funding is required to complete this project.

JET PROPULSION LABORATORY
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO VARIOUS BUILDINGS FOR SEISMIC PROTECTION



GEOLOGICAL FAULT MAP OF LOS ANGELES COUNTY

FIGURE 2

KENNEDY
SPACE CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

JOHN F. KENNEDY SPACE CENTER

	Amount	Page No.
Office of the Comptroller:		
Rehabilitation of High Temperature Hot Water System, Zone 2, Industrial Area	760,000	CF B-1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF HIGH TEMPERATURE HOT WATER SYSTEM, ZONE 2, INDUSTRIAL AREA
LOCATION PLAN

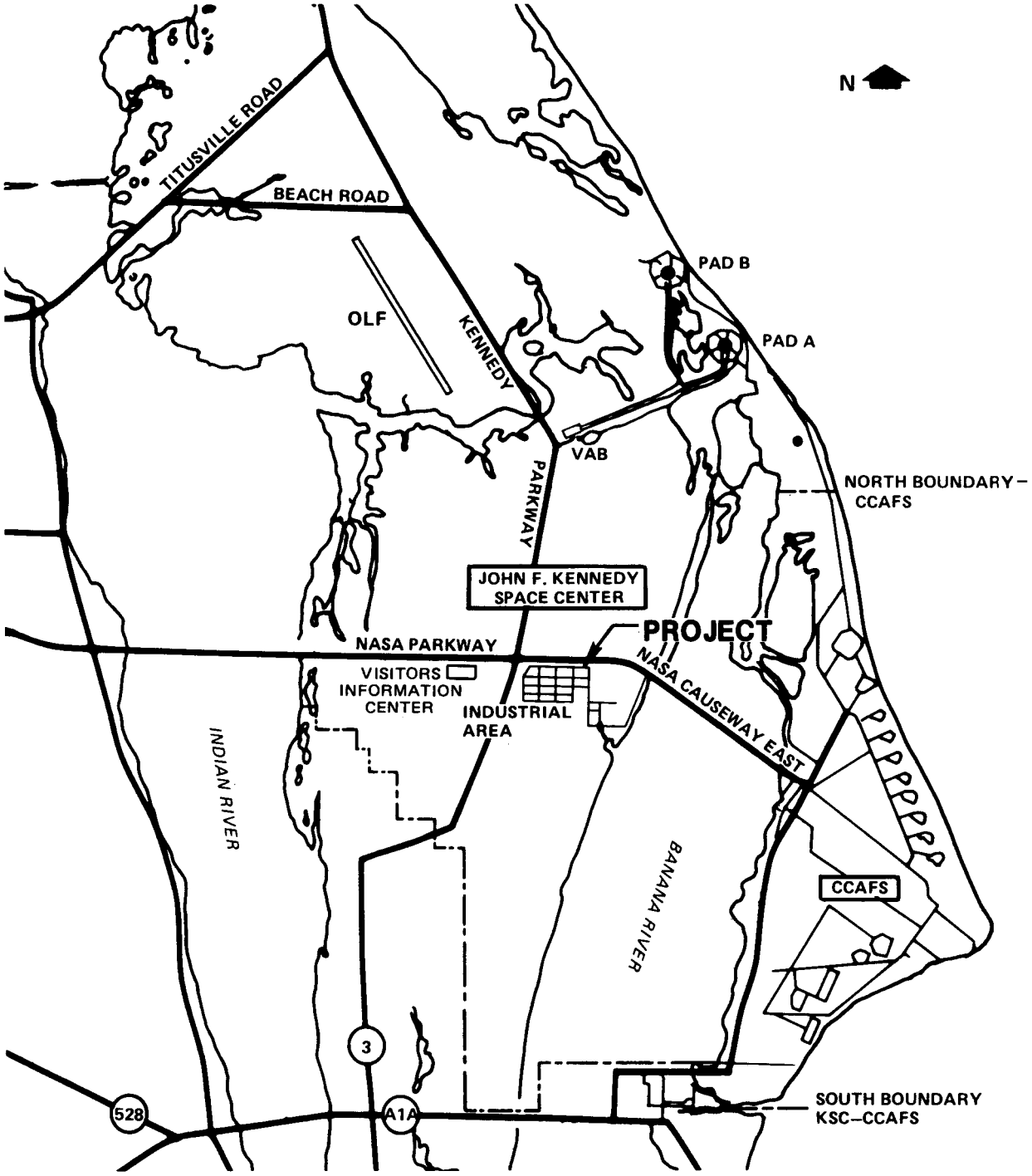


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PHOJECT TITLE:	Rehabilitation of High Temperature Hot Water System, Zone 2, Industrial Area
INSTALLATION:	John F. Kennedy Space Center
FY 1981 CoF ESTIMATE:	$760,000

LOCATION OF PROJECT: John F. Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICS: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEAHS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	51,000	---	51,000
Capitalized investment	N/A	4,459,000	4,459,000
Total	51,000	4,459,000	4,510,000

SUMMARY PURPOSE AND SCOPE:

This project will replace approximately 3,000 linear feet (914 meters) of 8-inch (20.3 centimeter) diameter and 2,000 feet (610 meters) of 6-inch (15.2 centimeter) diameter high temperature hot water (HTHW) pipe and appurtenances which are used for critical environmental control in the Operations and Checkout Building, M7-355; the Supply, Shipping and Receiving Building, M7-505; and the Flight Crew Support Building, M7-409 at the Kennedy Space Center (KSC). The existing piping is located in a concrete trench which floods during heavy rains, causing deterioration of the insulation and corrosion of the pipe, valves and expansion joints. Approximately 3,100 linear feet (945 meters) of 8-inch pipe and 2,300 linear feet (701 meters) of 6-inch pipe

will be installed above grade in a grassed utility island (Figure 2) where it will not be subject to the destructive flooding and corrosive conditions. This project will assure the reliability of the system to support Shuttle Payloads, and will significantly reduce maintenance costs and fuel consumption. it will also eliminate potential safety hazards.

PROJECT JUSTIFICATION:

This project is the final increment of work for replacing an underground HTHW system with an above ground system. The rate of deterioration on this last portion of the below ground system has accelerated to the point where during a recent three-month period it was necessary to make emergency replacement of one 8-inch and two 6-inch expansion joints and repair a hole in a corroded 6-inch feeder to the Operations and Checkout Building. Because of the extremely adverse condition of the existing underground system there is a strong probability of increasingly frequent failures with the consequent loss of controlled environment in the critical Shuttle activity areas in the Supply, Shipping and Receiving Building, the Flight Crew Support Building, and especially in the Operations and Checkout Building. In this facility, environmentally sensitive Spacelab flight hardware is located, and temperature and humidity critical payloads are to be tested and checked out. The present system provides no means of supporting the buildings with high temperature hot water in the case of a failure. A minimum of 24 hours is required to cool down the system to accomplish repairs and bring it up to operating temperature again.

On several occasions, because of this advancing deterioration, sections of the system have literally disintegrated (usually at the expansion joints), throwing off the heavy steel trench covers and spraying a jet of scalding water in a heavily used automobile parking area.

The net energy loss resulting from the wet, deteriorated insulation is estimated to average 1,190,000 BTU per hour, resulting in a waste of approximately 55,000 gallons (206,000 liters) of fuel oil a year at a cost in current dollars of $25,000 a year. Records indicate that the maintenance cost (labor and materials) for keeping this portion of the system operational is approximately $10,000 a year.

IMPACT OF DELAY:

Delay of this project increases the risk of impacting the test control and checkout of Spacelab and horizontal processed payloads which are dependent on precise temperature and humidity. The potential hazard to personnel and equipment in the parking area will continue. High maintenance costs will continue as repairs to the below ground system increase and approximately 55,000 gallons of fuel oil will be wasted during each year of delay.

PROJECT DESCRIPTION:

This project will replace approximately 3,000 linear feet of 8-inch diameter pipe and 2,000 linear feet of 6-inch diameter pipe and appurtenances located in a concrete trench. This is the final portion of the high temperature hot water distribution system which is being replaced incrementally. Approximately 3,100 linear feet of 8-inch diameter pipe and 2,300 linear feet of 6-inch pipe will be located above ground in a grassed utility island. The new pipe will have the same capacity as the existing pipe and will be covered with a 4-inch (10.2 centimeter) cellular glass insulation and wrapped with ultraviolet resistant polyvinyl chloride jacketing.

The construction of the new system will take place without interfering with the use of the present system. The outage for the final tie-in of the new system will be scheduled to avoid interruption of essential operations.

PROJECT COST ESTIMATE:

This cost estimate is based on a Preliminary Engineering Report and related studies.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	760,000
Sitework.....	LS	---	---	26,000
Pipe and fittings	LF	5400	30.43	164,000
Valves	EA	53	138.72	8,000
Pre-fab pipe-in-conduit	LF	415	177.30	74,000
Pipe insulation and jacket	LF	5400	28.31	153,000
Pipe supports, etc	LS	---	---	335,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				760,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan

OTHER EQUIPMENT SUMMARY:

There is no other equipment required to be used with this facility project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There is no future funding required for this facility project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF HIGH TEMPERATURE HOT WATER, ZONE 2, INDUSTRIAL AREA

SITE PLAN

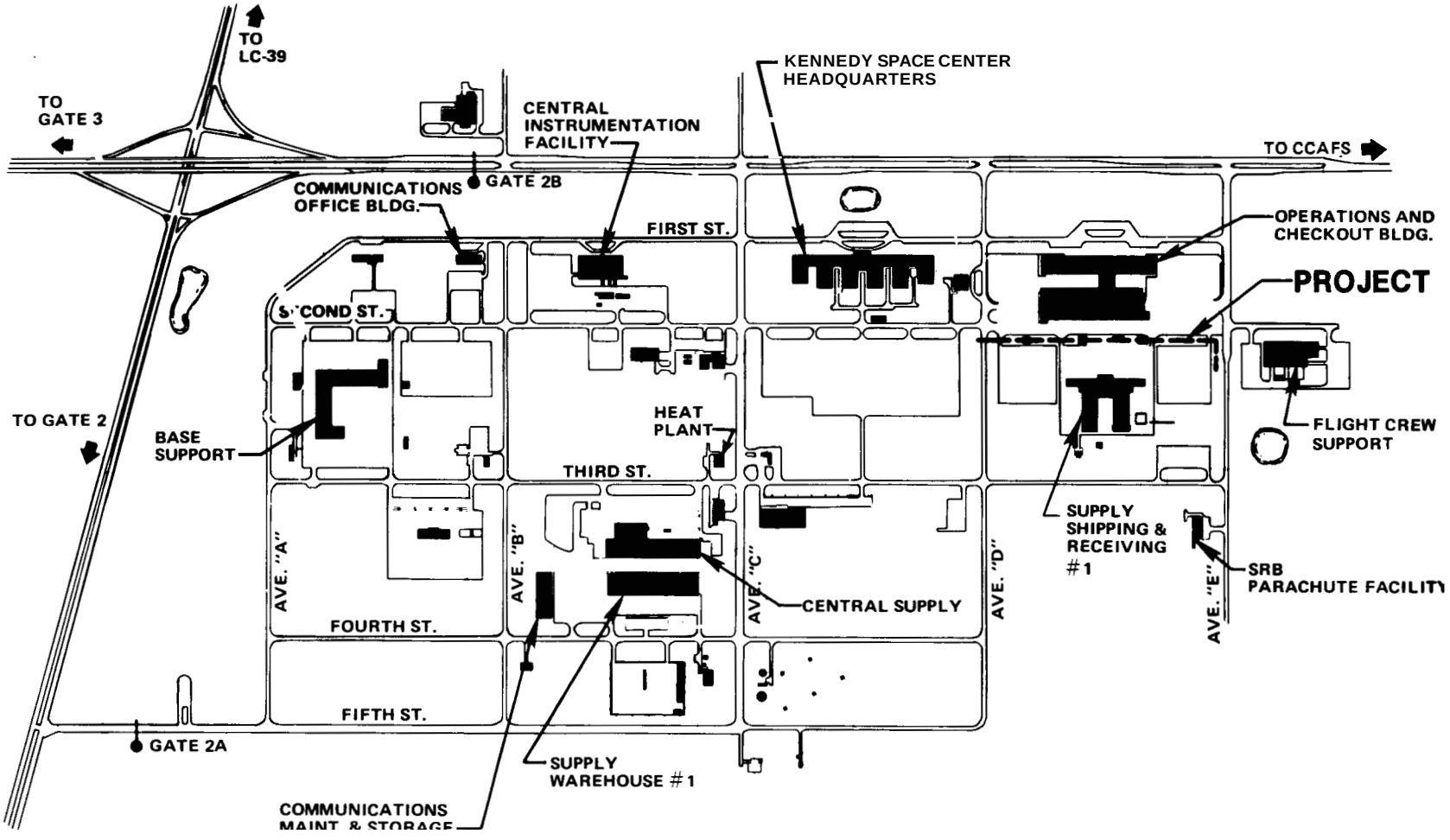


FIGURE 2

N

LANGLEY
RESEARCH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

LANGLEY RESEARCH CENTER

	Amount	Pane No.
Office of Aeronautics and Space Technolony;		
Modifications for Avionics Integration Research Laboratory (1220)	5,756,000	CF 4-1
Modifications to Aircraft Landing Dynamics Facility (1257)	15,000,000	CF 4-8
Rehabilitation and Modification of Gas Dynamics Laboratory (1247)	2,000,000	CF 4-17
Total.....~.....	22.756. 000	

LANGLEY RESEARCH CENTER

FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS FOR AVIONICS INTEGRATION RESEARCH LABORATORY, BUILDING 1220

LOCATION PLAN

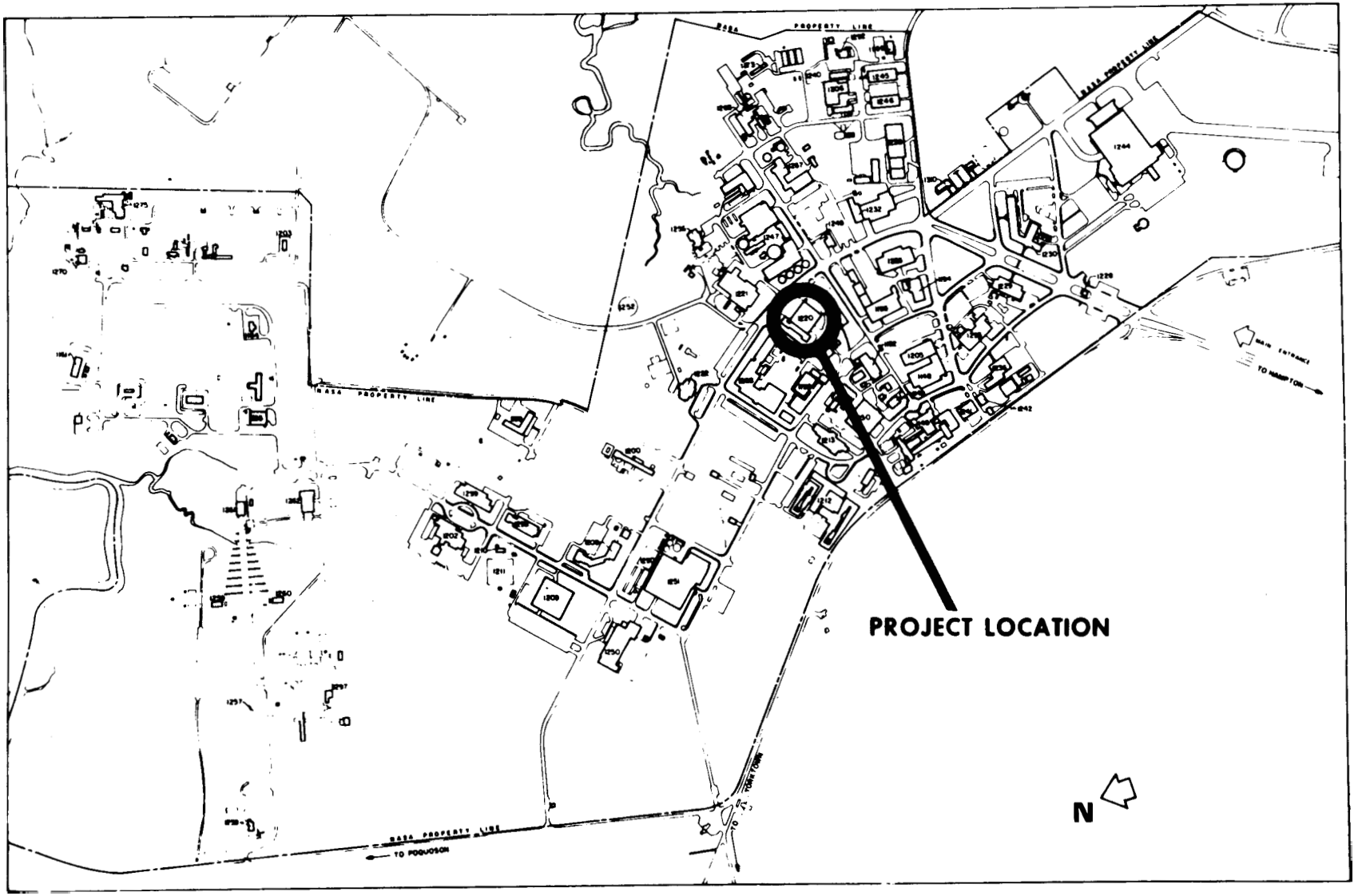


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modifications for Avionics Integration Research Laboratory, Building 1220

INSTALLATION: Langley Research Center

FY 1981 CoF ESTIMATE: $5,756,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	570,000	---	570,000
Capitalized investment	N/A	2,629,313	2,629,313
Total	570,000	2,629,313	3,199,313

SUMMARY PURPOSE AND SCOPE

Modifications for the Avionics Integration Research Laboratory (AIRLAB) at Langley Research Center (LaRC) will provide capability to conduct avionics integration research to formulate, study, and design automated avionics systems for future aircraft. This research will be broadly applicable to General Aviation, Vertical/Short Take-Off and Landing (V/STOL), and Conventional Take-Off and Landing (CTOL) aircraft. The facility will be used to perform research in advanced aircraft control systems, avionic data distribution

systems, highly reliable fault tolerant avionic systems, sensors, and actuators. In addition, it will be used to study and evaluate full systems integration of' new technology concepts for cockpit display and flight management. There is no facility that can provide this vital research capability.

PROJECT JUSTIFICATION:

This facility is required to support LaRC's assigned roles and missions for aeronautical avionics and control programs. AIRLAB will simulate an entire aircraf't avionics system. This comprenensive simulation capability will permit realistic assessment of new technology in a safe ground test environment, and encourage timely development and use of potentially high benefit (cost and performance) technology in future aircraft designs. The facility will be used to study advanced integrated avionics systems tnrough the use of actual flight hardware, microprogrammed simulators, unique logic emulators, and analytical modeling. AIRLAB will provide a capability, which does not exist, for bringing together advanced technology avionics and control elements into configurations which can be assessed and optimized. While complex avionic systems are readily conceived at this time, practical development and testing is limited. AIRLAB will be the catalyst and driving influence for assessment and safety assurance of fault tolerant fully integrated systems.

Projections of' future aircraft development point to more complex design requirements dictated by economics, noise control, energy efficiency, increased air traffic and control, stringent reliability, maintainability, and safety factors. These growing design complexities lead to a greater dependency on avionic systems for safe flight. The traditional method of flight testing tnese critical systems is unacceptable because of risks to aircraft and crew, as well as the aircraft fuel consumption and other operating costs resulting from the extremely long test times needed to gather performance and reliability data on advanced avionics systems.

Alternate approaches using existing facilities have been determined marginally suitable. The NASA-Johnson Space Center's Shuttle Avionics Integration Laboratory (SAIL) facility is dedicated to the Space Shuttle and would require extensive technological reconfiguration to pursue the activities proposed for AIRLAB. Air Force and Navy facilities are heavily scheduled and dedicated to tactical military problems including weapon delivery and, therefore, involve trade-off's not germane to the civil sector. None of the above facilities are dedicated to obtaining basic research data to guide development of advanced avionics and controls systems.

Research results from AIRLAB will be of keen interest to industry, the Department of Defense, the Federal Aviation Administration and the engineering community at large, as well as NASA. Industry and university on-site involvement in research is basic to the concept of AIRLAB. The research that will be performed in AIRLAB is required before the full benefits of advanced aircraft design concepts and future air traffic control systems and operational procedures can be realized. Advanced technology resulting from the use of this laboratory

should be developed, validated, and made available for designers by the late 1980's. because of the lead time necessary to bring this laboratory into operation and to accomplish the required research, it is imperative that this project be funded in FY 1981.

IMPACT OF DELAY:

This facility is needed to support development and evaluation of advanced avionics and controls technology. This technology is necessary for complementary research in areas such as crew-system integration and advanced aircraft control concepts. Without this facility, research analysis of advanced experimental avionic and control components cannot be effectively accomplished in a comprehensive, fully integrated, efficient manner.

PROJECT DESCRIPTION:

The AIRLAB will be a single story structure located within an existing high-bay area in the Simulation Research Facility, Building 1220 (Figures 1 and 2). The proposed modifications include construction of gypsum board walls, a ceiling, a raised removable-type computer room floor, and installation of air-conditioning. Existing primary electrical service is adequate for supplying the needed power for the new power distribution panels to be installed within AIRLAB. The equipment supporting the advanced avionics integration and interfacing research activities will be divided into eleven work areas within the AIRLAB facility. Nine of the eleven work areas are equipped with a minicomputer, disk mass-memory, a control console with keyboard and cathode ray tube (CRT) display, a printer-plotter, experimental control and graphics display unit, analog data recording equipment, and a laboratory-to-experimental systems interface rack. Each of the nine areas ("stations") will have the capability (through software) to not only simulate completely, or in part, an appropriate research function, out also to control experiments (fault insertions, performance monitoring, etc.) and retrieve, reduce, and display engineering data. One of the two remaining work areas will function as a research coordination control, and data acquisition center for conducting advanced avionics systems integration and interfacing experiments, and also as the interface to external systems such as those at the LaRC Data Reduction Center. This equipment includes: a digital data link interface to the Data Reduction Center, a minicomputer with disk mass-storage, a highspeed printer-plotter, analog data recorders, magnetic tape recorders, and a test control and display console. The remaining work area, the Digital Avionics Design and Reliability Analyzer, will be a computer and system diagnostic emulator consisting of a computer, disk and tape mass-storage, computer control and display equipment, and emulation experiment controllers and graphics display consoles.

PROJECT COST ESTIMATE:

The project cost estimate is based on a completed Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	623.000
Architectural/structural	SF	7,600	57.50	437,000
Mechanical	SF	7,600	22.50	171,000
Electrical	SF	7,600	28.30	215,000
[illegible]	---	---	---	4,933.000
Research support stations	EA	9	342,000	3,078,000
Research coordination, control and data acquisition center	LS	---	---	647,000
Digital avionics design and reliability analyzer	LS	---	---	1,208,000
Fallout Shelter (not feasible)	---	---	---	---
Total				5,756,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan

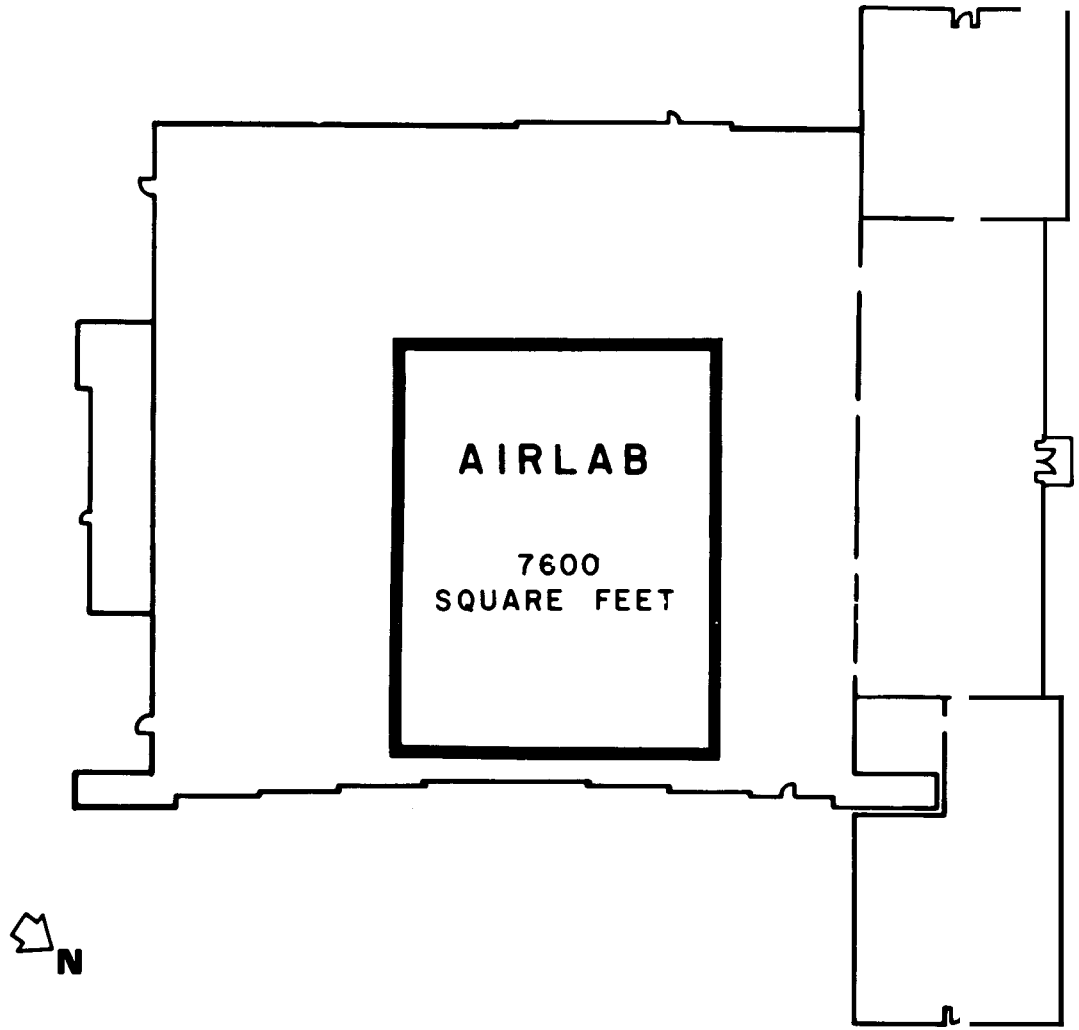
PMENT SUMMARY:

No additional equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future funding is required to complete this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS FOR AVIONICS INTEGRATION RESEARCH LABORATORY, BUILDING 1 20
SITE PLAN



FIGURE

LANGLEY RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO AIRCRAFT LANDING DYNAMICS FACILITY BUILDING 1257
LOCATION PLAN

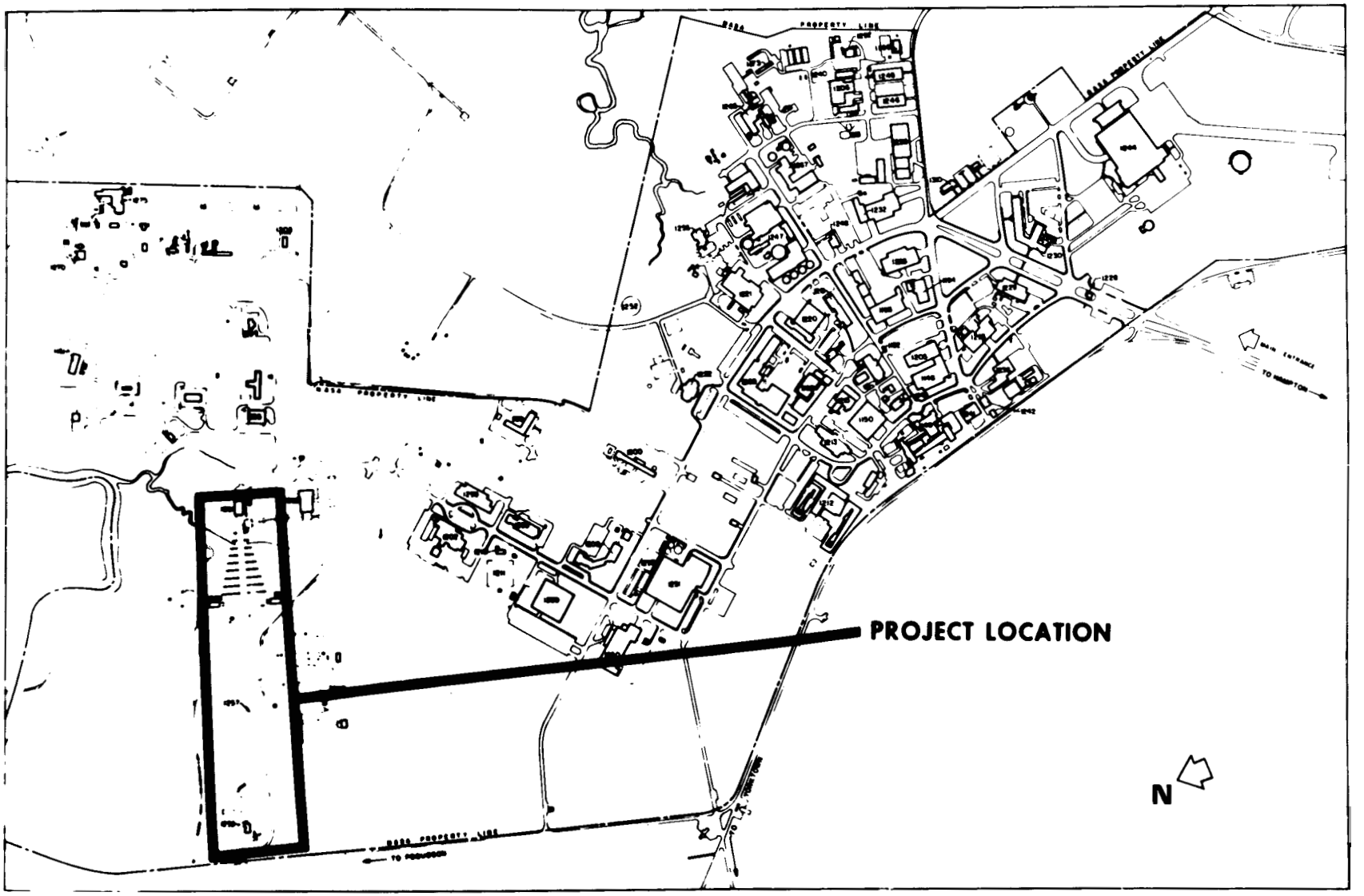


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modifications to Aircraft Landing Dynamics Facility (1257)

INSTALLATION: Langlev Research Center

FY 1981 CoF ESTIMATE: $15.000.000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUAR ERS OFFICE: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,440,000	---	1,440,000
Capitalized investment	N/A	5.401.305	5.401.305
Total	1.440.000	5.401.305	6.841.305

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to increase the test speed capability of the Aircraft Landing Dynamics Facility, located at the Langley Research Center (LaRC), from 110 to 220 knots to provide a facility capable of meeting current and anticipated needs for aircraft landing gear research. This research pertains to the solution of current operational and safety problems associated with landing gear systems of existing aircraft, as well as the development of technology for future aircraft and space vehicles. The carriage propulsion system will be modified to provide the increased thrust necessary to achieve the higher test speed capability; the present test track will be extended approximately 600 feet (183 meters) to increase the length of the test section;

and an improved, higher capacity carriage arresting system will be installed downstream of the lengthened test section. Also included is a new test carriage that will withstand the increased catapult and arrestment loads and which will feature an open bay area to accommodate larger landing gear test specimens. Service and storage space for the new carriage and the existing carriages will also be provided.

The modified facility will simulate landing speeds of existing and proposed aircraft as well as explore ground operations problems. It will also provide capability for testing the newer multiwheel landing gear. khen modified the facility will duplicate actual flight conditions (loads and speeds) for identifying causes of landing gear failures. This significantly improved test capability will lead to implementation of corrective actions for preventing failures that could cause loss of lives and multimillion dollar aircraft.

PROJECT:

Most research on runway grooving, braking and steering performance, slush drag and tire hydroplaning has been accomplished at the NASA Langley Aircraft Landing Dynamics Facility. The need for continued research is exemplified by the 25 landing gear related accidents experienced by commercial airlines in 1978. Three of these involved fatalities and all resulted in significant property damage. During the past two years, nearly 300 test runs were conducted at the Aircraft Landing Dynamics Facility. These tests included braking tests on blown tires and simulation of the catastrophic DC-10 accident at Los Angeles to support the National Safety Transportation Board (NSTB) investigations. However, the simulations were limited by the speed capabilities of the existing facility. Also tested during this period were several antiskid braking systems for slippery runways, a new "air cushion" landing gear concept, and the shimmy characteristics of the Space Shuttle nose gear. Tests are also scheduled for early 1980 to investigate F-4 and F-15 landing gear and runway interaction problems.

Another major concern to airlines and aircraft manufacturers is the high maintenance costs for landing gear, brakes and tires. This facility will provide the capability to analyze stresses for optimizing design and performance and to achieve reduced operation and maintenance costs.

The present Landing Dynamics Facility became operational in 1956. At that time, 100 knot landing speeds were standard for propeller driven aircraft. After the facility became operational, jet aircraft development pushed landing speeds up to 120 to 160 knots. Current aircraft operating speeds have increased to 160 knots at touchdown and nearly 200 knots at take-off, necessitating the development of improved tires, braking systems, and landing gear shock absorbers. Aircraft have grown in size such that multiwheel landing gear systems are required to reduce surface bearing pressure levels to within the load bearing capacities of the existing runways. Such landing gear present many design and performance problems which have not been adequately

researched. In addition, tire-runway interface characteristics require better definition, especially those affected by water, snow, or ice. Research testing in the upgraded facility is essential to improve such distributed load landing systems for aircraft of the future.

A major area of emphasis for commercial transport development is all-weather landing systems and a means for metering and spacing aircraft to increase runway utility, especially during inclement weather. A part of this research includes the exploration of high speed turnoffs and taxiway maneuvering. Such high speed ground operations are necessary to avoid simply moving the congestion from the final glide path to the runway. The Terminally Configured Vehicle (TCV) will be subjected to flight and landing experiments which must be accompanied by controlled high speed tests in this facility. Data from such testing will also provide engineering criteria for landing dynamics simulators. These complementary research activities should be conducted concurrently to realize the maximum benefits of fully integrated research.

Capability does not exist for conducting full-scale tests on landing gear systems for future space vehicles returning from orbit. Normal Space Shuttle landing speeds are expected to be in the 160 to 200 knot range. Pad-abort landing speeds may approach 220 knots. With the increased capability provided by this facility, ground tests on flight hardware can be conducted under actual flight operating conditions with no risk to personnel or the space vehicles. Unconventional landing gear concepts, such as the skids used on the X-15, are promising candidates for future space vehicle applications and can be developed using this facility.

IMPACT OF DELAY:

This project must be accomplished now to provide increased capability for developing technology required for upgrading and modifying landing gear systems on existing civil and military aircraft. The existing facility, with its current test limitation of 110 knots, can only explore about 60 percent of the safety and operating problems of current and proposed aircraft. No capability exists for testing high speed conditions which currently present very complex engineering design problems. Without capability for full-scale testing of future landing gear systems under simulated take-off and landing conditions, advancements in landing system technology will be limited. For example, safe operation in all-weather environments, which appears achievable from the standpoint of approach and landing systems and avionics and controls, demands high speed operating capabilities for landing gear systems. Along with safety considerations, economic factors important to efficient operations are served by improvements in landing gear systems. Additionally, future space vehicle landing gear design and development must include full-scale tests before actual operations in order to reduce risks to crews and vehicles.

PROJECT DESCRIPTION

The following facility modifications will be made: (1) necessary site development; (2) extend the present track by approximately 600 feet (183 meters); (3) construct a carriage service building at the rear of existing Building 1262 (Office Building), and relocate Building 1261 (Track Shop) and Building 1261-B (Tire Storage Building) now located at the end of the existing track; (4) construct a high speed, open bay test carriage; (5) increase the thrust capability of the carriage propulsion system; (6) install an improved higher capacity carriage arrestment system; and, (7) make minor modifications to the support systems.

Site Development

The perimeter road will be extended approximately 600 feet (183 meters) and the tow path will be extended approximately 600 feet (183 meters); utilities relocated; surface drainage rerouted; an earthen berm provided for protection of neighboring facilities; and electric power provided.

Track Extension

The current track is 2,200 feet (671 meters) long and consists of a 400-foot (122-meter) carriage acceleration section, a 1,200-foot (367-meter) test section, and a 600-foot (183-meter) carriage arrestment section. The present track will be extended by approximately 600 feet (183 meters) to provide an 1,800-foot (549-meter) test section.

Carriage Service Building, Track Shop, and Tire Storage Building

A 14,000-square foot (1,338-square meter) Carriage Service Building will be constructed as an addition to Building 1262 to store and service all carriages, and to also provide an area for fabricating the new high speed carriage. The dimensions of this building will be approximately 180 feet (55 meters) long, 80 feet (24 meters) wide, 45 feet (14 meters) high. Building 1261 (Track Shop) and Building 1261-B (Tire Storage Building) will be relocated at the end of the new track extension to provide temporary on-track carriage storage and test tire storage.

High Speed, Open Bay Test Carriage

A new test carriage designed for forces to accelerate it to 220 knots will be constructed. The carriage will feature a large internal open bay area to accommodate bulky landing gear test specimens. The carriage will be approximately 72 feet (22 meters) long, 40 feet (12 meters) wide and 30 feet (9 meters) high, with an open area approximately 20 feet (6 meters) wide and 40 feet (12 meters) long. A model drop system capable of

loading test gear to 50,000 pounds (22,700 kilograms) will be provided. The carriage design will be of the same general character as the existing landing gear test carriage, and will be compatible with the existing test facility.

Carriage Propulsion System

The present carriage propulsion system will be replaced with a new, larger L-shaped pressure vessel, quick opening valve and exit nozzle system for rapidly ejecting high pressure water at increased thrust levels. The foundation for the present L-shaped vessel will be modified to accommodate the higher thrust loads of the new system. These modifications will produce sufficient thrust to accelerate an 85,000 pound (38,590 kilogram) carriage to 220 knots.

Carriage Arresting System

The new arresting system, installed along the lengthened test section, will be capable of absorbing more energy and of accommodating higher engagement speeds than the present system. However, the present system will remain operational to permit testing while the track is being extended, and to arrest the carriages during low speed tests and for high speed hydrodynamic tests which employ the water tank that parallels the track.

Modifications to Support Systems

Modifications to the support systems will include update of the catapult control system; overhaul of the valves to the air storage tanks; update of the hydraulic controls for the quick opening valve; modification of the liquid nitrogen tank, pump and converter; and, repair and extension of the existing runway test surface.

PROJECT COST ESTIMATE:

This project cost estimate is based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	5,570,000
Site development	LS	---	---	1,050,000
Track extension	LS	---	---	2,460,000
Carriage service building, track shop, and tire storage building	LS	---	---	2,060,000
Equipment	---	---	---	9,430,000
High speed, open bay carriage	EA	1	---	2,180,000
Carriage propulsion system	EA	1	---	5,170,000
Carriage arresting system	EA	1	---	1,910,000
Modifications to support systems	EA	1	---	170,000
Fallout Shelter (not feasible)	---	---	---	---
Total				15,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Plan View

OTHER EQUIPMENT SUMMARY:

No additional equipment is required for this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No additional future CoF funding is required for this project

LANGLEY RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO AIRCRAFT LANDING DYNAMICS FACILITY, BUILDING 1257
PLAN VIEW

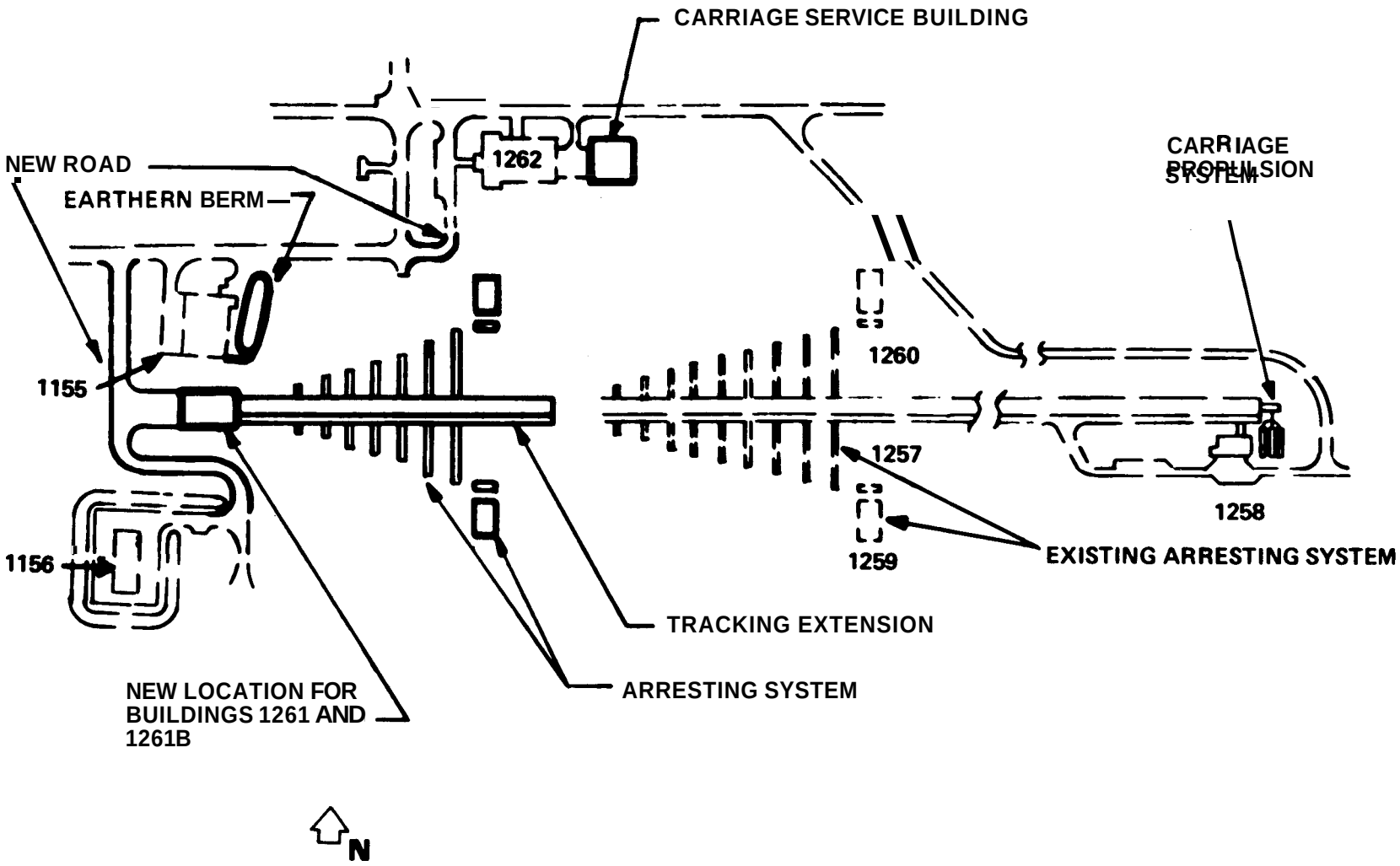


FIGURE 2

LANGLEY RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES

REHABILITATION AND MODIFICATION OF GAS DYNAMICS LABORATORY, BUILDING 1247
LOCATION PLAN

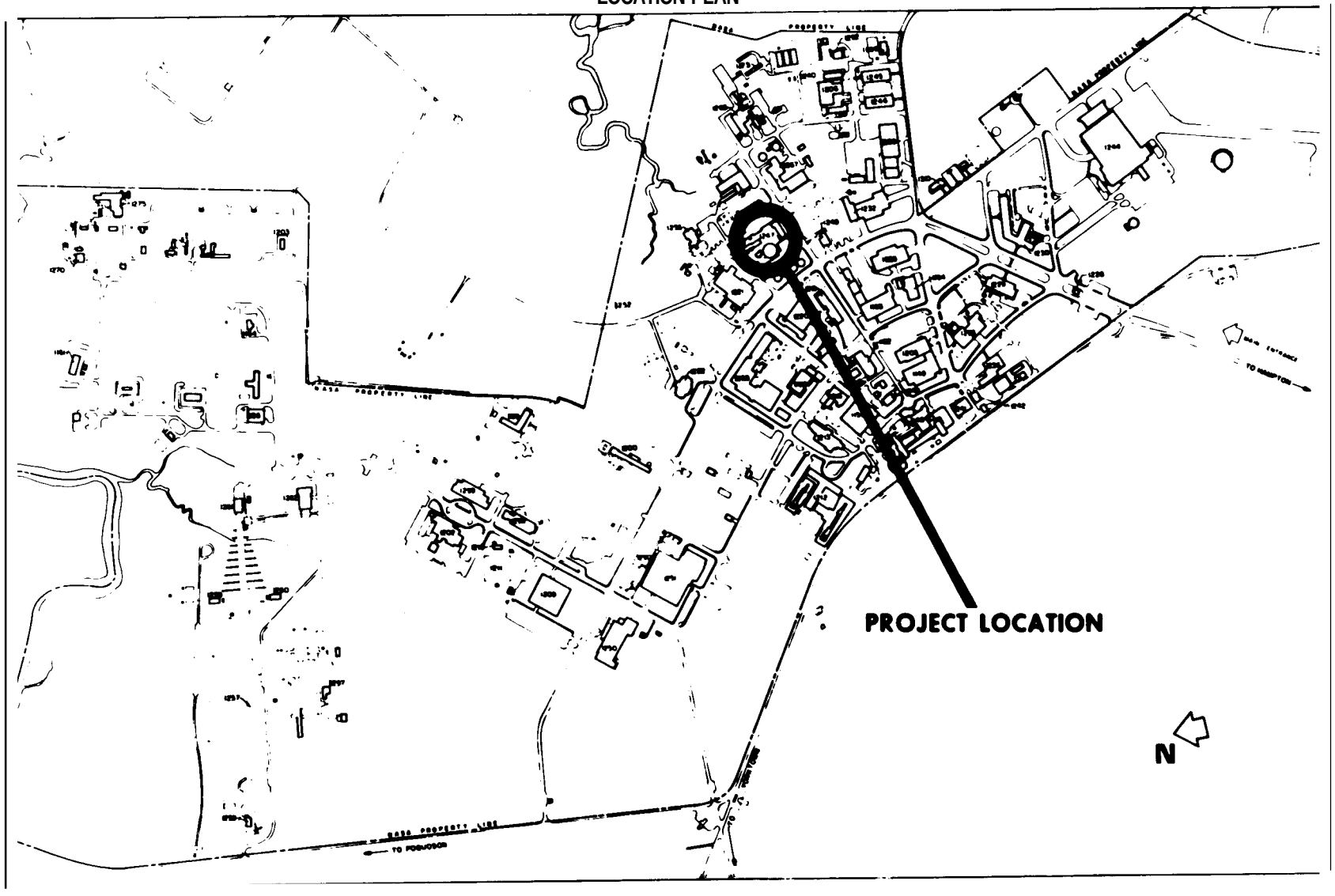


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of Gas Dynamics Laboratory (1247)
INSTALLATION:	Langley Research Center
FY 1981 CoF ESTIMATE:	$2,000,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology/Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	512,948	3,600,000	4,112,948
Capitalized investment	N/A	18,232,850	18,232,850
Total	512,948	21,832,850	22,145,798

SUMMARY PURPOSE AND SCOPE:

This project provides for the second and final phase of two phases of rehabilitation and modification of offices, laboratories and support equipment in the Gas Dynamics Laboratory (Figure 1) at the Langley Research Center (LaRC). The work is principally located in Building 1247A (High-speed Aerodynamics Division Laboratory offices), 1247B (Scramjet Test Facility), 12473 (Compressor Building), and 1247H (High Reynolds Number Helium Tunnel Complex (Figure 2). Building 1247D (Hypersonic Blowdown Tunnels) is being rehabilitated and modified by the FY 1980, Phase I project. This project includes overhauling, upgrading and modernizing as necessary

to meet safety, energy, and performance requirements related to wind tunnel control, wind tunnel flow, data acquisition, and noise abatement. Research in this facility complex supports many high priority NASA research programs such as laminar flow control, turbulent drag reduction, advanced supersonic transports, sonic boom alleviation, advanced space transportation systems (follow-on Shuttle), airbreathing launch vehicles, planetary entry probes, civil and military hypersonic aircraft, and hypersonic missiles.

PROJECT:

The Gas Dynamics Laboratory is a 28-year-old facility composed of several types of wind tunnels and test apparatus. New tunnels and facility equipment have been added over the years in response to changes in research emphasis. However, none of the older equipment has either been rehabilitated or received a major overhaul. This rehabilitation project completes the work initiated with the Phase I FY 1980 project on overhaul, upgrading, and modernizing which is necessary to assure future operations meeting safety, energy, and performance requirements.

The Building 1247 complex is critical to research testing from subsonic through hypersonic speeds. Its testing capabilities are particularly important in the Mach 3 to 8 speed range in which the next generation of advanced supersonic transports, hypersonic aircraft and missiles will fly. This laboratory of several small wind tunnels can test inexpensive, readily installed and easily modified models over a wide range of Mach numbers. Each of the facilities has at least one special experimental feature that makes its testing capability unique. Examples of such special features are high speed model injection mechanisms, laser-doppler velocimeter systems, Raman radiation instrumentation, electron beam flow visualization, varying Reynolds Numbers, and various flow media including air, nitrogen, and helium.

Interconnecting the vacuum systems of the east and west wings of the Gas Dynamics Laboratory by this project will provide approximately 500 percent more run time for five different facilities in Building 1247. The additional capacity will result in a cost savings of nearly $48,000 per year and a payback of just over six years. This is based on a $475 energy savings per test run resulting from less energy being used to pump down the connected vacuum systems than is used to pump up the gas storage system which operates the ejectors. The increased capacity will permit the long run times needed for both pressure distribution and boundary layer surveys for such programs as laminar flow control and turbulent drag reduction.

IMPACT OF DELAY:

Many of the components of this facility have been in existence since 1951 and have not had a major overhaul. If this facility is to continue to provide reliable research and testing capabilities, the necessary rehabilitation and modification work to maintain and improve the equipment and facility must be performed now.

If this project is delayed, failure of key components of this facility will severely impact critical ongoing and planned aerodynamic research work.

PROJECT:

The building structure and support equipment are virtually the same as originally constructed 28 years ago. Continuous use over the years has caused significant building and equipment deterioration and ever increasing maintenance workloads. This project addresses the following seven major areas of concern:

Rehabilitation of Buildings 1247B and 1247H

These buildings enclose floor areas of approximately 33,350 square feet (3,100 square meters), occupied by nine test cells and a small shop area. Also included are various control rooms, lavatory facilities, and a full basement. This structure was erected in 1951, except for a small addition (1247H) which was constructed in 1962. A new central air-conditioning system is needed to cool large quantities of electronic data gathering and signal conditioning equipment, and electronic control systems. The building roof and masonry walls will receive substantial repair work. Additionally, new windows will be installed, plumbing fixtures will be replaced as necessary, and the fire alarm system will be upgraded to present-day standards.

Rehabilitation Building 1247A

Building 1247A is a three-story office structure constructed in 1951. Its total floor area is approximately 17,300 square feet (1,607 square meters), plus a full basement. New air-conditioning will be provided, using the same central system as for Buildings 1247B, 1247D, and 1247H. The elevator will be modernized, the fire alarm system will be upgraded, and fire emergency egress will be improved by having one-hour rated enclosures installed on two existing stairwells. New lighting fixtures and windows will be installed. Offices will be equipped with suspended ceilings, and wall surfaces will be rehabilitated. Exterior masonry and roofing repairs as well as modifications for access by handicapped persons will also be provided.

- ch Vacuum Duct

A vacuum duct will be installed connecting the 100-foot (30.4-meter) vacuum sphere to the north vacuum system (Figure 2). This will consist of approximately 100 linear feet (30.4 meters) of 72-inch (183-centimeter) duct from the vacuum sphere to the roof of Building 1247D, where it will connect to an additional 100 feet (30.4 meters) of 36-inch (91-centimeter) duct being installed to connect, through an isolation valve, to the north vacuum pumping system.

Steam Ejector Muffler

A steam ejector is essential to the operation of the Scramjet Test Facility because of the possibility of hydrogen detonation from conventional mechanical vacuum pumping sources. This ejector produces ground level sound intensities in excess of 100 dBA for continuous periods of up to six hours. A muffler will be installed to reduce this noise to acceptable levels for personnel working outside and within the adjacent office building.

Mach 10/20 Tunnel Controls

The Mach 10 and Mach 20 legs of the High Reynolds Number Helium Tunnel are operated by programmable control systems which sequence events such as tunnel flow and model injection. Existing electronics are from the vacuum tube technology era. Work on these controls includes installation of solid state amplifier modules in all power supplies and controllers to provide greater reliability, less maintenance, and generally improved operating efficiencies and characteristics.

Air Storage Field Valve Installation

The 5,000-psi (3,515,000 Newtons/meter) air storage field at Building 1247E is divided into four sections, each having a 6-inch (15-centimeter) discharge line through a utility tunnel to the Gas Dynamics Laboratory. The existing manually operated, obsolete isolation valves are at the Laboratory end of the utility tunnel. These valves leak and are physically difficult to operate. This is an unsafe condition for such high pressure lines. The replacement valves will be installed at the storage field and will be motorized for fast, efficient and safe operation. The addition of these three valves will provide isolation capability for the whole or any section of the bottle field for safety and maintenance requirements, and will offer the flexibility and economies of using air at different storage pressures as required for research testing.

22-Inch Tunnel Supply Valves

There are two sets of valves, three per set, used for sectionalizing the helium storage tank system from the supply line to the 22-Inch (58-centimeter) Tunnel system. During runs, a valve operator in radio contact with the tunnel operators must be stationed outside the building to operate these valves manually. These valves will be replaced by motorized valves, related motor control centers and necessary structural supports. The new valves will be remotely operated and monitored from inside the building by tunnel operators.

PROJECT COST ESTIMATE:

This project cost estimate is based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1.260.000
Rehabilitation (1247B, and 1247H)	SF	33,350	13.00	430,000
Rehabilitation (1247A)	SF	17,300	48.00	830,000
Equipment	---	---	---	740.000
72-inch vacuum duct	LS	---	---	300,000
Steam ejector muffler	LS	---	---	100,000
Mach 10/20 tunnel controls	LS	---	---	70,000
Air storage field valve installation	LS	---	---	120,000
22-inch tunnel supply valves	LS	---	---	150,000
Fallout Shelter (not feasible)	---	---	---	---
Total				2.000.000

LIST OF RELATED GRAPHICS

Figure 1 - Location Plan
Figure 2 - Site Plan

OTHER EQUIPMENT SUMMARY:

There is no additional equipment required for this project.

FUTURE CoF ESTIMATED FUNDING TO COMPLETE THIS PROJECT:

There is no additional funding required for this project.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION AND MODIFICATION OF GAS DYNAMICS LABORATORY, BUILDING 1247
SITE PLAN

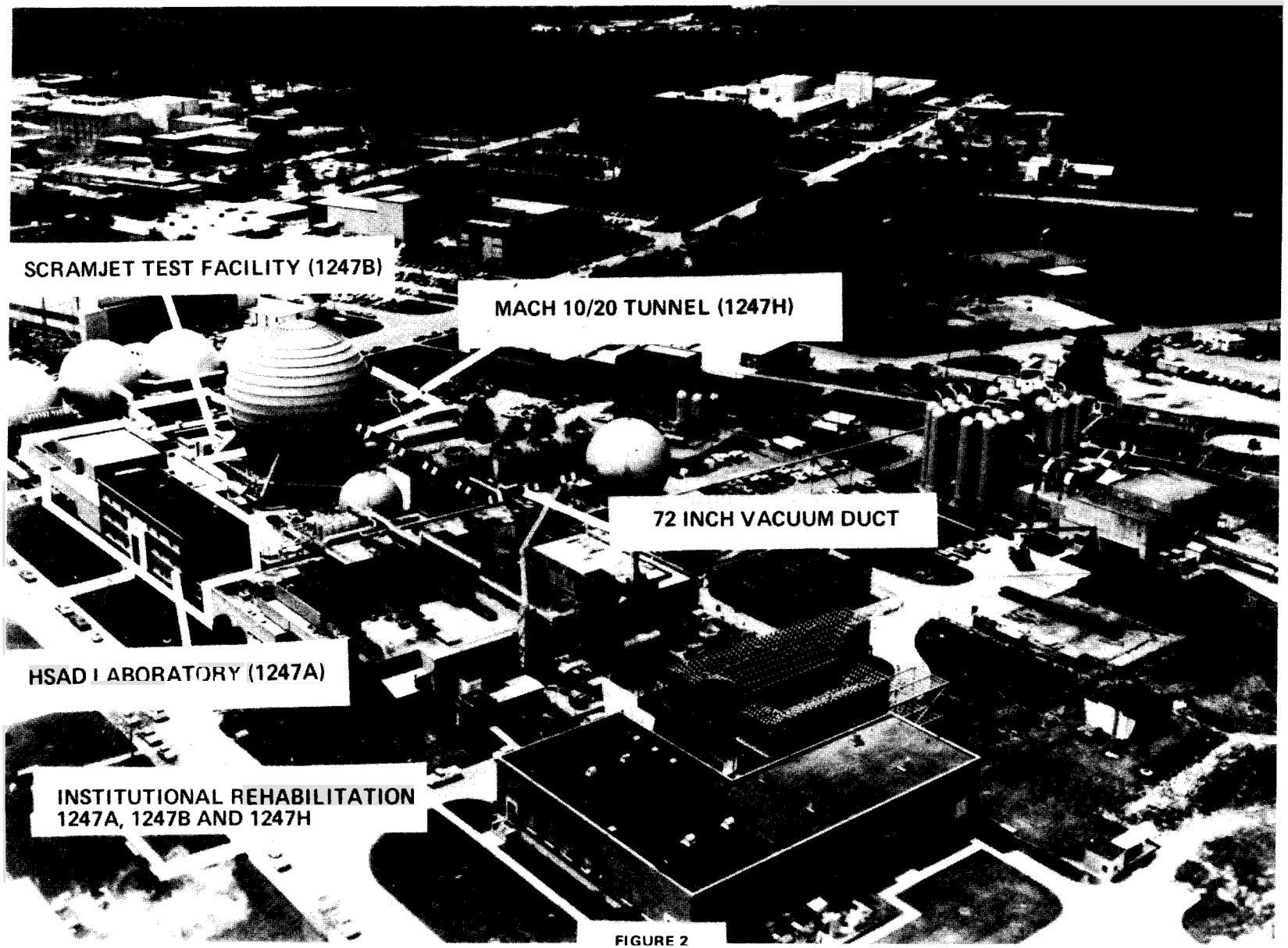


FIGURE 2

LEWIS
RESEARCH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

LEWIS RESEARCH CENTER

	Amount	Page No.
Office of the Comptroller:		
Decommissioning of Plum Brook Station Reactor Facility.	3,000,000	CF 5-1
Office of Aeronautics and Space Technology:		
Modifications to Central Air System, Various Buildings	7,655,000	CF 5-10
Rehabilitation of Electrical Switchgear, Engine Research Building 5.....	1,700,000	CF 5-21
Total.....	12,355,000	

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
DECOMMISSIONING OF PLUM BROOK STATION REACTOR FACILITY
LOCATION PLAN

PROJECT LOCATION

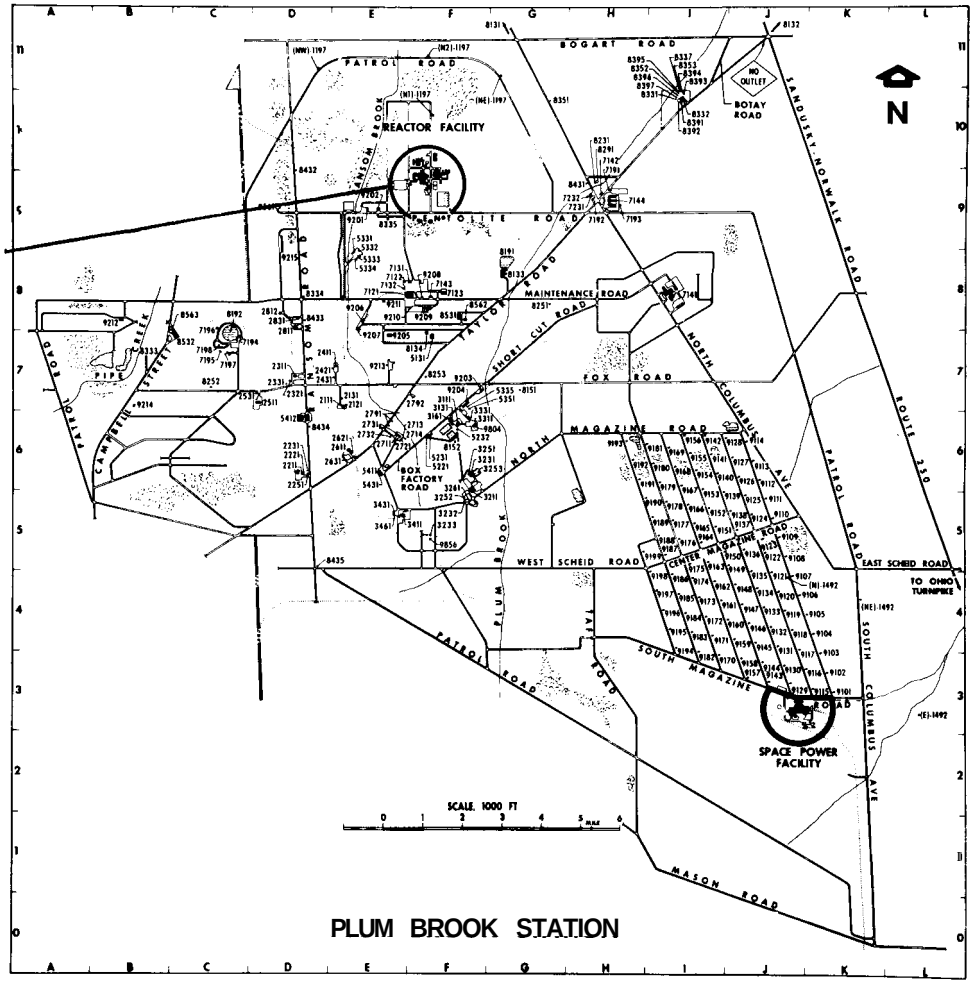


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Decommissioning of Plum Brook Station Reactor Facility
INSTALLATION:	Lewis Research Center
FY 1981 CoF ESTIMATE:	$3,000,000

LOCATION OF PROJECT: Plum Brook Station, Sandusky, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF finding	180,000	---	180,000
Capitalized investment	N/A	18.591.000	18.591.000
Total	180,000	18.591.000	18.771.000

SUMMARY PURPOSE AND SCOPE:

This project is the first of five phases of work estimated to cost $15 million for decommissioning the Lewis Research Center's (LeRC) Plum Brook Station Reactor Facility (Figures 1 and 2). Because of work constraints associated with radiation safety, decommissioning of this facility will require approximately five years of effort. The work included in this project is all that can reasonably be accomplished in FY 1981. Included is the removal of radioactive pipe and paving from the site ditches (Figure 3) and the removal of all

radioactive materials from the containment vessel in Building 1111 (Figure 4). All work will be in strict accordance with Nuclear Regulatory Commission (NRC) requirements and other applicable safety and health standards.

PROJECT JUSTIFICATION:

Research operation of the Reactor Facility was terminated in January 1973 and the facility was subsequently placed in standby status. Because radioactive materials are still present at the site, it is necessary to maintain this facility in its standby status until it can be decommissioned.

This 60 megawatt reactor facility was originally built for nuclear irradiation testing of nuclear fueled and unfueled experiments for space applications. Construction was started in 1956 and full power operation was achieved in April 1963. The reactor operated continuously at nearly 60 megawatts until operations were discontinued in 1973. During the period from January 1973 to July 1973, the entire facility was prepared for placement in standby status. At that time all nuclear fuel and fissionable materials were removed. It has now been determined that this facility will never be reactivated.

Currently, LeRC is under three NRC licenses. These include one for possession but not operation of the 60 megawatt test reactor, one for possession but not operation of a small mock-up reactor, and one for possession of radioactive materials. To meet the requirements for these licenses, LeRC must maintain the facility, provide adequate security and general surveillance, and provide quarterly radiological monitoring. In addition to maintaining the integrity of the buildings, building locks, and fences, LeRC must also maintain electrical power and designated temperature levels in the facility and cathodic protection of the reactor containment vessel. A continuous nitrogen gas purge through the reactor vessel, an alarm system, emergency lights, and telephone service must also be maintained. A communication center that is manned 24 hours per day and an administrative staff are required to fulfill all of these NRC requirements. The cost of maintaining this facility in standby status is approximately $300,000 per year in terms of 1981 dollars. This "holding" activity cost will continue until the radioactive materials are removed from the facility. A study has shown that the other options for decommissioning this facility, all of which involve delayed dismantling, would cost between $35 million and $45 million in terms of 1981 dollars. Prompt decommissioning will avoid these higher long term costs.

IMPACT OF DELAY:

Maintaining this unneeded facility in a standby status is costly and a continuing liability to NASA. Delay in performing this decommissioning work will unnecessarily extend these standby maintenance activities and their costs.

PROJECT:

This first phase of the total work for decommissioning the 60 megawatt Plum Brook Station Reactor Facility includes removal of all radioactive material from the containment vessel in Building 1111 and the removal of radioactive material from the site ditches (Figures 3 and 4). This includes removal of contaminated and irradiated equipment from the four experiment quadrants, the dry annular area, and Canal E of the containment vessel. Contaminated equipment will be decontaminated if possible. Also included is the decontamination of all containment vessel surfaces. Additionally, the concrete piping and asphaltic paving material in the site ditches will be removed and decontaminated.

Decontamination of radioactive equipment requires the reactivation of the existing decontamination equipment at the Reactor Facility. This includes the clothing laundry equipment and the equipment for reducing contaminated liquids to radioactive sludge. These reactivation tasks are included in this project.

Radioactive wastes, including irradiated equipment and radioactive materials accumulated during decontamination operations, will be disposed of by transfer to Nuclear Regulatory Commission approved burial sites.

PROJECT COST ESTIMATE:

This cost estimate is based on an evaluation study and a completed Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	---
Demolition	---	---	---	3,000,000
Removal of contaminated and irradiated equipment	LS	---	---	715,000
Decontamination of containment vessel	LS	---	---	560,000
Decontamination of contaminated equipment	LS	---	---	570,000
Removal and decontamination of site ditch piping and paving	LS	---	---	280,000
Disposal of radioactive wastes	LS	---	---	80,000
Support services	LS	---	---	795,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Aerial Photograph of Reactor Facility
Figure 3 - Site Plan
Figure 4 - Reactor Building (1111) Plan

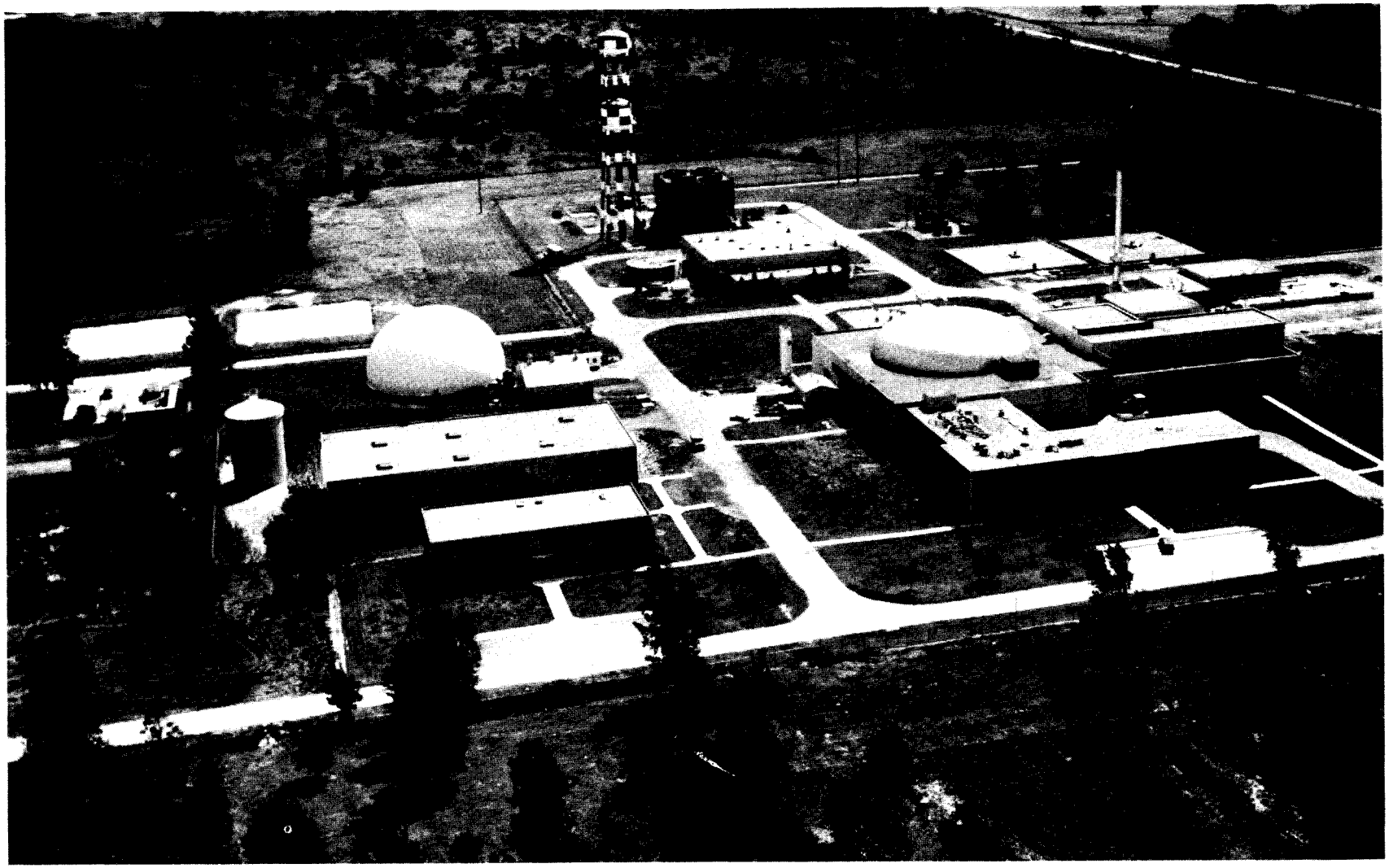
OTHER EQUIPMENT SUMMARY:

No other equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that an additional $12 million will be required to complete decommissioning of this facility. Current planning indicates that approximately $3 million per year for the next four years (FY 1982 - 1985) will be required to adequately support this effort.

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
DECOMMISSIONING OF PLUM BROOK STATION REACTOR FACILITY



AERIAL PHOTOGRAPH OF REACTOR FACILITY

FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
DECOMMISSIONING OF PLUM BROOK STATION REACTOR FACILITY
SITE PLAN

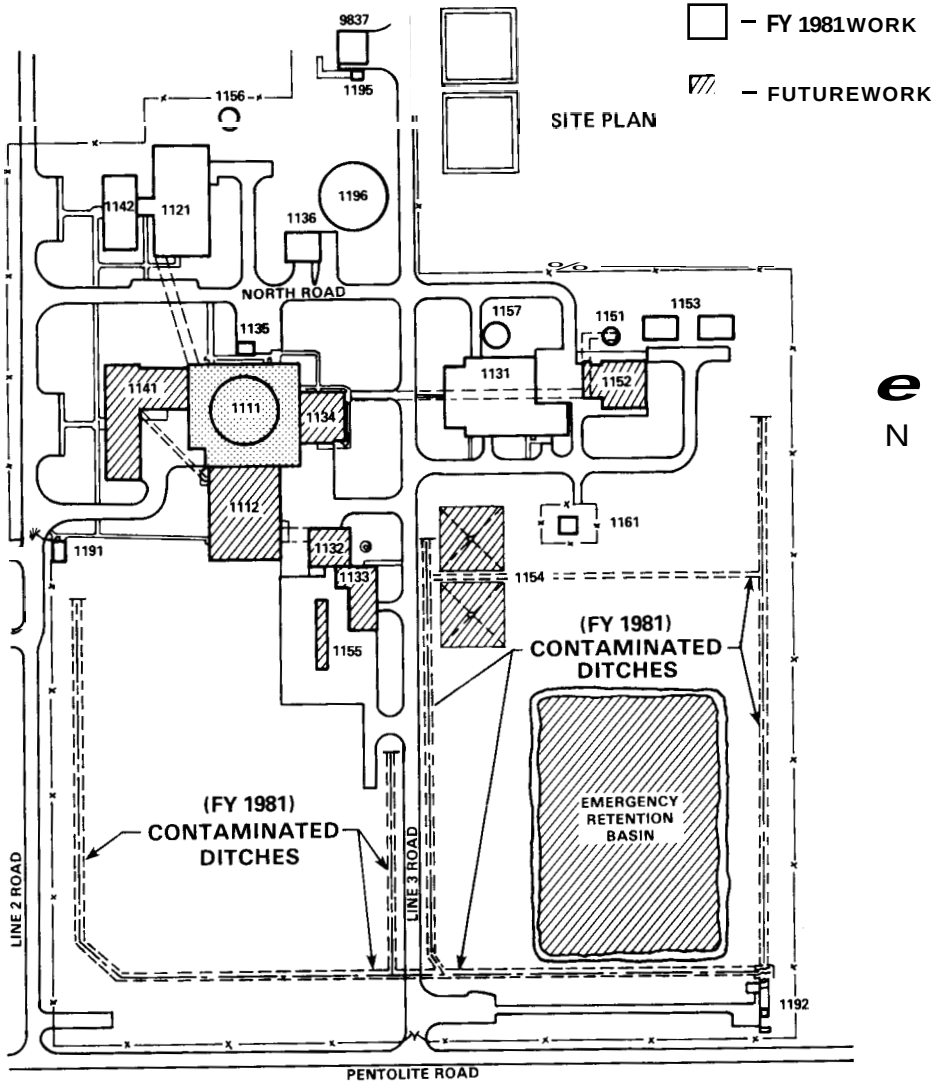
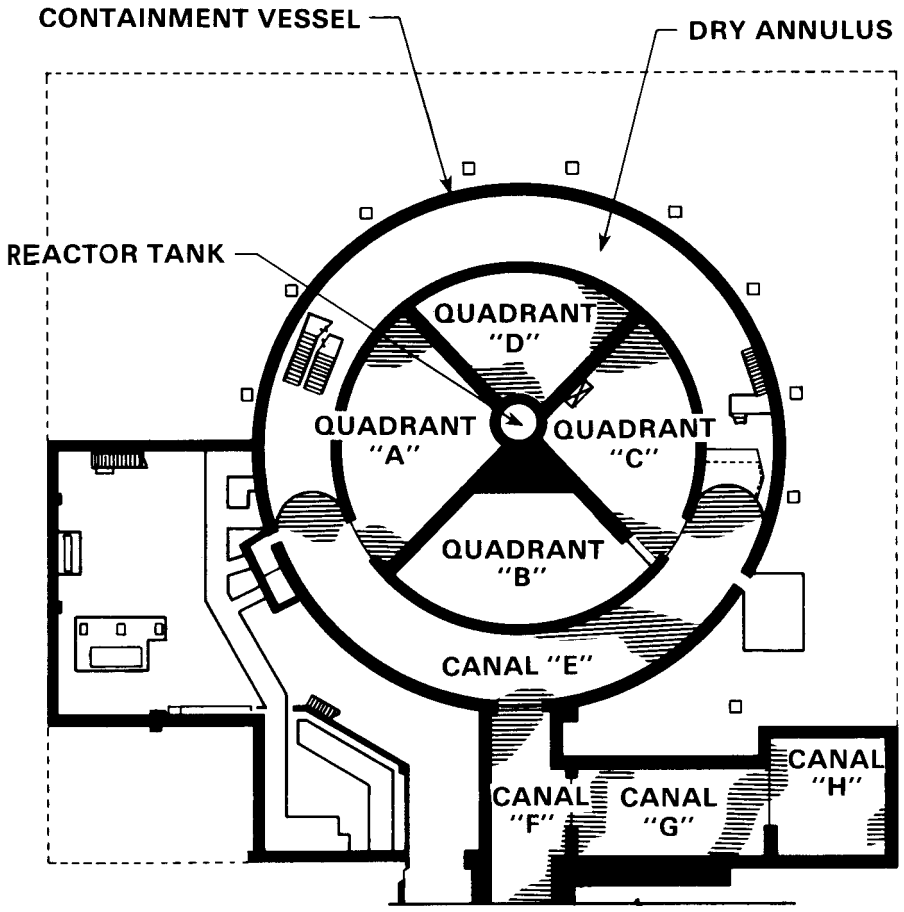


FIGURE 3

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
DECOMMISSIONING OF PLUM BROOK STATION REACTOR FACILITY



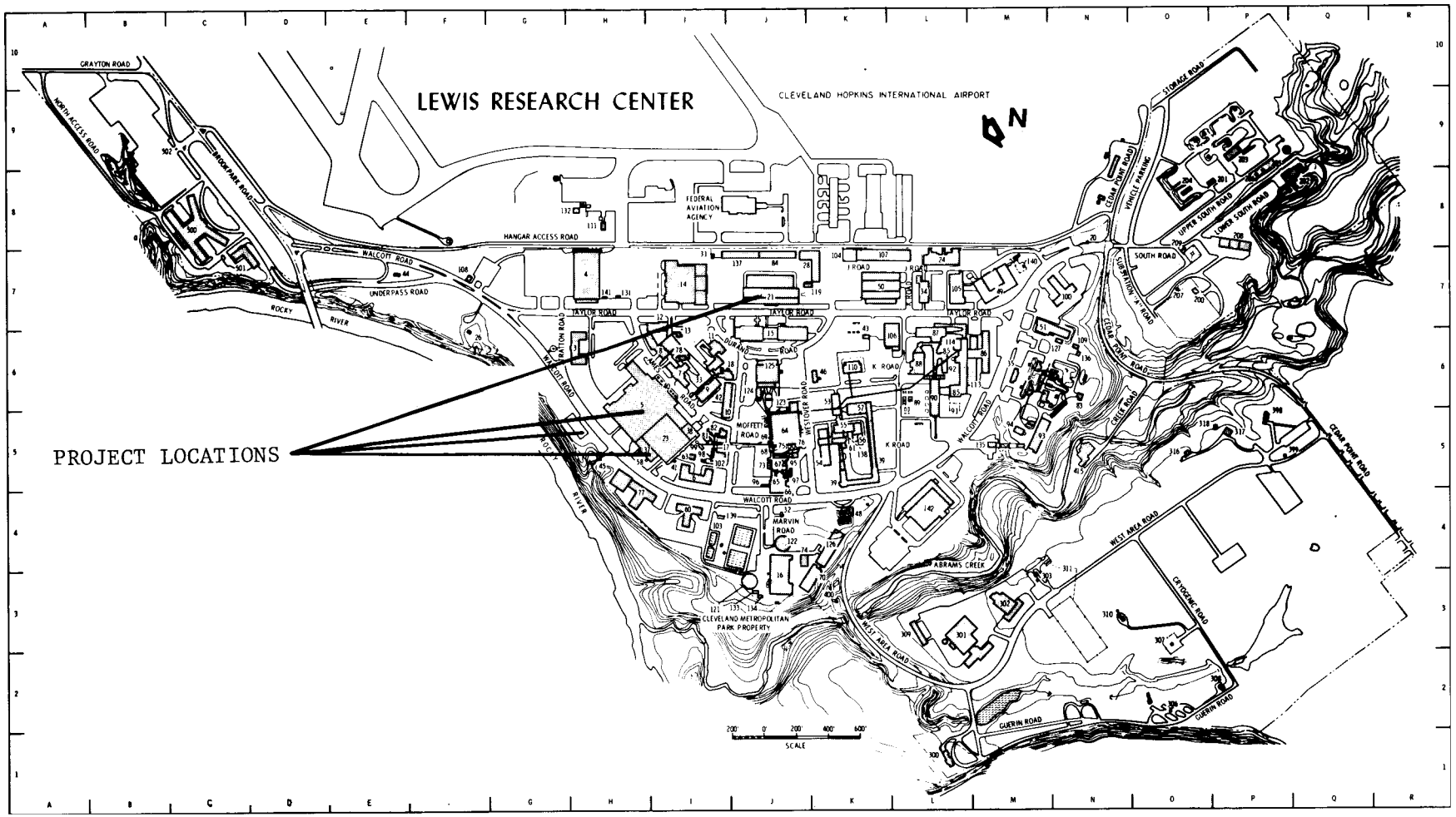
REACTOR BUILDING (1111) PLAN

FIGURE 4

LEWIS RESEARCH CENTER

FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS TO CENTRAL AIR SYSTEM, VARIOUS BUILDINGS



LOCATION PLAN

FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modifications to Central Air System, Various Buildings

INSTALLATION: Lewis Research Center

FY 1981 CoF ESTIMATE: ~~$7,655,000~~

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

~~COGNIZANT HEADQUARTERS OFFICE~~: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF finding	1,859,000	6,172,000	8,031,000
Capitalized investment	N/A	17,271,000	37,271,000
Total	1,859,000	41,441,000	45,102,000

SUMMARY PURPOSE AND SCOPE:

This project completes modifications to the Central Air System at Lewis Research Center (LeRC) begun with FY 1980 funding. These modifications provide for centralized operation of the Central Air System equipment located in the Engine Research Building complex (Buildings 5, 23, 37, and related areas). In addition, it centralizes the air and electrical services dispatching and utility control functions, and provides for replacement of the aging high pressure air system compressor (Figure 1). This project completes the overall upgrading of the Central Air System's outdated control and data acquisition systems started with the FY 1980 project.

The Central Air System provides essential compressed air and exhaust services to the majority of research test setups at the Center. The research supported is primarily aeronautical propulsion testing. Research programs include improvements in engine performance, durability, and efficiency and have as a goal the reduction of engine fuel consumption and polluting exhaust emissions.

The obsolete manual controls and data acquisition systems being upgraded by this project are unreliable. They are also inadequate for efficient support of research operations. Efficiency is also degraded by having the air and electrical power dispatching functions in two different locations. A failure of the high pressure air compressor would seriously disrupt research programs at LeRC. The modifications provided by this project will substantially increase the reliability and efficiency of the research support provided by the Central Air System.

PROJECT:

The Central Air System provides vital compressed air and exhaust services for the operation of over 100 different research test setups. Equipment concentrated at the Propulsion Systems Laboratory and the Engine Research Building complexes is connected to various test areas throughout the Center by a complex distribution piping system (Figure 2). The 20-30 year old Propulsion Systems Laboratory equipment primarily serves the larger research activities where tests of full scale gas turbine engines or other tests requiring high flow rates are conducted. The 30-35 year old Engine Research Building equipment primarily serves the smaller research activities where engine component tests and other tests with low flow rate requirements are conducted. This modification project for the Engine Research Building equipment and for the Central Air Dispatch, Electrical Power Dispatch and Utility Control System functions is fully integrated with the previously funded FY 1980 work in the Propulsion Systems Laboratory. This requested funding will provide for continuity and orderly, implemented improvement to the overall Central Air System.

The Engine Research Building equipment was installed in the 1940's. Although the basic air handling equipment is in good operating condition, the control systems are obsolete. These systems are pneumatically operated and are manually adjusted at control stations near the operating equipment (Figure 3). They are worn out and replacement parts are no longer available. Even when they were in satisfactory operating condition, these controls were too sluggish to respond to sudden changes in flow rate demands of the research test setups. The new control systems provided by this project will be electro-hydraulic systems for fast response to changing conditions and will be remotely operated from the new control area provided by the FY 1980 project.

The present data acquisition system also is inadequate. It consists of locally mounted gages near the operating equipment. Monitoring of the equipment is mostly by visual inspection and requires experienced operators to detect potential problems. The new data acquisition system provided by this project will monitor

critical equipment parameters and air flow conditions. It will also improve safety conditions by providing alarms when abnormalities and system shutdown occur, and allowable operating limits are reached. For efficient remote monitoring, all data displays and hard copy printout equipment will be located in the new control area.

Current operations are inefficient because Engine Research Building equipment operators are scattered in many locations. The Central Air Dispatch function is in yet another Engine Research Building location (Figure 5), and the Electrical Power Dispatch function is in Building 21 (Figure 6). Relocation of these functions to one central control room will greatly improve the operating efficiency of the Central Air System.

The current trend in gas turbine engine research is to higher pressures and temperatures to improve operating efficiencies. The 450 pounds per square inch (310 Newtons per square centimeter) high pressure air system supplies air for this research. This system consists of only one high pressure compressor. This compressor is now over 30 years old. Replacement parts must be custom made and delivery times are long. The new compressor system provided by this project will have a 38 pounds per second (17 kilograms per second) flow capability which is equal to that of the existing compressor. The new system will be installed as the primary supply system and the existing compressor system will be maintained as a backup.

IMPACT OF DELAY:

This project must be implemented now to provide vitally needed control and data acquisition systems for the Engine Research Building equipment, to increase the reliability of the high pressure air system, and to realize the benefits of centralized operations for the entire Central Air System and the associated Electrical Power Dispatch function. Because this project includes integration with the control and data acquisition systems provided with the FY 1980 project, a comprehensive concurrent design of both projects is being used to maximize the design process efficiency and to eliminate the possibility of system incompatibilities. Continuation at this time with the planned improvements to the Central Air System, begun with the FY 1980 project, will provide for the orderly and expeditious completion of these modifications and will provide maximum uniformity of equipment.

PROJECT:

This project provides computer-based, automated control and data acquisition systems for the Central Air System equipment in Buildings 5, 23, and 37 of the Engine Research Building complex and in related areas. Operation of these new systems will be from consoles installed in the new control area provided by the FY 1980 project. This FY 1981 project also provides for the relocation of the Central Air Dispatch function, the Electrical Dispatch function, and the Utility Control System master station from presently dispersed locations

to the new control area. In addition, a new 450 pounds per square inch (310 Newtons per square centimeter) high pressure air compressor system will be acquired and installed.

Installation of the new control system includes replacement of the obsolete pneumatic local controls with electro-hydraulic controls, the installation of various remote operated air routing valves, and the installation of all necessary hydraulic components, including a high pressure oil supply system. Operators' consoles will be installed in the new control area and integrated with the systems installed with the FY 1980 project. For safety and simplicity, these consoles will include television screen type displays with which operators interact by means of a lighted pen or similar electronic device for selection of "on-off" operations.

The new data acquisition and display system will include extensive instrumentation, television type displays, and recording devices. These will be used to monitor and record the equipment performance and operating characteristics. This system will be installed in the new control area and integrated with the systems installed with the FY 1980 project.

Included in this control and data acquisition systems work is the installation of new controls and monitoring equipment for the Central Air Dispatch and Electrical Power Dispatch functions. The Central Air Dispatch function will be relocated from the Engine Research Building 5 to the new control area. Similarly, the Electrical Power Dispatch function and the Utility Control System master station will be relocated from Building 21 to the new control area.

The new high pressure air compressor system includes building modifications and installation of a new 450 pounds per square inch (310 Newtons per square centimeter) compressor and related piping.

PROJECT COST ESTIMATE:

This cost estimate is based on a completed Preliminary Engineering Report and related studies.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	465,000
Demolition and repair of vacated services dispatch areas	LS	---	---	80,000
Building modifications for high pressure air compressor system installation	LS	---	---	385,000
Equipment	---	---	---	7.190 .000
Controls installation and integration	LS	---	---	2,900,000
Valve and hydraulic system component installation	LS	---	---	250,000
Data acquisition and display equipment installation and integration	LS	---	---	1,450,000
Transducer installation	LS	---	---	625,000
Multiplexer installation	LS	---	---	460,000
High pressure air compressor system installation	LS	---	---	1,505,000
Fallout Shelter (not feasible)	---	---	---	---
Total				7.655 .000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Aerial View of Piping Network
Figure 3 - Typical Local Compressor Controls
Figure 4 - Central Air Dispatch Control Room, Building 5
Figure 5 - Electrical Dispatch and Utility Control Master Station Control Room, Building 21

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

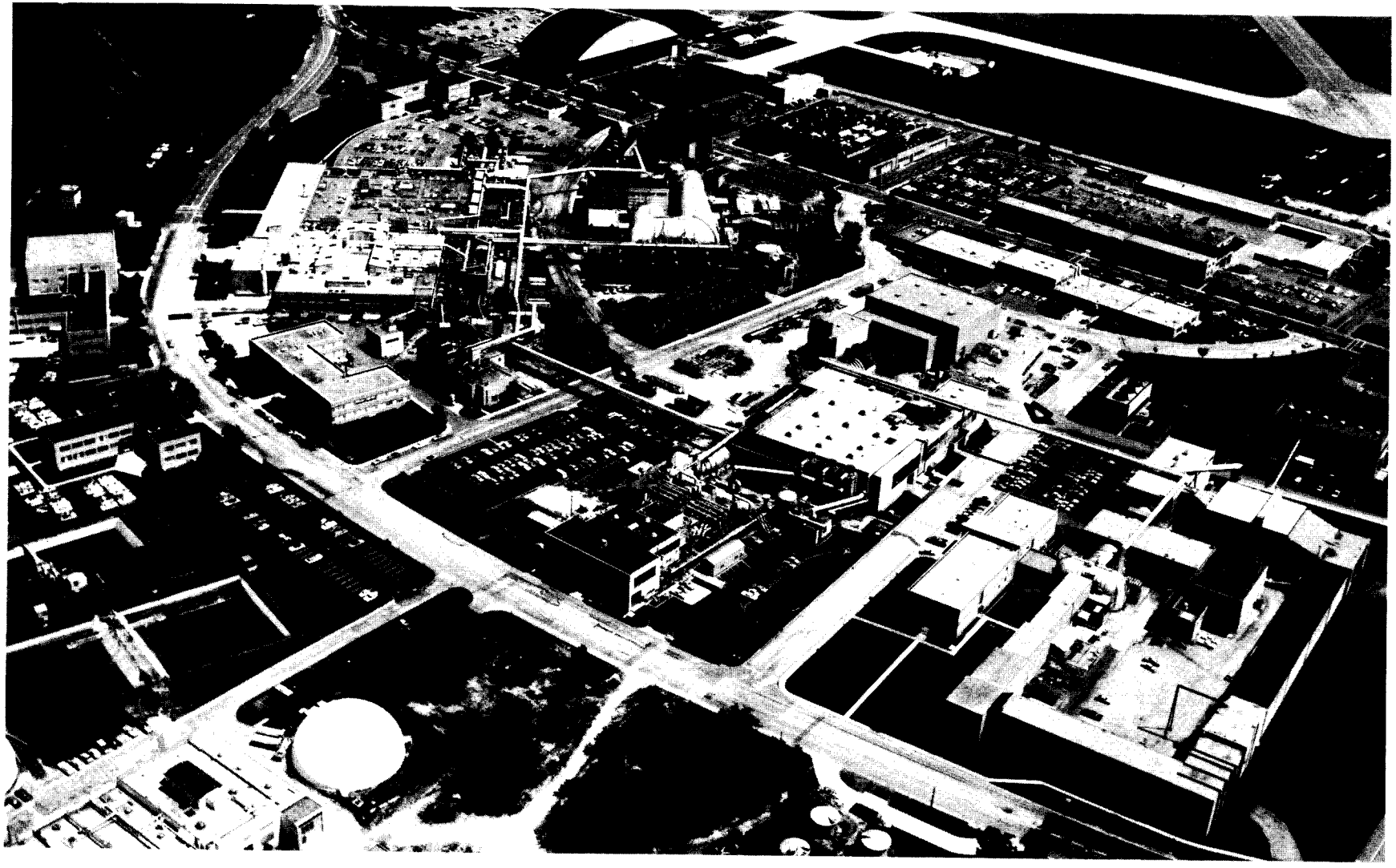
FUTURE CoF ESTIMATED FUNDING REQUIREMENTS TO COMPLETE THIS PROJECT:

No future CoF finding is required to complete this project.

LEWIS RESEARCH CENTER

FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS TO CENTRAL AIR SYSTEM, VARIOUS BUILDINGS



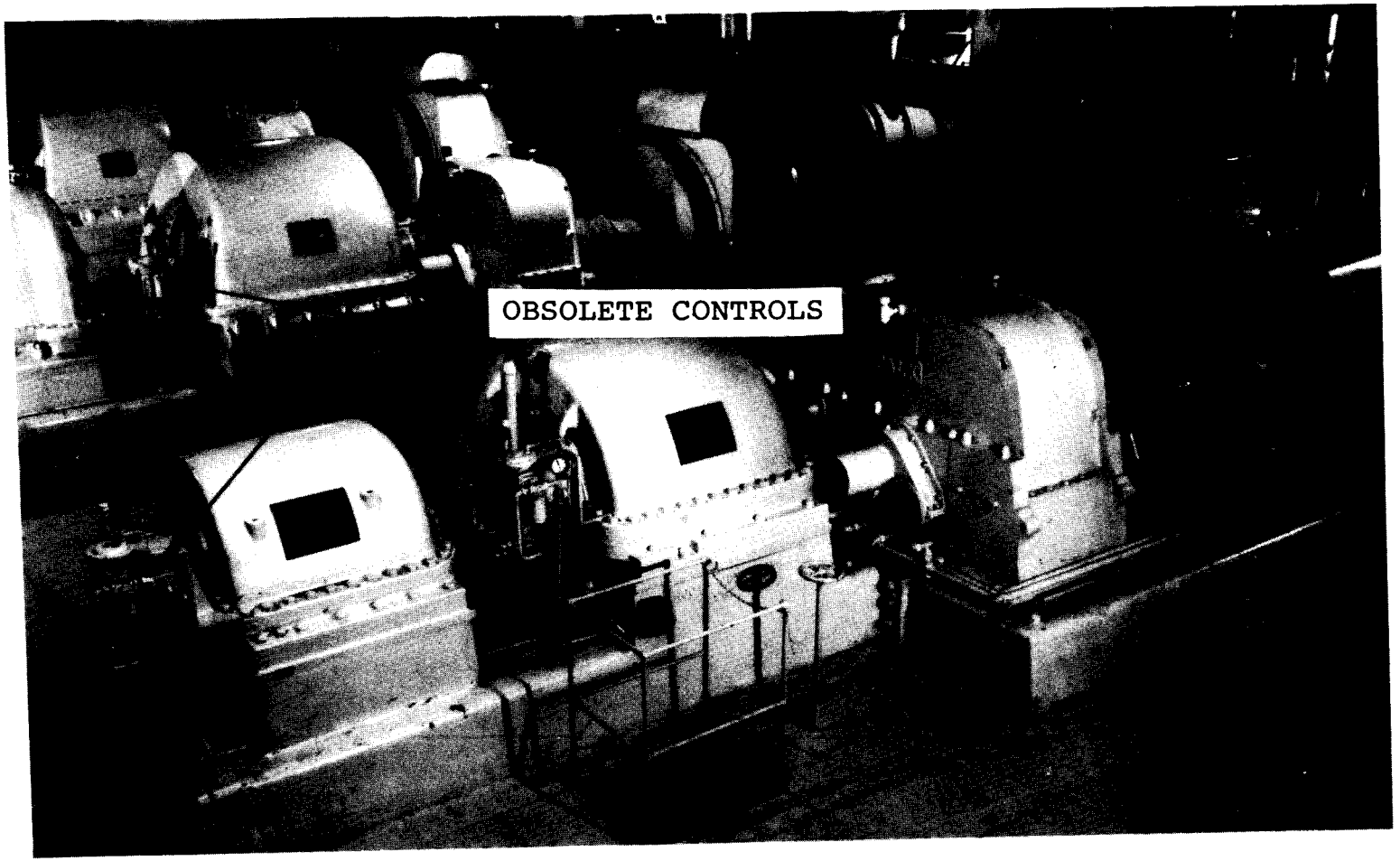
AERIAL VIEW OF PIPING NETWORK

FIGURE 2

LEWIS RESEARCH CENTER

FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS TO CENTRAL AIR SYSTEM, VARIOUS BUILDINGS



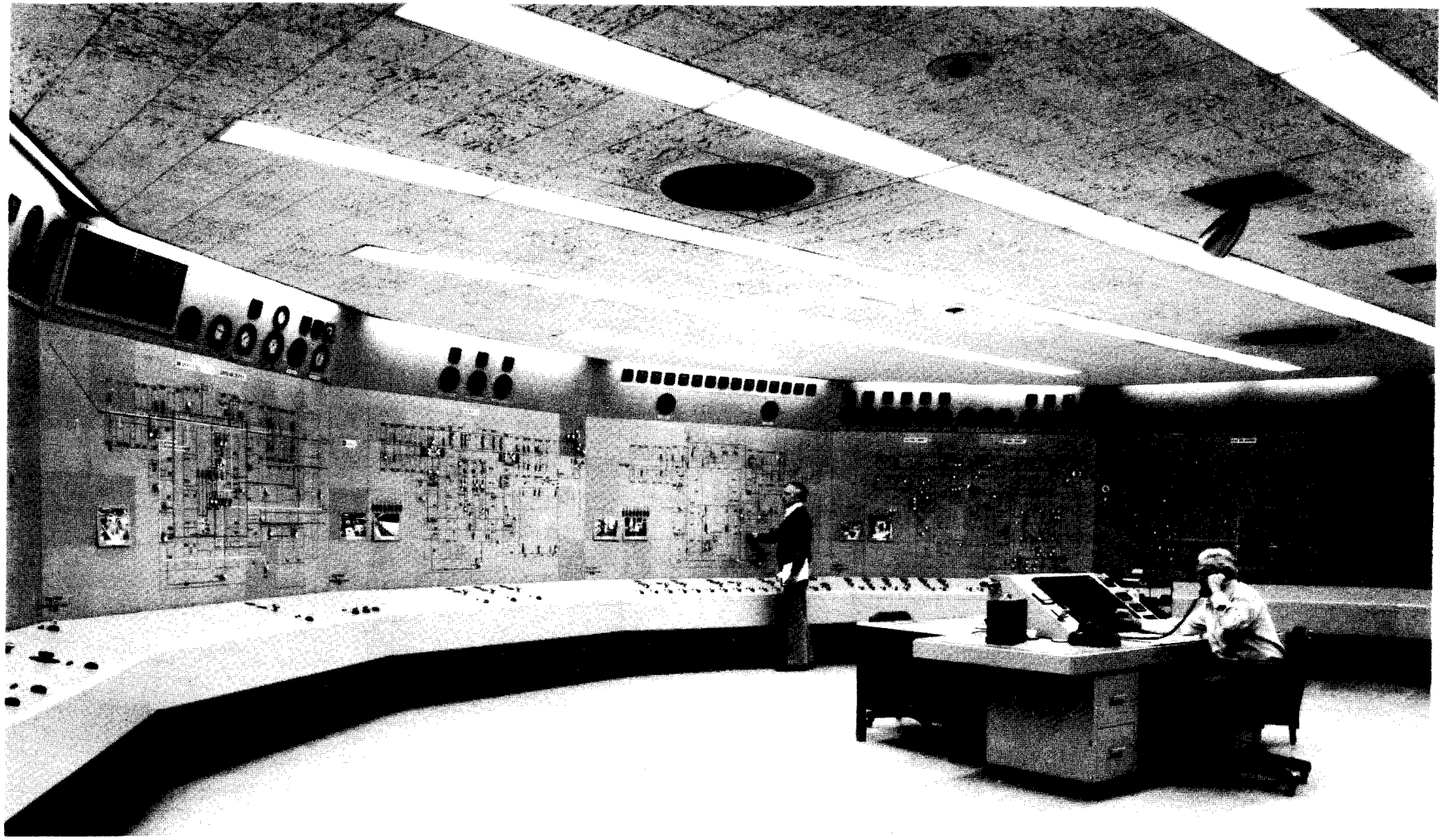
TYPICAL LOCAL COMPRESSOR CONTROLS

FIGURE 3

LEWIS RESEARCH CENTER

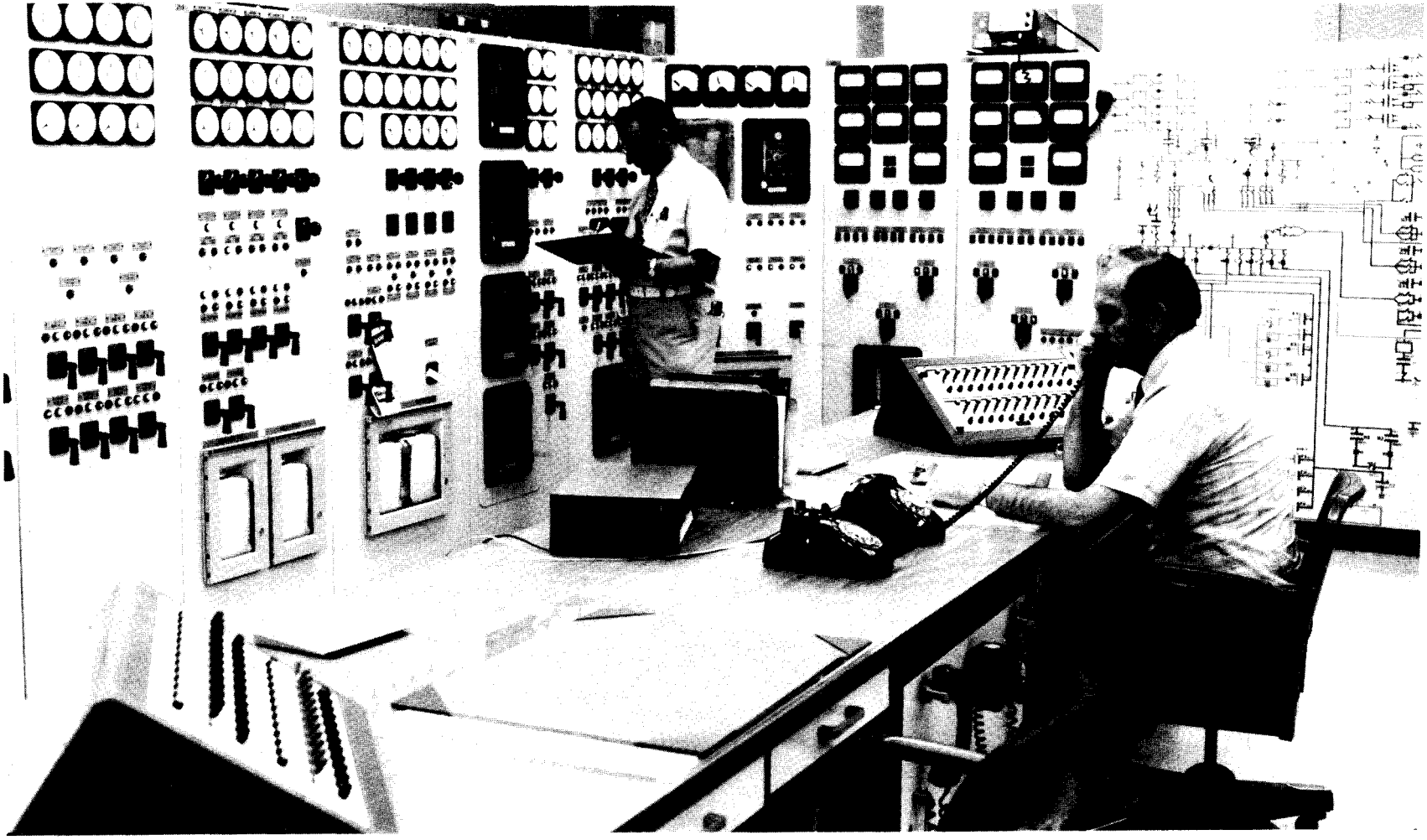
FISCAL YEAR 1981 ESTIMATES

MODIFICATIONS TO CENTRAL AIR SYSTEM, VARIOUS BUILDINGS



CENTRAL AIR DISPATCH CONTROL ROOM, BUILDING 5

FIGURE 4



ELECTRICAL DISPATCH AND UTILITY CONTROL MASTER
STATION CONTROL ROOM, BUILDING 21

FIGURE 5

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF ELECTRICAL SWITCHGEAR, ENGINE RESEARCH BUILDING 5
LOCATION PLAN

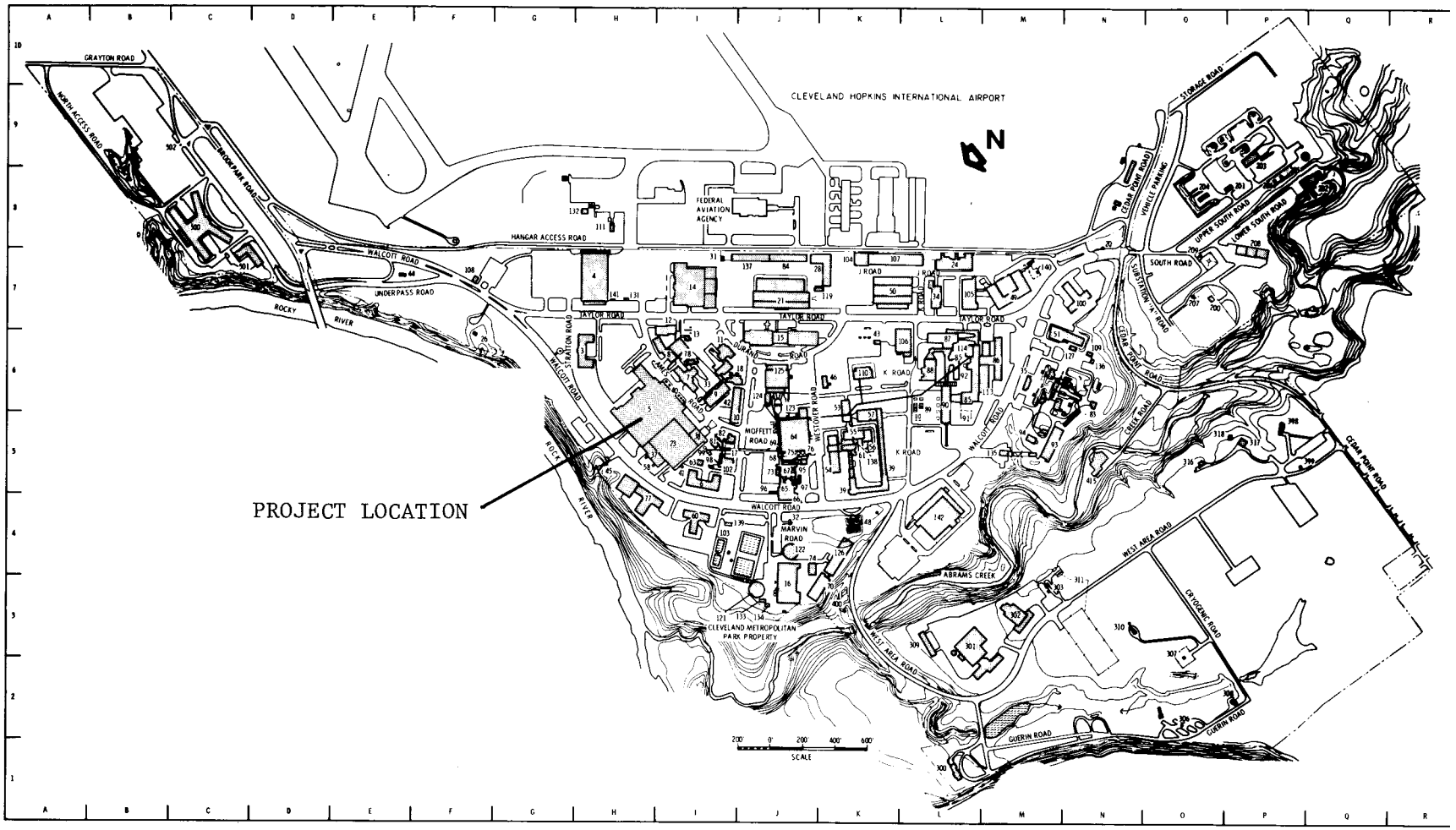


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Rehabilitation of Electrical Switchgear, Engine Research Building 5

INSTALLATION: Lewis Research Center

FY 1981 CoF ESTIMATE: $1,700,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	117,000	---	117,000
Capitalized investment	N/A	---	---
Total	117,000	---	117,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the replacement of forty (40) obsolete and unreliable medium voltage oil-filled electrical circuit breakers (Figures 2 and 3) in the basement of the Engine Research Building 5, at the Lewis Research Center (LeRC) (Figure 1). Air or vacuum type circuit breakers and fused motor starters, which conform with the National Electric Code, will be installed.

A potential for an explosion of these breakers exists, and such an explosion and resulting fire would be a serious hazard to personnel and vital research support equipment located in the vicinity of this switchgear.

Also, the existing circuit breakers, which are an integral part of the electrical power distribution system in the Engine Research Building complex (Buildings 5, 23, 37, and 38), do not conform with the National Electric Code. The new switchgear provided by this project will eliminate this hazard, increase the reliability of the electrical power distribution system in the Engine Research Building complex, and comply with the National Electric Code standards.

PROJECT:

The existing oil-filled circuit breakers are over 35 years old. The manufacturer of these units has derated their capacity on several occasions since original installation. Because of this derated capacity and the heavy duty required of them, these units are not adequate to successfully close during an electrical fault condition. Heat generated during a fault situation could be sufficient to cause an explosion of these circuit breakers. The oil in these units generally catches fire during such an explosion. If such an explosion and fire occurred, the hazard to nearby personnel and unique electrical and mechanical equipment, including many components of LeRC's Central Air System, would be great. In addition to these safety considerations, repair parts for these aging circuit breakers are no longer available and reliability of the breakers is decreasing.

The ability to test medium voltage electrical equipment under all conditions of operation has improved considerably since the existing switchgear was manufactured. As a result of improved testing, the manufacturer of the existing LeRC equipment has significantly reduced its ratings. The present rating of this equipment is being exceeded by 25 percent because the load approaches the full original rating. Although some margin of safety is usually incorporated in manufacturers' maximum ratings, adequate performance of this equipment at 25 percent above its maximum rating is a serious risk.

Twenty-four new circuit breakers provided by this project will replace the existing transformer main secondary circuit breakers and various feeder circuit breakers. These feeder breakers provide power to key LeRC research test facilities and critical research support equipment including the Central Air System service air compressors and altitude and atmospheric exhaust pumps, 250 volt direct current motor-generator sets, cooling water pumps, high speed variable voltage motor-generator sets, specialty transformers, and ventilation fans. The eleven motor starters provided in this project will replace 16 existing circuit breakers being used for this purpose. These starters will serve the drive motors for the Central Air System service air compressors and altitude exhaust pumps and the 250 volt direct current motor-generator sets. These motors range in power from 500 horsepower (373 kilowatts) to 2,150 horsepower (1,604 kilowatts).

IMPACT OF DELAY:

This work must be accomplished now to eliminate the hazards to personnel and equipment resulting from possible failures of existing switchgear. Extensive damage to critical research support equipment resulting from such a failure probably would also seriously impact research operations at LeRC. In addition, this work will substantially improve the overall reliability of the electrical power distribution system.

PROJECT:

This project provides for the replacement of forty (40) medium voltage, oil-filled, electrical circuit breakers and associated wiring located in the basement of the Engine Research Building 5 (Figures 2 and 3). Twenty-four of the existing circuit breakers which serve as 2,400 volt transformer secondary main and feeder circuit breakers will be replaced with air or vacuum type circuit breakers. The other 16 circuit breakers which are used as 2,400 volt motor starters and reduced voltage motor starters will be replaced with 11 fused air type motor starters. This equipment and installation will be in conformance with the National Electric Code and other applicable standards.

PROJECT COST ESTIMATE:

The project cost estimate is based on a completed Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	---
Equipment	---	---	---	1.700.000
Transformer main secondary circuit breakers installation	EA	4	70,000	280,000
Feeder circuit breaker installation	EA	20	43,300	866,000
Full voltage motor starter installation	EA	9	46,000	414,000
Reduced voltage motor starter installation	EA	2	70,000	140,000
Fallout Shelter (not feasible)	---	---	---	---
Total				1.700.000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Typical Switchgear
Figure 3 - Switchgear Wiring

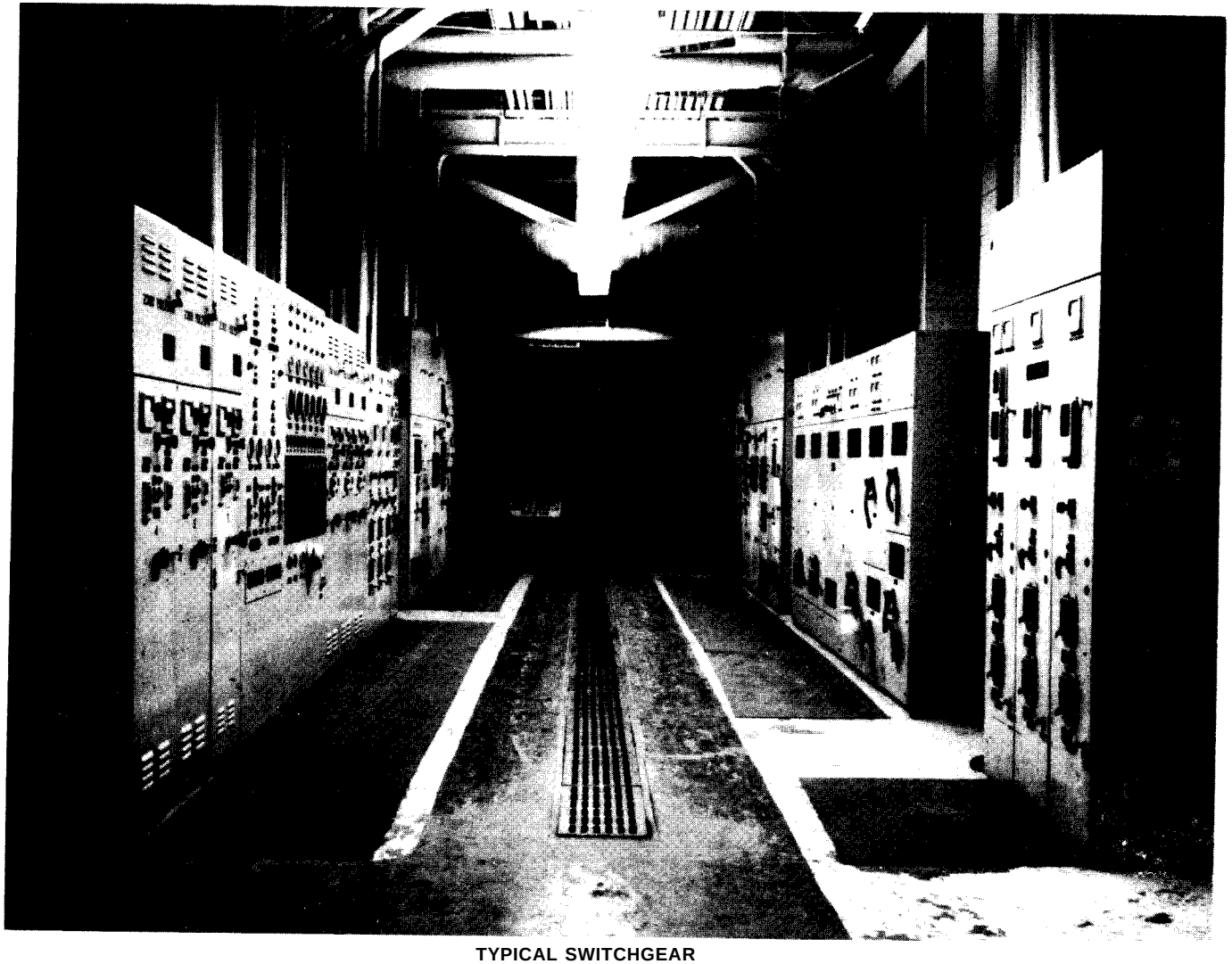
OTHER EQUIPMENT SUMMARY:

No other equipment required to complete this project

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

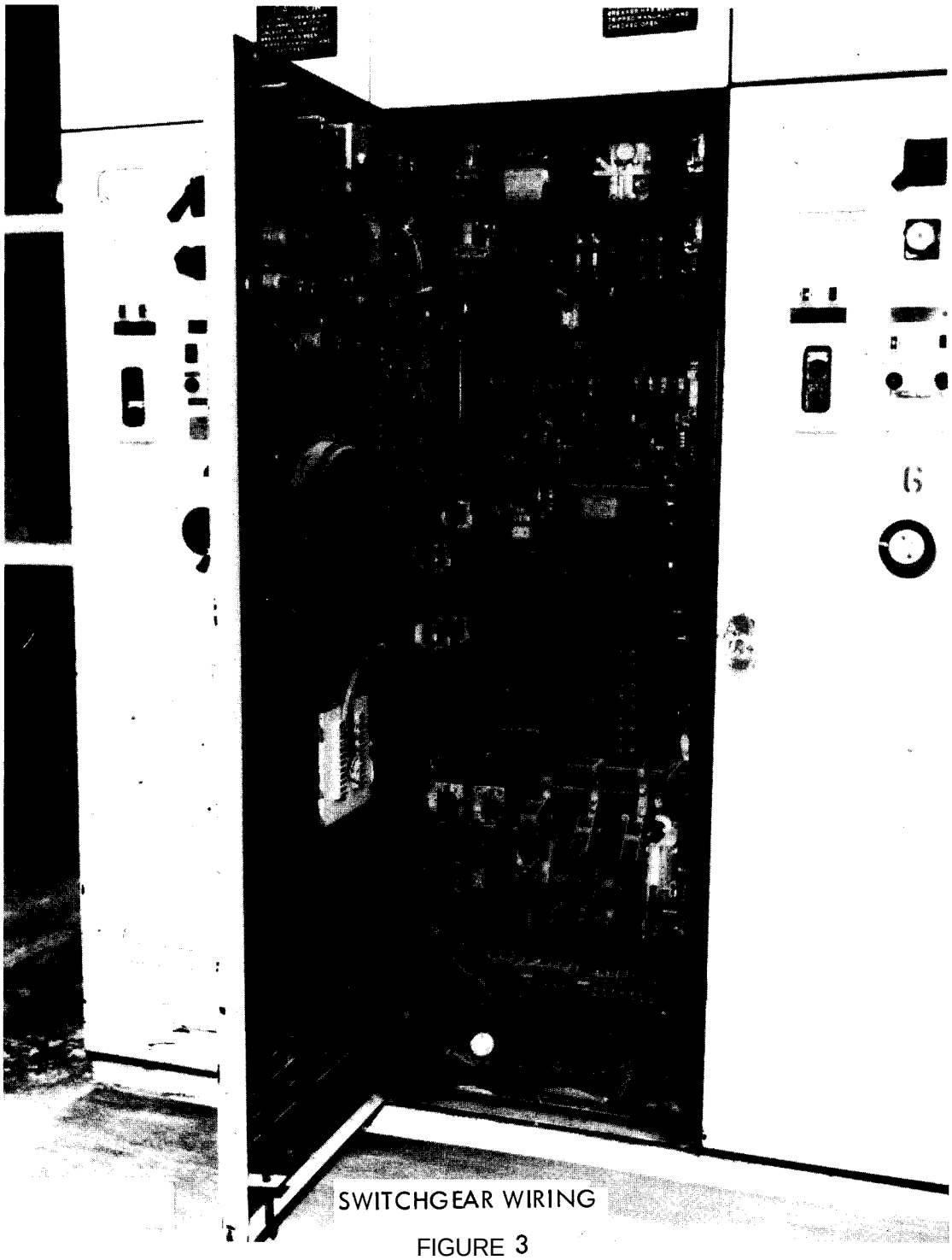
No future CoF funding is required to complete this project

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF ELECTRICAL SWITCHGEAR, ENGINE RESEARCH BUILDING 5



TYPICAL SWITCHGEAR
FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF ELECTRICAL SWITCHGEAR, ENGINE RESEARCH BUILDING 5



SWITCHGEAR WIRING

FIGURE 3

MICHOUD

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

MICHOUD ASSEMBLY FACILITY

	Amount	Page No.
Office of the Comptroller:		
Rehabilitation of the Roof, Phase II Building 103	1,300,000	CF 6-1
Rehabilitation of Chilled Water System.....	[redacted]	CF 6-6
Total.....	[redacted]	

MICHOUD **ASSEMBLY FACILITY**
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF THE ROOF, PHASE 11, BUILDING 103
LOCATION PLAN

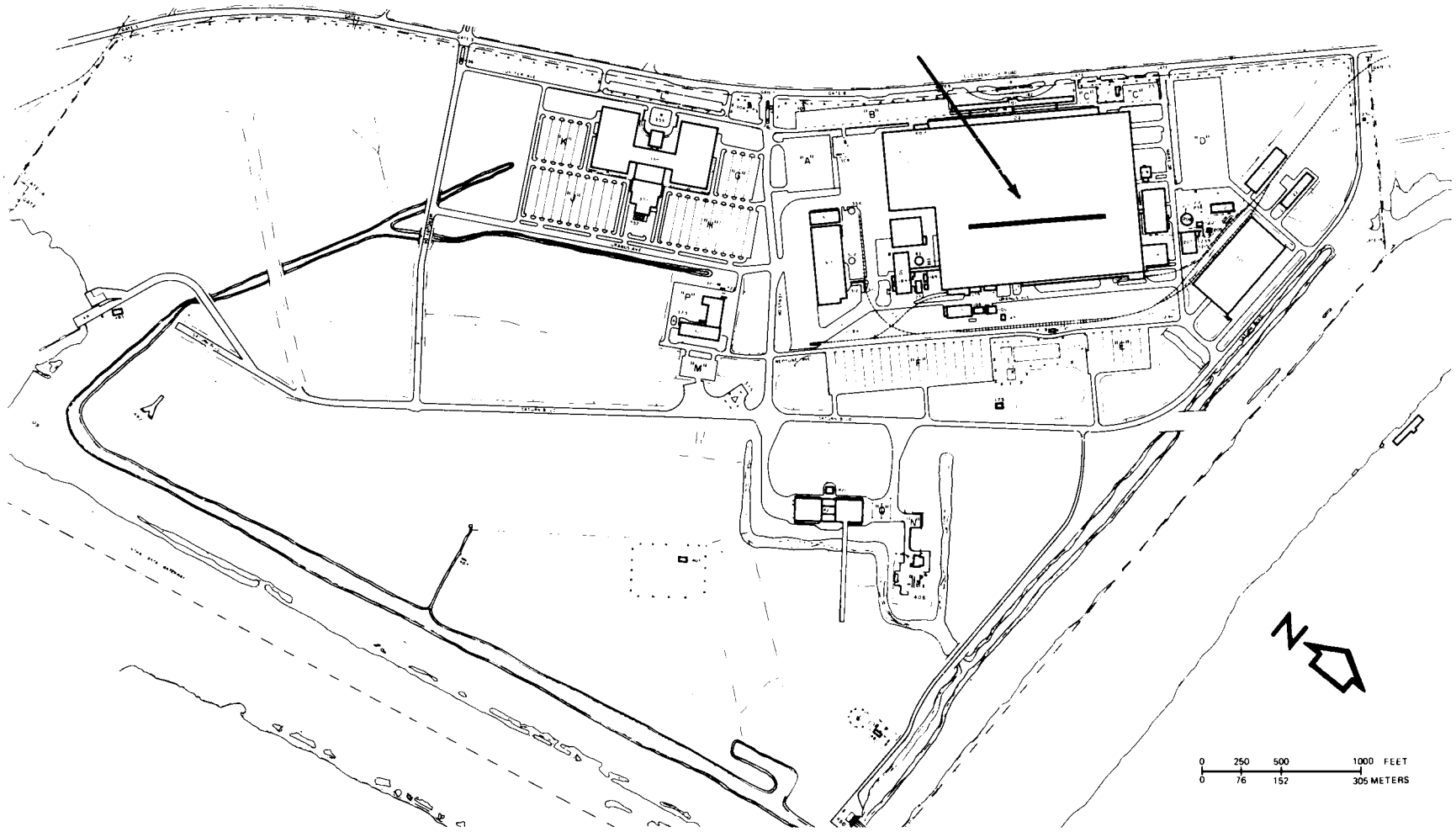


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Rehabilitation of the Roof, Phase II, Building 103

INSTALLATION: Michoud Assembly Facility

FY 1981 CoF ESTIMATE: $3,800,000

LOCATION OF PROJECT: New Orleans, Orleans Parish, Louisiana

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding..	491,000	3,100,000	3,591,000
Capitalized investment	N/A	---	---
Total	491,000	3,100,000	3,591,000

SUMMARY PURPOSE AND SCOPE:

This project will complete the rehabilitation of the roof of the Main Manufacturing Building (Building 103) at the Michoud Assembly Facility (Figure 1). The first phase was authorized in the FY 1980 program. The FY 1980 project provided for repair of approximately one half of the roof. This proposed work includes the removal of roofing not replaced during Phase I of the project and installation of an aggregate-surfaced, asphalt built-up roof over a concrete deck. It will reduce future maintenance costs and eliminate the possibility of damage from leaks to Space Shuttle external tank production equipment and materials.

PROJECT:

Building 103 is the main manufacturing facility at the Michoud Assembly Facility (MAF), and is used exclusively for production of External Tanks for NASA's Space Shuttle Program. This building is the primary facility used for external tank manufacturing. Therefore, it is imperative that it be maintained at a level consistent with the programmatic manufacturing demands. This building was constructed in 1943 and was reroofed in 1963. There have been two major repair efforts since 1963: (1) after hurricane Betsy in 1963 damaged the SE corner of the roof; and (2) a project to repair roof valleys in 1972. The roof will be 18 years old in 1981. The estimated roof life in the New Orleans area is 12 years. Consequently, for the past several years, an ever increasing repair effort has been necessary to protect the structural integrity of the building and to prevent manufacturing interruptions due to leaks. During the period of September 1977 to December 1978, $252,000 was expended for roof repair. These repair efforts have not been able to keep pace with the rapidly deteriorating conditions. Currently, the roof has soft spots caused by saturated insulation, blisters caused by trapped moisture, valleys that are breaking down and causing leaks, and horizontal roof drains that have deteriorated to the point that they must be replaced. Roof traffic to service the many fan houses and other roof structures has also caused a breakdown in roof integrity. A Preliminary Engineering Report, prepared by an A-E consulting firm in 1978, concluded that the roof of Building 103 should be reroofed immediately due to the "very deteriorated condition" and that then current repair efforts could not solve the problem. The consultant's recommendation to reroof also included changes in roof design that will reduce future maintenance effort by improving drainage and reducing roof traffic and will reduce energy consumption through more effective insulating techniques.

IMPACT OF DELAY:

Delaying the repair of the roof will subject the building, its contents and the tank production processes to continued damage from water leakage. Stop-gap repair measures are not sufficient to adequately repair the roof and prevent potential damage to the building and its contents.

PROJECT:

This project will provide for completing the second phase (900,000 square feet) (83,610 square meters) of a two-phase roof replacement begun with FY 1980 resources (Figure 2). This project includes the removal of existing roofing and the installation of an aggregate-surfaced, asphalt built-up, 5-ply roof with insulation over the existing concrete deck. Additional flashing, expansion joint covers and pitch pockets, etc. will be repaired/replaced as needed. Also included will be the rehabilitation or replacement of roof hatches, joints, and wood purlins as required. The roof drainage system (vertical and horizontal pipes that carry the water from the roof down through the plant to an underground storm drainage system) will be rehabilitated to prevent water ponding on the roof.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
[redacted]	---	---	---	3,800,000
Architectural/structural	SF	900,000	3 90	(3,500,000)
Drainage system	LS	---	---	(300,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				3,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - MAF Location plan
Figure 2 - Site Plan

OTHER EQUIPMENT SUMMARY:

No other equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Building 103 roof rehabilitation will be completed with this project

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF THE ROOF, PHASE II, BUILDING 103
SITE PLAN

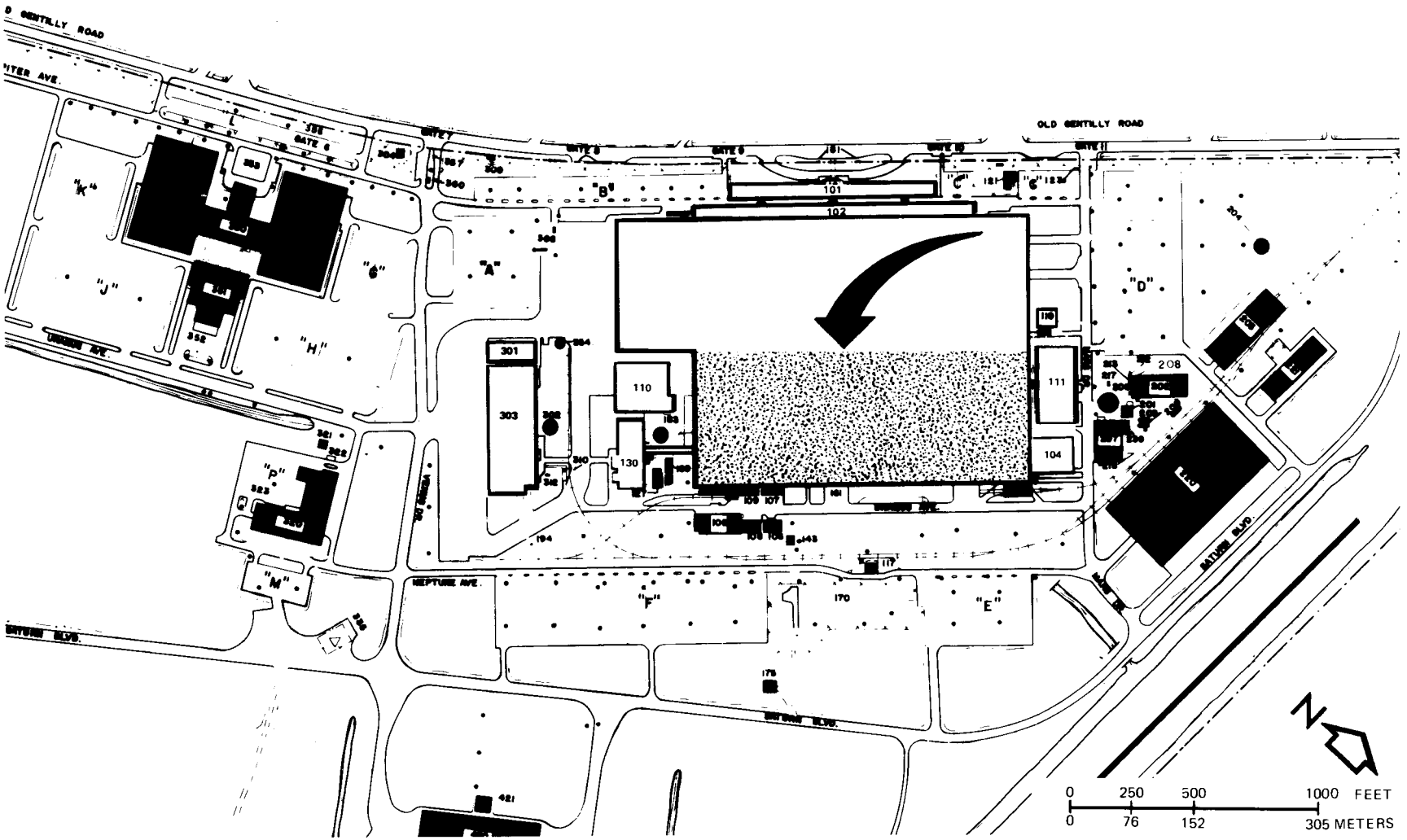


FIGURE 2

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATES
REHABILITATION OF CHILLED WATER SYSTEM
LOCATION PLAN

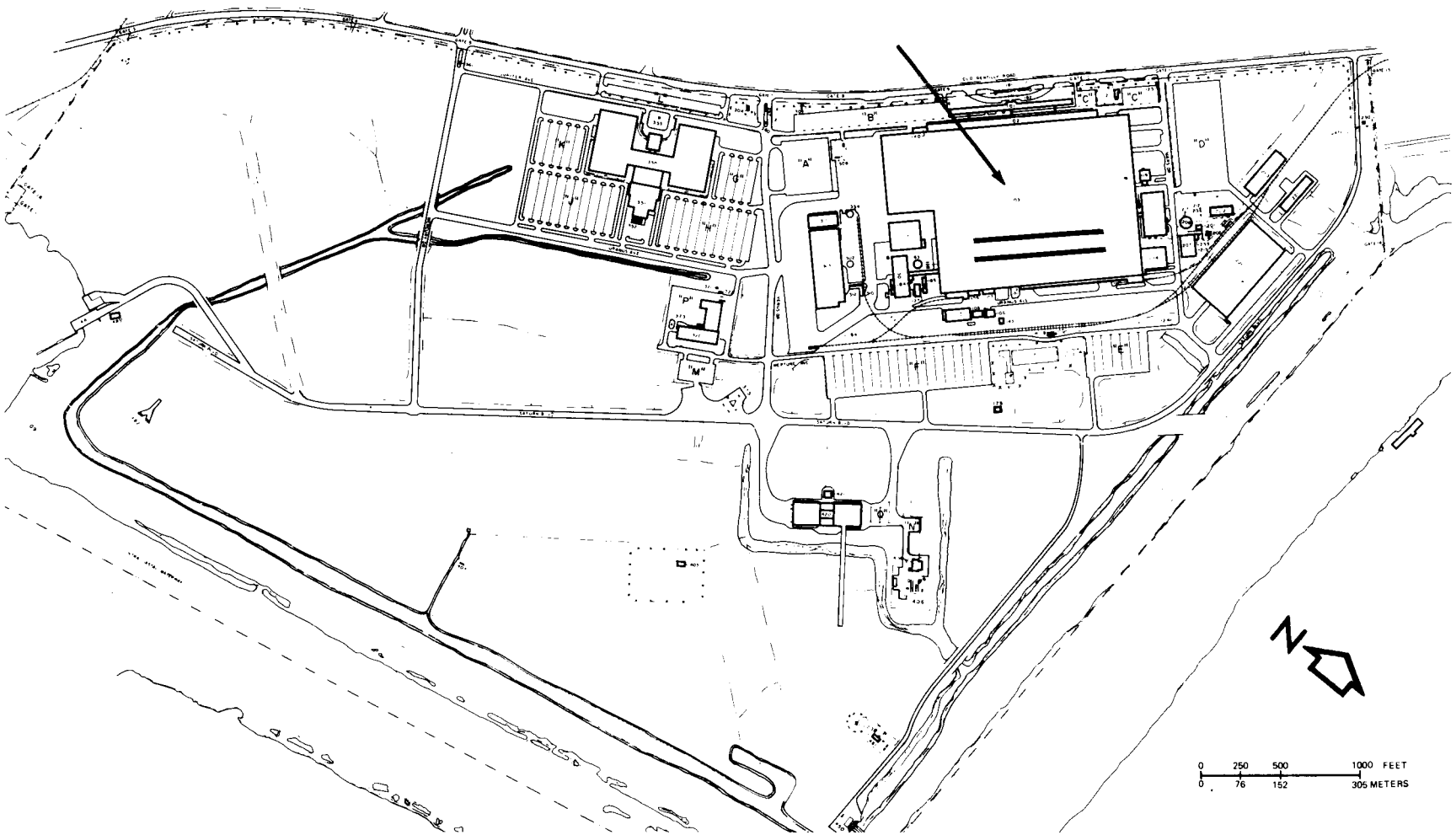


FIGURE 1

CF 6-6

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Rehabilitation of Chilled Water System

INSTALLATION: Michoud Assembly Facility

FY 1981 CoF ESTIMATE: $782,000

LOCATION OF PROJECT: New Orleans, Orleans Parish, Louisiana

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller, Facilities Division

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF finding	75,000	---	75,000
Capitalized investment	N/A	---	---
Total	75,000	---	75,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the rehabilitation of the central chilled water system in the External Tank (ET) production area of Building 103 (Figure 1), Michoud Assembly Facility (MAF), with connections to the systems supporting the thermal protection system (TPS) area, Buildings 110 and 130. Approximately 4,300 linear feet (1,300 meters) of the existing chilled water distribution system steel piping will be replaced and reinsulated along with numerous joints, elbows and other fittings. The central chilled water system provides environmental control of the main manufacturing area through 42 fan houses as well as environmental control through various heat exchangers in several special areas. Additions to the chilled water system for the Saturn program and

now for ET production, have caused an imbalance in the system flow. This project will provide for changes in the system to correct the imbalance and will include connections to the systems that support the TPS area thereby providing backup capability.

PROJECT :

The chilled water distribution system was installed in 1943 with light gauge spiral welded steel used for the large size pipe. The need for numerous spot repairs since 1962 have indicated an increasing tendency for this pipe to deteriorate at the seams and to leak. The ET production operations require closely controlled environmental conditions. With the increasing need for repairs, frequent interruptions in the chilled water system could cause serious production delays or shutdown. Part of TPS area is served by the central system. Loss of chilled water and the needed environmental conditions during TPS application could necessitate removing TPS material already applied and recleaning of the tank. Leaking overhead lines also cause damage to tooling and production items. The critical nature of the TPS operations also requires a backup chilled water system. This project will provide that backup capability as well as correct flow problems in existing distribution lines in the west end of Building 103 where the demand has greatly increased.

IMPACT OF DELAY:

As ET production increases to support the projected Space Shuttle launch schedule, there will be less opportunity to close down the chilled water system for planned repairs and rehabilitation. Emergency repairs will adversely impact the ET production and could result in serious cost and schedule impacts.

PROJECT:

This project provides for the replacement and reinsulation of approximately 4,300 linear feet (1,300 meters) of the chilled water distribution system steel piping in Building 103. The work will involve the use of man-lifts and/or scaffolding to perform repairs, as most of the pipe, 2 to 20 inches in diameter, is located in the forty-foot high roof trusses of the manufacturing plant. Scheduling of work must be coordinated with on-going ET manufacturing processes and must be performed in close proximity to jigs, fixtures, equipment and machine tools. Additionally, the project will balance the flow of the system and provide a chilled water backup system for Building 110 and Building 130. This backup capability will be provided by connecting the systems in Buildings 130 and 110 with the central chiller system (Figure 2).

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	782,000
Rehabilitation of chilled water lines	LS	---	---	441,000
Interconnection & modification of chilled water system.	LS	---	---	341,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				782,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Piping Diagram

OTHER EQUIPMENT SUMMARY:

No other equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

This project and other necessary work addressed in the repair, and rehabilitation and modification programs in this year's budget estimates is part of a comprehensive rehabilitation program for MAF utilities systems. These initiatives are based on requirements identified in engineering studies of utilities capacities, efficiencies, energy conservation and repair status. Is is planned to continue with similar maintenance efforts in future years that respond to priority requirements in reasonable increments of work. Such planning will focus on non-interference with ET manufacturing while keeping this unique national asset at an adequate level of repair.

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATES

REHABILITATION OF CHILLED WATER SYSTEM

PIPING DIAGRAM

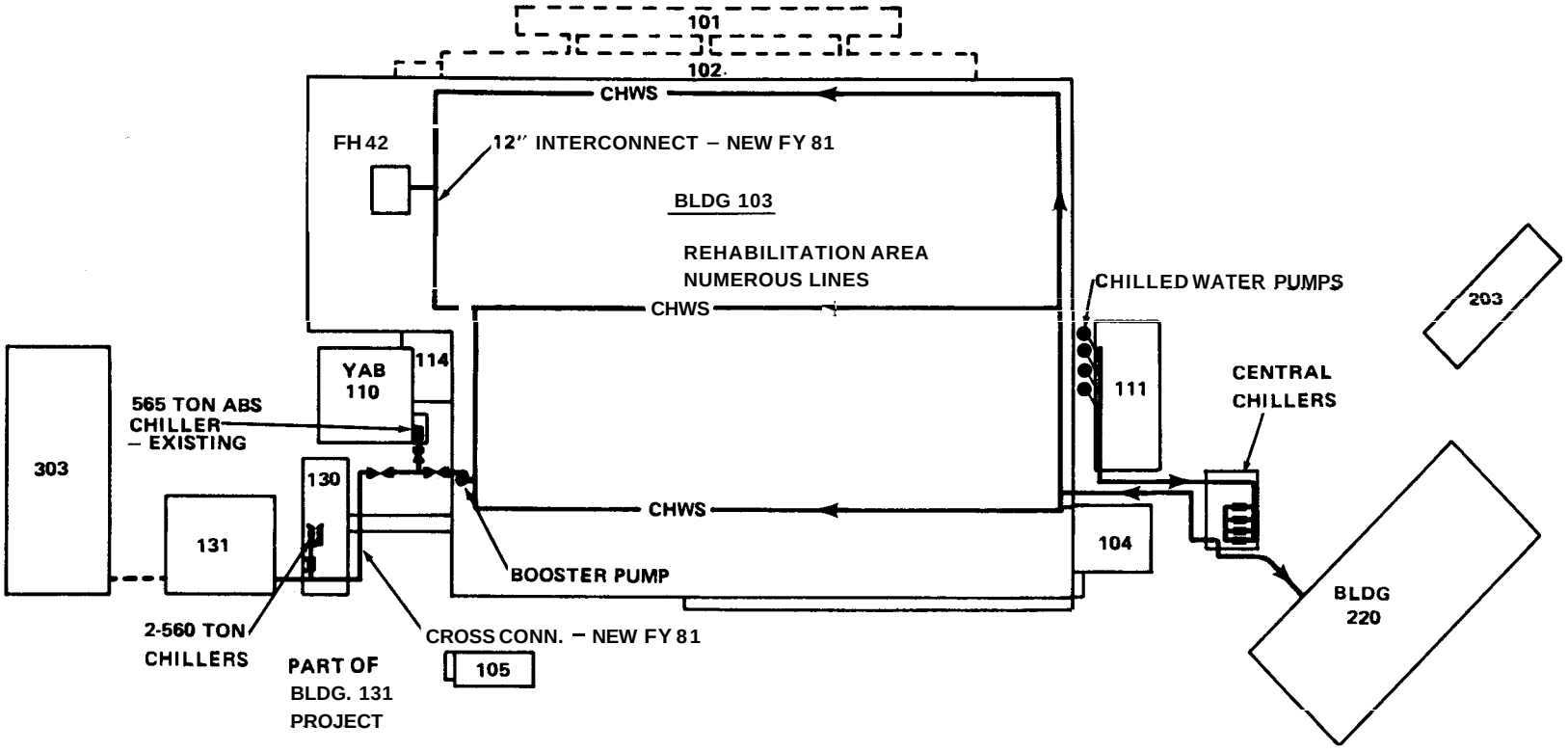


FIGURE 2

VARIOUS
LOCATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

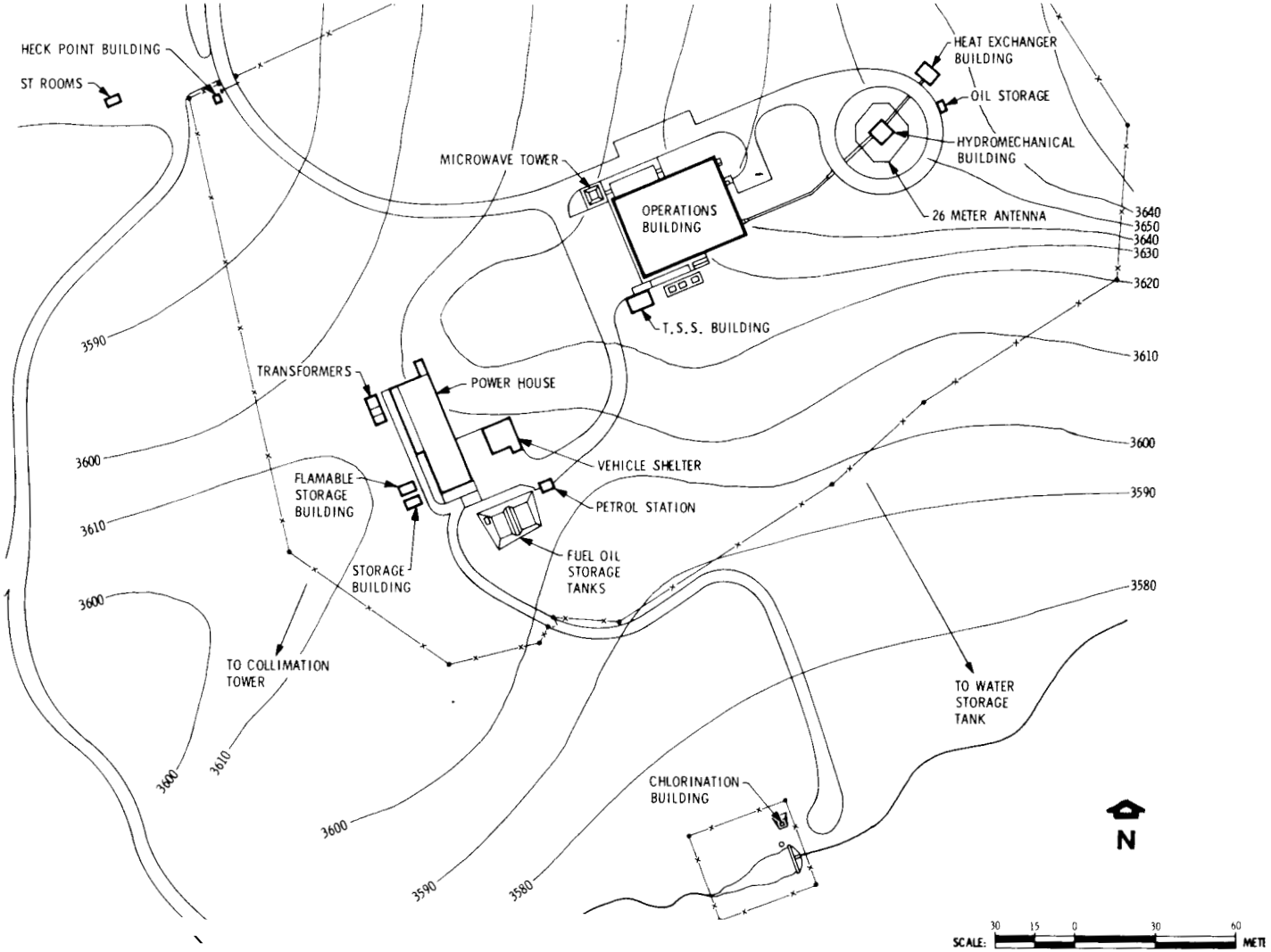
FISCAL YEAR 1981 ESTIMATES

SUMMARY

VARIOUS LOCATIONS

	Amount	Page No.
Office of Space Tracking and Data Systems:		
Modification of 26-Meter Antenna, DSS-44, Canberra, Australia (JPL).....	1,000,000	CF 7-1
Replacement of Azimuth Radial Bearing, DSS-14, Goldstone, California (JPL).....	950,000,000	CF 7-5
Total	2,150,000,000	

VARIOUS LOCATIONS
FISCAL *YEAR* 1981 ESTIMATES
MODIFICATION OF 26-METER ANTENNA
DSS-44, CANBERRA, AUSTRALIA



SITE LOCATION
FIGURE 1

CF 7·

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modification of 26-Meter Antenna, DSS-44 Canberra, Australia

INSTALLATION: Jet Propulsion Laboratory

FY 1981 CoF ESTIMATE: $1,200,000

LOCATION OF PROJECT: Canberra, Australia

COGNIZANT HEADQUARTERS OFFICE: Office of Space Tracking and Data Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	72,000	---	72,000
Capitalized investment	N/A	11,083,000	11,081,000
Total	72,000	11,081,000	11,155,000

SUMMARY PURPOSE AND SCOPE:

Since a significant portion of the NASA deep space missions are characterized by vastly increasing distances from earth, higher frequencies (e.g., X-band) must be employed by both the Spacecraft and the Deep Space Network (DSN), to determine position in space and to achieve an acceptable science data return. The NASA/Australian Deep Space antenna at Honeysuckle Creek, Canberra, Australia, will be modified to operate at X-band frequencies as part of an overall plan to update all such Deep Space Facilities (Figure 1). This will also provide NASA with the capability to array all antennas in the current DSN in Australia at Xi-band to achieve a substantial increase in data rate return over that which has been possible up to now. The existing antenna will be converted

from 26 to 34 meters to provide this necessary support. The other Deep Space Facility in Australia has already been modified.

PROJECT JUSTIFICATION:

The basic justification for the addition of an X-band capability to existing DSN 26-meter stations is to support presently approved and near term NASA flight missions, which have the following characteristics:

Data Return from Greater Distances

The primary data mode for many on-going and future planetary and interplanetary spacecraft is X-band for achieving higher data rates and precision navigation at greater distances.

Viewing of In-Flight Spacecraft

The very long flight time (years) to the outer planets and the relative positions of the planets produce a "bunching effect" of enroute spacecraft as seen from earth. Thus, more antenna capability is required at each complex to support space missions, since more spacecraft are in view simultaneously. As an example, the close Mars flyby southern trajectory condition will prevail for the Galileo mission, which will require heavy support from the southern hemisphere stations. Other approved missions in flight in the mid 1980's will be in view at the same times from the Australian location, and will require concurrent support.

IMPACT OF DELAY:

FY 1981 funds will assure an operational capability by the mid-1980's to adequately support the in-flight planetary missions.

PROJECT:

This project provides for the modification of the existing 26-meter antenna at Canberra, Australia, to operate at both S and X-band frequencies with an aperture of 34 meters to assure adequate performance retention of S-band frequencies. It will include primarily the structural modifications necessary to support a new S and X-band microwave subsystem. This work consists of backup structure modifications, strengthening bolted joints by welding, extending foundations, replacement of air-conditioning and servo lines, and safety modifications to ladders and platforms.

PROJECT COST ESTIMATE:

The basis for this cost estimate is an in-house preliminary engineering analysis based on the three previous conversions.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1,200,000
Antenna foundation	LS	---	---	265,000
Counterweights, ladder, installation	LS	---	---	250,000
Weld joints	LS	---	---	275,000
Strip antenna, site preparation, etc.	LS	---	---	410,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				1,200,000

LIST OF RELATED GRAPHICS:

Figure 1 - Site Location

OTHER EQUIPMENT SUMMARY

Electronics data handling equipment, and radio frequency and microwave equipment associated with the S-X conversion is estimated to cost $5,510,000, and will be provided with R&D funding in FY 1981 - 1983.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future funding is required for this facility project.

VARIOUS LOCATIONS
FISCAL YEAR 1981 ESTIMATES
REPLACEMENT OF AZIMUTH RADIAL BEARING
DSS-14, GOLDSTONE, CALIFORNIA

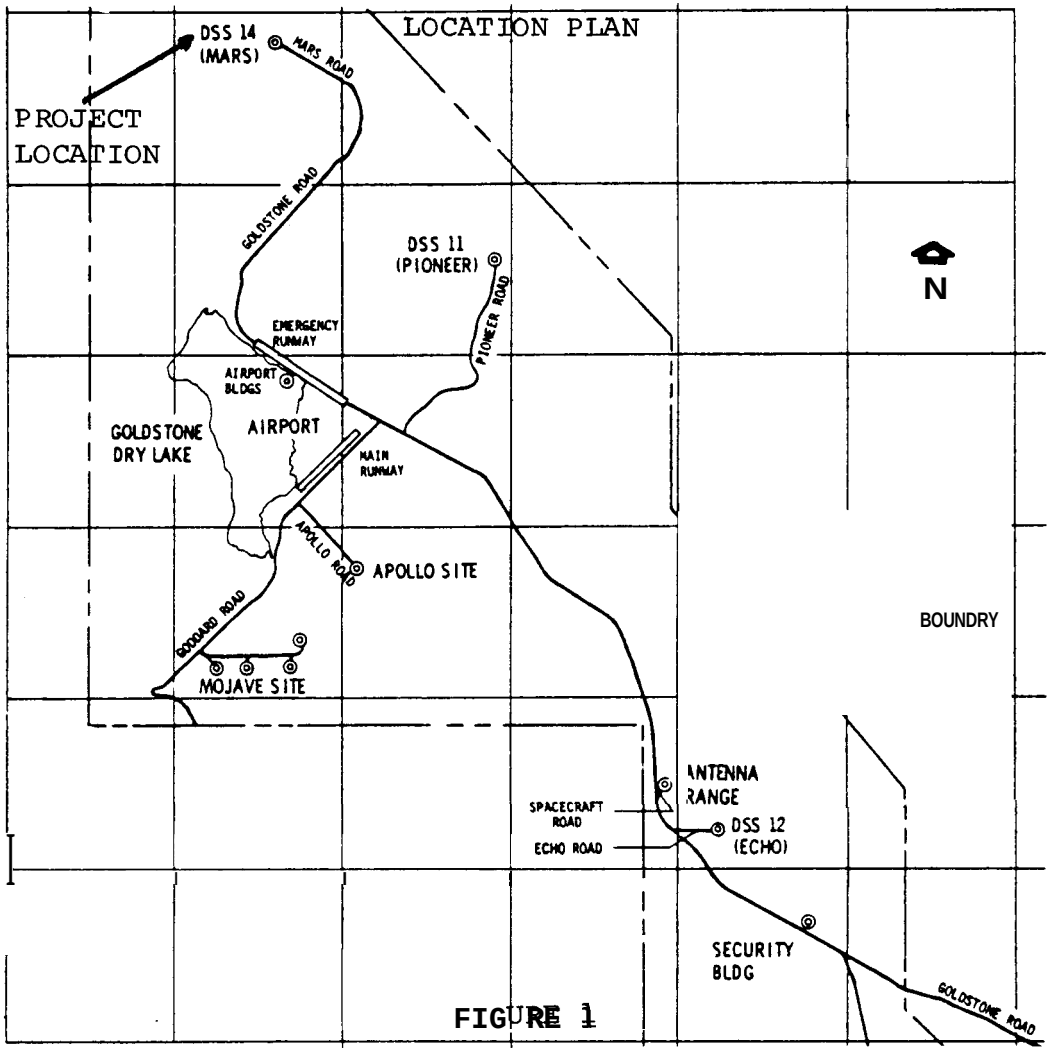


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Replacement of Azimuth Radial Bearing, DSS-14, Goldstone, California

INSTALLATION: Jet Propulsion Laboratory

FY 1981 CoF ESTIMATE: $950.000

LOCATION OF PROJECT: Goldstone, California

COGNIZANT HRADQUARTERS OFFICE:: Office of Space Tracking and Data Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	57,000	---	57,000
Capitalized investment	N/A	27,143,000	27,143,000
Total	57,000	27,143,000	27,200,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the rehabilitation of the radial bearing of the 64-Meter Tracking Antenna (DSS-14) at the Goldstone Deep Space Communication Complex, Goldstone, California (Figure 1). This antenna has been in service for nearly 15 years. In that time, the radial bearing has deteriorated and the risk of failure has increased. The bearing will be rehabilitated by replacing the runner and wearstrip (Figures 2 and 3).

PROJECT JUSTIFICATION:

The replacement of the radial bearing and wearstrip assembly is required in order to preclude an unscheduled shutdown of DSS-14 due to radial bearing failure. A failure of this type could cause a loss of spacecraft data for several months. In addition to the increased risk of failure, the present deteriorated condition of the radial bearing runner results in a loss of antenna performance in high winds. In order to compensate for the present runner condition, the preload has been reduced from 330,000 pounds (150,000 kilograms) to a value under 200,000 pounds (91,000 kilograms). This has caused the antenna to be less stiff in response to both steady and gusty winds. This reduction in stiffness also causes a small increase in tracking error under normal conditions.

The DSS-14 radial bearing has, in the past, shown evidence of a very high deterioration rate. The deterioration was such that it was visible as gaps between the runner and the grout which increased from 0.020-inch to 0.045-inch (.051 centimeter to .11 centimeter). In two areas concrete spalled directly below the runner joint. Since that time, the preload in the wheel assemblies has been reduced and the sheared wearstrip bolts have been replaced. Corings in the grout were made and severe rusting on the grout side of the runner was discovered. Also, there was evidence of shear failure of the dowel pins in the runner. The mechanical joints in the runner were reinforced by welding a portion of the joint, and a polyester material was used to seal the runner-grout gap to exclude moisture and stabilize the oxidation process in the grout.

IMPACT OF DELAY:

The 64-meter antenna subnet is the "backbone and workhorse" of the Deep Space Network. Downtime for the installation portion of this project is four months. The first interval between major mission support periods is May through August 1982. If this project is delayed, then installation cannot be accomplished during a quiet time for the antenna. Work would then have to be scheduled during important mission support periods.

PROJECT DESCRIPTION:

This project will replace the existing radial bearing wearstrip and runner assembly. This will consist of removing the existing radial bearing wearstrip and runner assembly, fasteners, and grout; preparing the concrete collar surface, replacing the fasteners, installing the runner assembly and wearstrip and re-grouting between the runner and concrete collar. The alignment of the runner which is 5-inch (12.7 centimeter) thick steel, 30 feet (9.1 meters) in diameter, is a major and very critical task.

PROJECT COST ESTIMATE:

The basis for this cost estimate is an in-house Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	950,000
Fabrication of wearstrip.	LS	---	---	85,000
Fabrication of runner	LS	---	---	700,000
Removal of wearstrip and runner	LS	---	---	80,000
Installation and alignment	LS	---	---	85,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				950,000

LIST OF RELATED GRAPHICS

Figure 1 - Location Plan
Figure 2 - Azimuth Radial Bearing Design
Figure 3 - Present Condition of Bearing

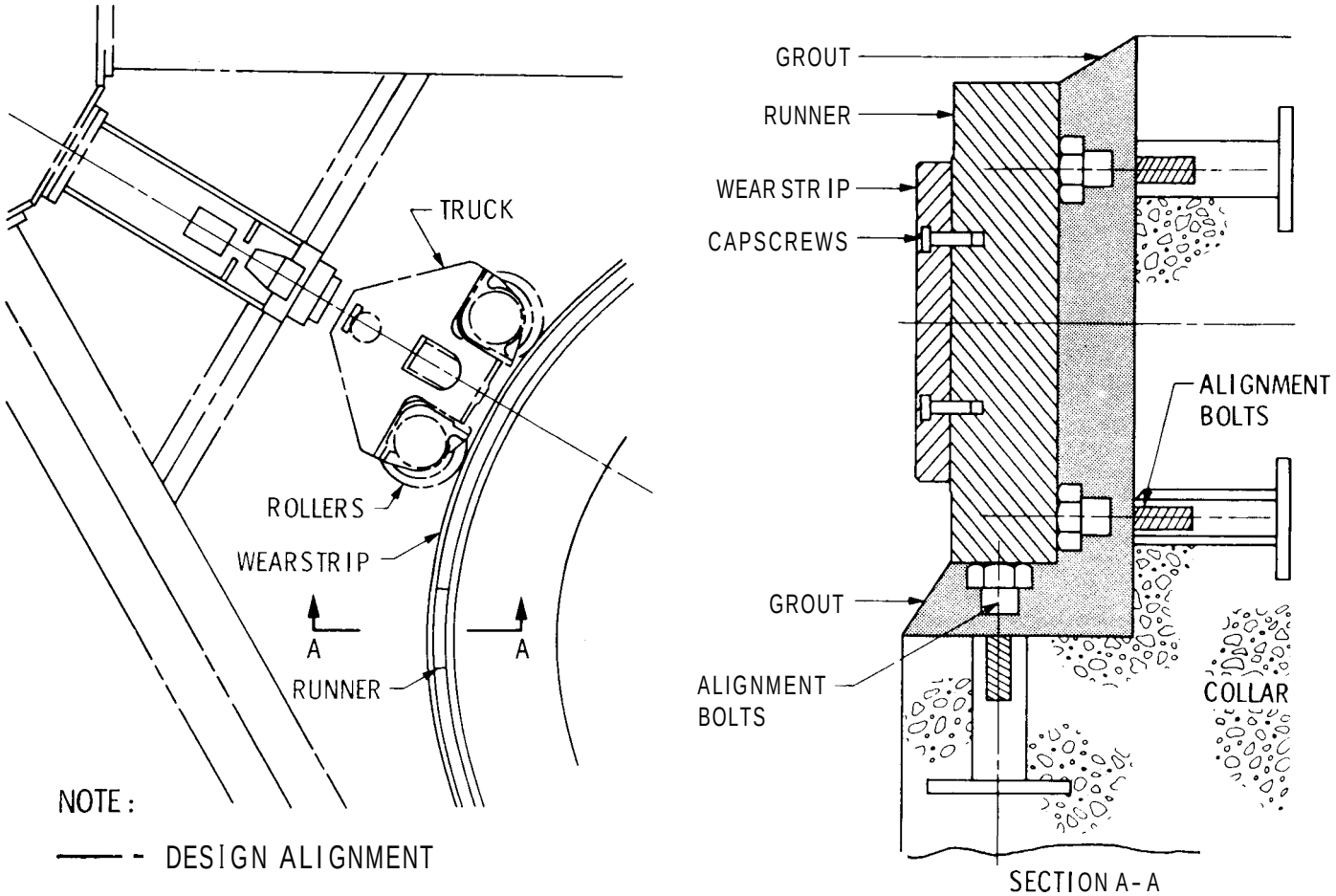
OTHER EQUIPMENT SUMMARY:

No other equipment is required.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

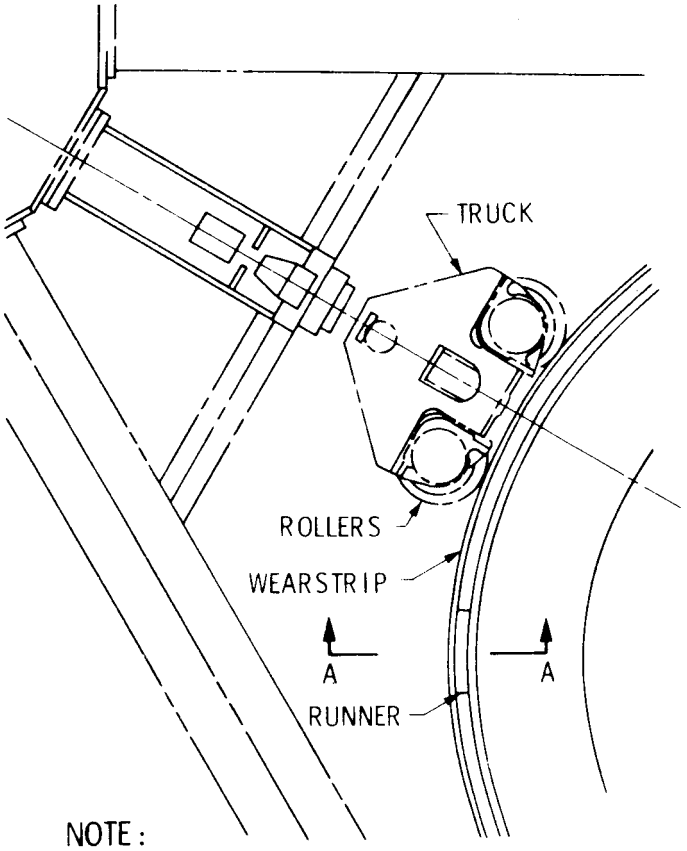
No future funding is required to complete this project.

VARIOUS LOCATIONS
FISCAL YEAR 1981 ESTIMATES
REPLACEMENT OF AZIMUTH RADIAL BEARING
DSS-14, GOLDSTONE: CALIFORNIA



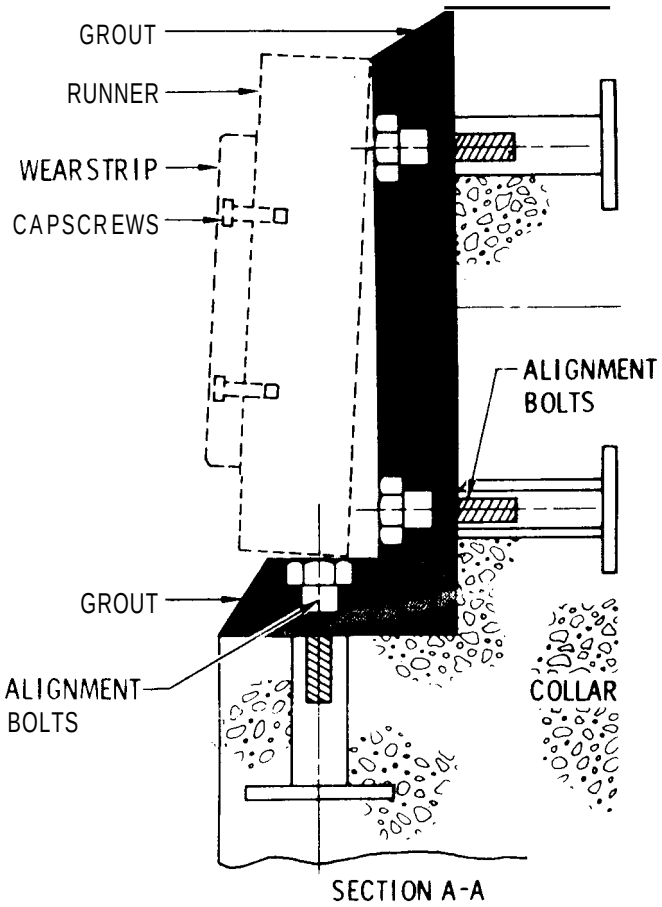
AZIMUTH RADIAL BEARING DESIGN
FIGURE 2

VARIOUS LOCATIONS
FISCAL YEAR 1981 ESTIMATES
REPLACEMENT OF AZIMUTH RADIAL BEARING
DSS-14, GOLDSTONE, CALIFORNIA



NOTE:

— — - PRESENT SLOPED CONDITION



PRESENT CONDITION OF BEARING
FIGURE 3

SPACE SHUTTLE
FACILITIES

NATIONAL AERONAUTICS & SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

SPACE SHUTTLE FACILITIES

	Amount	P
Office of Space Transportation Systems:		
Summary		CF 8-1
Manufacturing and Final Assembly Facilities:	8,100,000	
Modification of Manufacturing and Final Assembly Facilities for External Tanks (MAF)	5,400,000	CF 8-4
Modifications to SRM Manufacturing and Assembly Facilities, Thiokol Plant, Wasatch, Utah (MSFC)	2,700,000	CF 8-14
Minor Facilities:	2,000,000	
Minor Shuttle-Unique Projects, at Various Locations	2,000,000	CF 8-28
Total	10,100,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Space Shuttle Facilities

INSTALLATION: Various Locations

FY 1981 CoF ESTIMATE: $10,100,000

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

COGNIZANT HEADQUARTERS OFFICE: Office of Space Transportation Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	6,817,000	69,671,000	76,488,000
Capitalized investment	N/A	117,175,000	137,175,000
Total	6,817,000	206,846,000	213,663,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to rehabilitate, modify, and add to existing Government-owned facilities, and to construct new facilities to meet unique requirements of the Space Shuttle Program. As in prior years, this Shuttle facilities package includes all major facility requirements unique to the Space Shuttle Program. In FY 1981, the proposed Shuttle facilities are primarily related to the external tank (ET) manufacturing and final assembly at Michoud Assembly Facility (MAF) and the solid rocket motor (SRM) manufacturing and final assembly at Thiokol. The majority of requirements addressed in this request were envisioned in previous planning. Certain other requirements have just now become known as manufacturing experience has begun to

mature and the program has developed. Also included are minor rehabilitation and modification projects which are required to support the Space Shuttle and are therefore considered Space Shuttle unique projects.

PROJECT:

Prior year CoF budgets for the Space Shuttle Program authorized modification and construction of facilities for technical development, Space Shuttle main engine tests, ground tests, manufacturing, and launch and landing. All of the facilities to support the first Manned Orbital Flight and the Design, Development, Test and Evaluation portion of the program are essentially completed and have been put into operation or are being activated. The major projects in this funding request are for continuation of modifications to manufacturing facilities for the ET's and SRM's. These projects are required at this time to add to manufacturing capabilities at MAF and Thiokol to meet production needs which, in turn, support planned operational Space Shuttle mission capability.

As in previous requests, the projects included have been carefully reviewed against operational projections and mission capabilities to insure they are not prematurely requested.

PROJECT COST ESTIMATE:

Manufacturing and Final Assembly Facilities	8,100,000
Modification of Manufacturing and Final Assembly Facilities for External Tanks, Michoud Assembly Facility	5,400,000
Modifications to Solid Rocket Motor Manufacturing and Assembly Facilities, Thiokol Plant, Wasatch, Utah	2,700,000
Minor Shuttle Unique Projects	[illegible]
TOTAL	10,100,000

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATES
MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES
FOR EXTERNAL TANKS

LOCATION PLAN

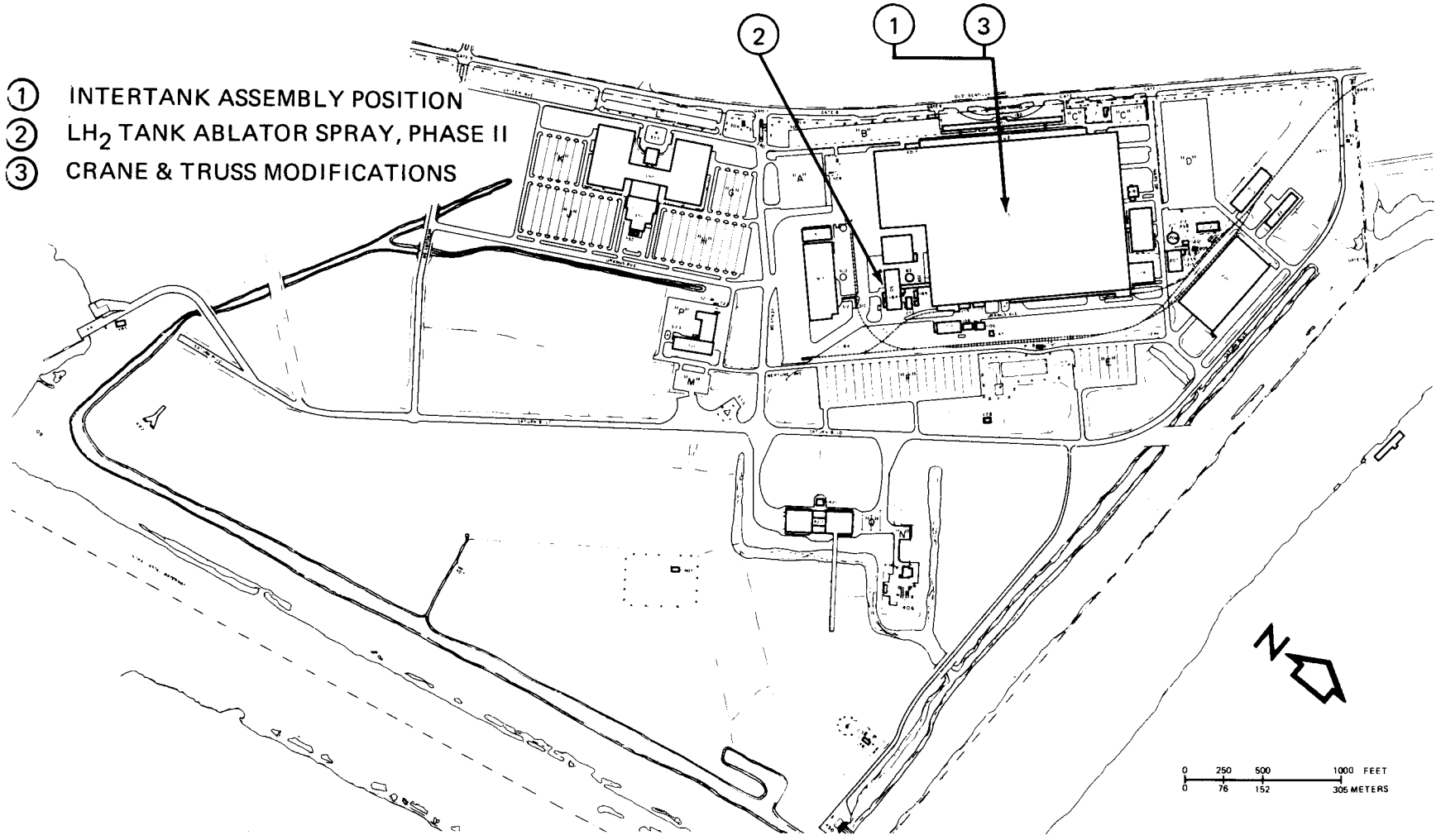


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Modification of Manufacturing and Final Assembly Facilities for External Tanks

INSTALLATION: Michoud Assembly Facility

FY 1981 CoF ESTIMATE: $5,400,000

LOCATION OF PROJECT: New Orleans, Orleans Parish, Louisiana

COGNIZANT HEADQUARTERS OFFICE: Office of Space Transportation Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	5,618,000	59,041,000	64,659,000
Capitalized investment	N/A	132,927,000	112.927,000
Total	5.618,000	191.968,000	197.586,000

SUMMARY PURPOSE AND SCOPE:

This project continues work begun with prior years resources, including FY 1980. It provides for the modification of manufacturing and final assembly facilities at the Michoud Assembly Facility (MAF) for the Space Shuttle External Tank (ET) production. It is required to provide the facilities necessary to fabricate and assemble the three major components of the ET, to test and clean them, to apply the Thermal Protection System (TPS), and to assemble the major components into a complete ET. The assembled ET is then equipped with plumbing and electrical systems and checked for acceptance to be shipped to the launch site.

Prior years resources provided modifications to the Main Manufacturing Building, Building 103; the Vertical Assembly Building (VAB), Building 110; the Final Acceptance and Checkout Building, Building 420; the construction of Phase I, High Bay Addition, Building 114; a facility to apply ablator to the LH_2 tank, Building 131; a proof test facility for the LH_2 tank, Building 451; a Thermal Protection System waste disposal facility; and major rehabilitation of various facilities to support the production of the Shuttle External Tank.

The FY 1980 project provided additional production facilities needed to support ET manufacturing and final assembly. Work also included a facility to dispose of TPS wastes; and two projects to assure the integrity, reliability, and energy efficiency of the total ET manufacturing plant and its basic support systems.

This FY 1981 project (Figure 1) provides for additional facilities for increasing production rate capabilities required to support scheduled Shuttle launches. These facilities are the the third and last phase of the Horizontal LH_2 Tank Spray Ablator Facility, begun with FY 1979 funding and continued with FY 1980 resources, and additional/modified crane coverage and associated truss modifications in the Main Manufacturing Building 103. These projects have been implemented in phases to meet the requirements for production as they increase, but limited so as to avoid unnecessary overbuilding in the early years. Work has been scheduled so that construction will be completed in the central production areas before the ET production rates become critical to the overall program. The current schedule is devised to minimize interference between construction work and ET production.

In addition to the continuation of modifications listed above, one new modification is included in this FY 1981 request. The assembly of the intertank is now being accomplished on a modified tool and foundation from the Saturn program. This tooling configuration has proven inefficient and cannot meet planned production rates. Foundations for two new intertank assembly positions, included in this estimate, will accommodate new, more efficient tooling. This will result in improved production operations and significant cost savings in intertank assembly.

PROJECT:

LH_2 Tank Ablator Spray Facility, Cell "M", Building 131

This phase of facilities modifications for ET manufacturing completes the construction of the third and last cell of the Horizontal LH_2 Spray Ablator Facility. FY 1979 and FY 1980 projects provided a cleaning and priming cell and one ablator spray cell, along with the foundation for this third cell. Because the first ablator spray cell can support a rate of only 16 tanks per year during the early production, a second Cell M, is needed to achieve the rate required to meet the program demands when it is scheduled to come on line in early 1982. The ultimate capability for the ablator application in these two identical cells will be 60 LH_2 tanks per year.

Crane and Truss Modifications, Building 103

Modifications to the existing crane systems in the Main Manufacturing Building 103 are required to help smooth production flow and provide adequate crane coverage in vital areas. The work flow experience of the first few tanks has validated the requirement for additional crane coverage to improve the efficiency of moving material in the production area. Also, existing cranes which range in age from seventeen to thirty-six years have deteriorated. These units must be overhauled to assure their reliability and to meet current OSHA safety standards. Increasing material handling requirements necessitate accomplishing this work at this time to minimize production interruptions when higher production rates are required. Some modifications to the truss system are required to support the crane work.

Intertank Assembly Facilities:

The intertank is presently assembled using modified Saturn tooling. As each intertank is completed, the tooling must be disassembled to permit removal of the completed intertank. This time-consuming disassembly and assembly will prevent meeting future planned production rates. Therefore, to meet the production requirement, a new tool must be installed to allow for crane removal of the intertank without tool disassembly. This project provides the foundation for two intertank assembly positions required to satisfy the ultimate production rate. The intertank assembly positions will also be relocated to provide an improved layout for more efficient operations and to allow collocation of the other associated intertank assembly tasks. The resulting anticipated increased efficiency will lower unit production costs of the intertank.

IMPACT OF DELAY:

The Horizontal LH_2 Spray Ablator, Cell M and the Intertank Assembly Facility are required to support production rates that are projected to be needed at the time these facilities are scheduled to be completed. Failure to provide them at this time would prevent attainment of needed capability to manufacture ET's to support flight rates in 1983. Delay of the crane and truss modifications would necessitate modifications at a time when the production schedule has increased and construction interruptions of manufacturing would be critical.

PHOJECT DESCRIPTION:

This project continues work authorized in prior years. It includes construction and modifications in Buildings 103 and 131; adding a spray ablator cell to Building 131, modification of the cranes in Building 103, construction of the foundation for new intertank assembly positions and associated utilities support.

Horizontal LH_2 Tank Spray Ablator Facility, Cell M, Building 131

This is the third cell of a three-cell building (Figure 2). This phase of work will provide the second spray ablator cell. Included in this estimate is the building shell, approximately 50 feet wide (15.2 meters), 60 feet high (18.2 meters), and 150 feet long (45.6 meters); access platforms, stairways, doors, and interior structures. This cell will be connected to the mechancial and utility systems of the existing structure, requiring an increase in capacity to support this new cell. Cranes, fire suppression and other utility service for this cell will also be provided.

Crane and Truss Modification:

Modificatons to existing cranes in the manufacturing facility, Building 103, include new crossovers, relocating existing crossovers, cleaning shoes and rails, replacing or reworking control systems, installing pendants, shortening rails, removing bridges and rails, and in some cases increasing capacities (Figure 3). Areas serviced by this expanded coverage include the Liquid Oxygen Tank offload and storage area, the new offload positions for the Liquid Hydrogen Tank, portions of the operations on the east side of the building and the Chemical Clean and Finish Area.

Intertank Assembly Facility:

This FY 1981 project also provides for construction of a foundation to accommodate two intertank assembly tools, lighting, HVAC service and other supporting utilities. Also included is the installation of four cranes and necessary utility service to the intertank positions (Figure 4).

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	5.400 ,000
Intertank assembly position	---	---	---	1,400,000
Architectural/structural	LS	---	---	(1,135,000)
Mechanical systems	LS	---	---	(80,000)
Electrical systems	LS	---	---	(185,000)
LH_2 ablator spray facility	---	---	---	3,000,000
Architectural/structural	LS	---	---	(1,440,000)
Mechanical system	LS	---	---	(1,440,000)
Electrical systems	LF	---	---	(120,000)
Crane and truss modifications	---	---	---	1,000,000
Architectural/structural	Cranes	---	---	(900,000)
Electrical systems..	Cranes	---	---	(100,000)
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				5.400 ,000

LIST OF RELATED GRAPHICS:

Figure 1 - MAF Location Plan with general location of projects
Figure 2 - Horizontal LH_2 Ablator Spray Facility, Building 131 - Cell M
Figure 3 - Crane and Truss Modification Location Plan
Figure 4 - Intertank Assembly Position general layout

OTHER EQUIPMENT SUMMARY:

Special tooling (spray tooling, assembly tooling, unique work platforms, and special dollies) will be needed for ET production operations. They will be funded from R&D sources. Existing surplus Apollo tooling, with modifications as required, will be used to the maximum extent possible to meet this need.

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Additional CoF resources may be required in the future to provide for completion of production facilities to support the maximum ET production rate. This includes, additional chemical tank farm capacity, an ET storage facility, the remaining two TPS cells in the High Bay Addition (Building 114), and the second final acceptance and checkout station. Additional modification work, not now identified, may also be necessary to satisfy future programmatic requirements as they evolve.

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATE
MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES
FOR EXTERNAL TANKS
LH_2 TANK ABLATOR SPRAY FACILITY

CELL M

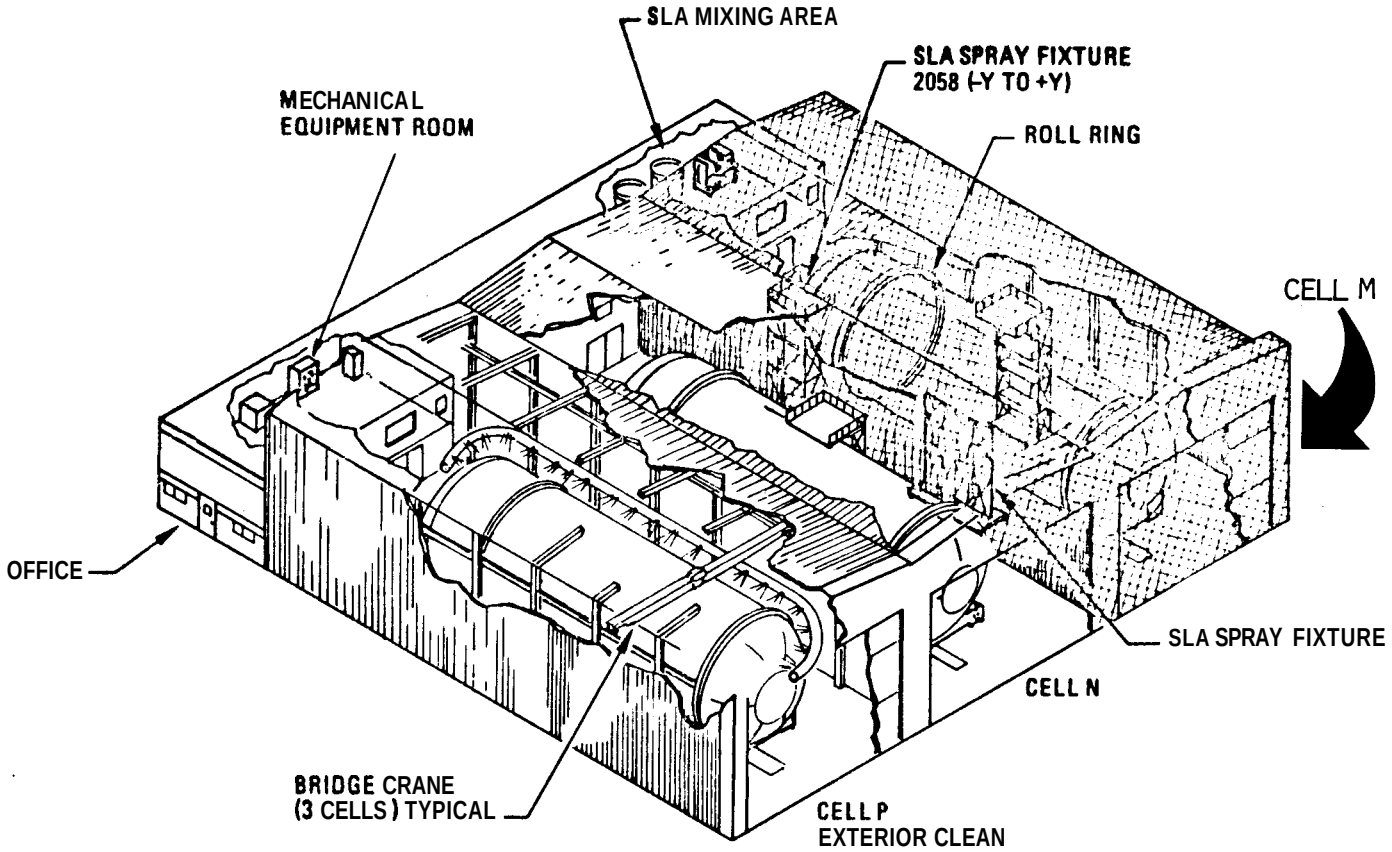


FIGURE 2

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATE
MODIFICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES FOR EXTERNAL TANKS
CRANE & TRUSS MODIFICATIONS

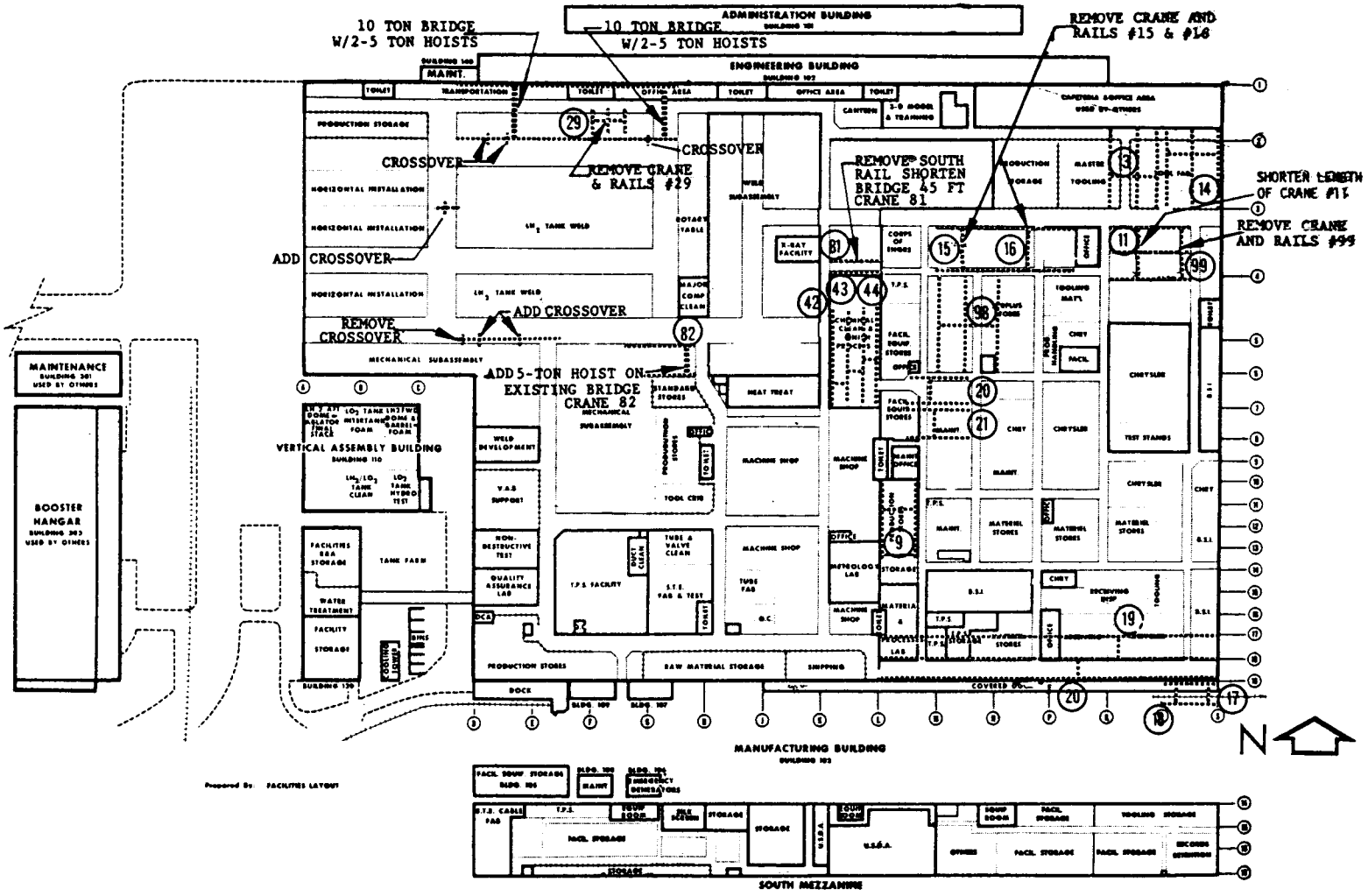
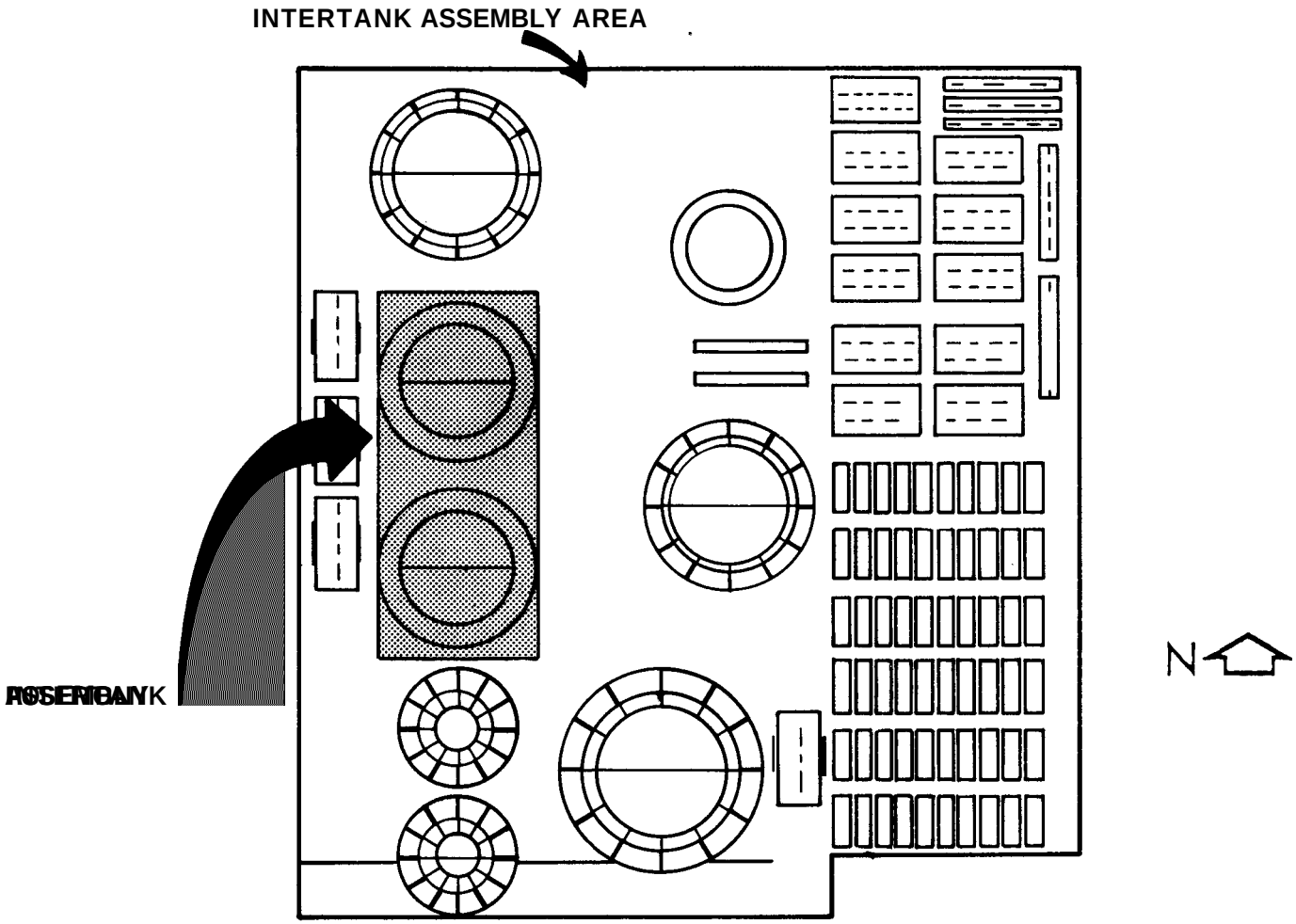


FIGURE 3

MICHOUD ASSEMBLY FACILITY
FISCAL YEAR 1981 ESTIMATES

MOD FICATION OF MANUFACTURING AND FINAL ASSEMBLY FACILITIES
FOR EXTERNAL TANKS

INTERTANK ASSEMBLY POSITION



LAYOUT

CF 8-13

FIGURE 4

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATIONS TO SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH

LOCATION PLAN

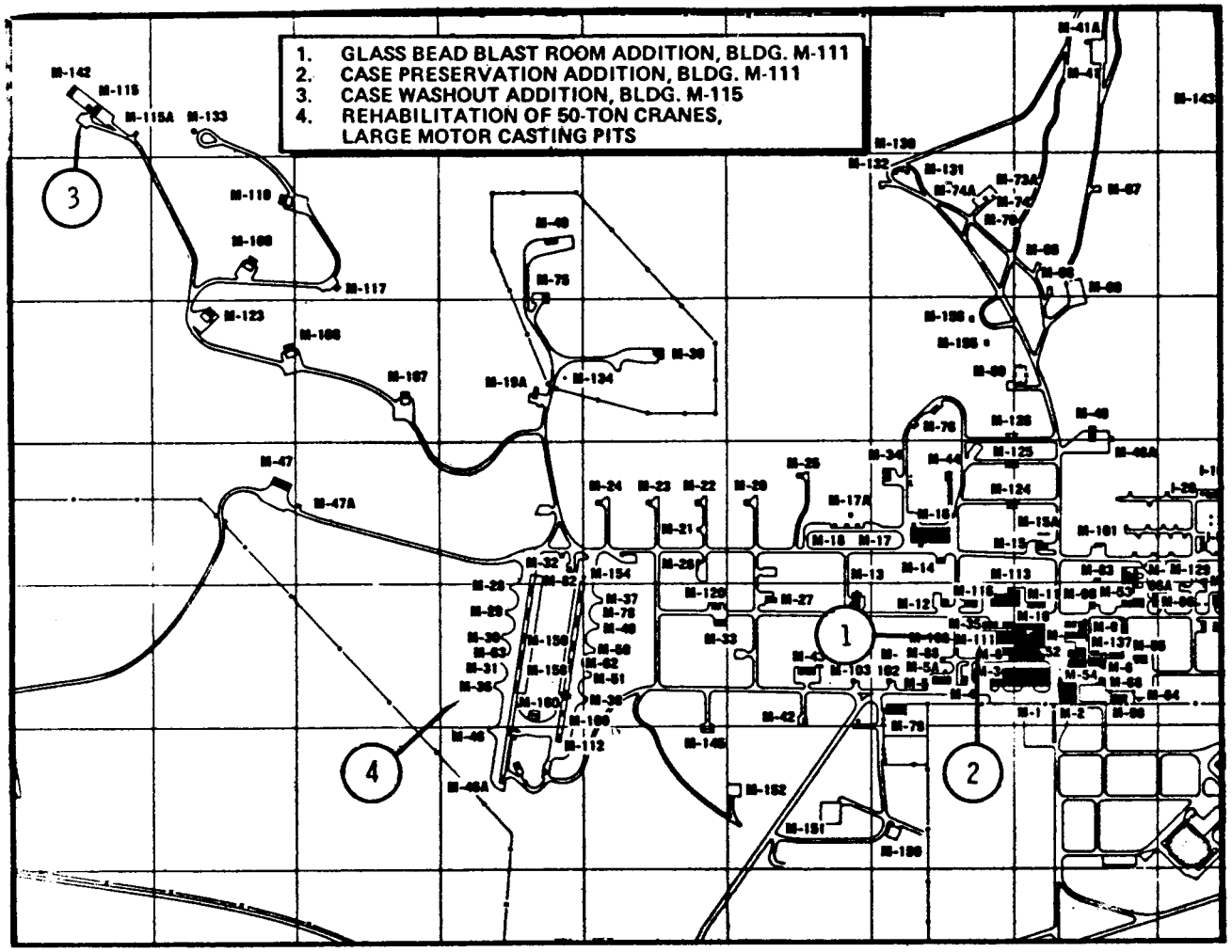


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Modifications to Solid Rocket Motor Manufacturinn and Assemblv Facilities
INSTALLATION:	Thiokol Plant. Wasatch Division. Utah
	FY 1981 CoF ESTIMATE: $2.700. 000

LOCATION OF PROJECT: Wasatch, Utah

COGNIZANT HEADQUARTERS OFFICE: Office of Space Transportation Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Desinn	Construction	Total
Specific CoF funding....	447,000	1,920,000	2,367,000
Capitalized investment.....	N/A	2.683.000	2.683.000
Total.....	447.000	4.603 .000	5.050 .000

SUMMARY PURPOSE AND SCOPE:

This project continues work begun with prior year resources, and further supplemented by FY 1978 and FY 1979 resources to provide Space Shuttle Solid Rocket Motor (SRM) production capability in Government-owned facilities at the Thiokol Plant, Wasatch Division, Wasatch, Utah (Figure 1). The government facilities involved are portions of Air Force Plant No. 78 located on the adjacent Thiokol facility. The cost of the basic "pre-shuttle" government plant facilities is not included in the prior years funding data above.

Prior year resources were used to modify existing Government-owned buildings to develop, manufacture, assemble, store, and test Space Shuttle Solid Rocket Motors (SRM's). These modifications were geared to provide SRM production and related facility capability for the test phase, early operational phase and to support the Shuttle launch rates in the range of 18 to 24 flights per year.

The FY 1975 funding provided modifications to the oxidizer grinding, case preparation and reclamation, radiographic inspection, nozzle joint test, and casting facilities to support up to 10 Shuttle flights per year. FY 1978 resources provided for an eight-segment process storage facility at Thiokol. The FY 1979 project was planned to increase the manufacturing capability to 24 flight sets per year. However, due to the increased time required to remove case insulation in the washout facility, this FY 1981 project is required to attain a refurbishment capability of 24 flight sets per year. This FY 1981 request will provide resources to further modify Government-owned facilities at the Thiokol/Wasatch plant to provide a production capability in support of a maximum rate of 24 flights per year, and at the same time, minimize production costs.

The proposed work includes an increase in the size of Building M-115 to permit washout and removal of insulation from fired case segments and to accommodate the longer stay times in the facility due to increased insulation complexity and thickness, and the modification of Building M-111 to add a glass bead blast capability to clean the mating joints. It also includes an addition to Building M-111 to provide the capability for inert case preservation, and rehabilitation of two 50-ton cranes at the Large Motor Casting Pits (LMCP) to achieve greater reliability and to meet current OSHA safety standards.

PROJECT:

The Space Shuttle vehicle consists of the Orbiter, a large External Tank, and two Solid Rocket Boosters (SRB's). This project supports the manufacturing of the SRB's. Each SRB consists of four 146-inch (370.8-centimeter) diameter SRM's, and a 152-inch long by 148-inch in diameter (386.1 -centimeter by 375.9-centimeter) nozzel and various structural components. SRM case segments are assembled, lined, and insulated in the inert operations complex. Assembled segments, (which are made up of 3 to 4 case segments) called casting segments, are then moved to the casting pits, where they are loaded with solid propellant. After the propellant is loaded, the segments are moved to the final SRM assembly area. There they are weighed, and the center of gravity is determined. The nozzel which consists of three major components (flexible bearing, throat assembly and exit cone) is lined, insulated and assembled. The systems tunnel, nozzle and igniter, instrumentation and handling harness rings are installed and inspected, and prepared for shipment to the launch site. After each flight, the Solid Rocket Motors are returned to Thiokol/Wasatch for case washout and reprocessing.

Case Segment Washout Facility, Building M-115

This facility addition will provide added required case washout capability. The increased complexity and amount of SRM lining/insulation has markedly lengthened the time required in the washout facility to remove the insulation. Rapid turnaround of case hardware is required to minimize procurement of new flight hardware. The new, second washout bay and work stations are required to meet the case segment refurbishment rate required to support a launch rate of 24 Shuttle flights per year.

Glass Bead Blast Room, Building M-111

During the preparation of the SRM case segment, considerable time is required to clean the case surfaces, particularly the clevis and tang areas. This operation presently must be done by hand because grit blasting has proven too abrasive. Process experiments have demonstrated that blasting these areas with glass bead grit reduces the hand cleaning to a minimum. This modification will provide a glass bead blast capability that will support a production rate of 24 Shuttle flight sets per year.

Case Segment Preservation Application Facility, Building M-111

Proper preservation of the SRM Case Segments is required to prevent corrosion. The process that was proposed for refurbished case segments has not proven effective. The refurbished case will, as a result of this project, receive the same treatment applied by the manufacturer to new cases when they are shipped to the Thiokol plant. This operation must be located with other related operations in Building M-111, but because of contamination possibilities, the preservation application functions must be isolated. This project provides the space and facilities, including utility service, for the electrostatic application of the case preservative.

Rehabilitation of 50-Ton Gantry Cranes

The two Government-owned 50-ton cranes at the Large Motor Casting Pits (LMCP) are 20 years old and must be rehabilitated. Time-consuming breakdowns cannot be tolerated when production rates reach a level to support 24 launches per year. Considerable maintenance and breakdown problems related to LMCP cranes have been experienced recently. The reliability of these cranes must be improved to insure continous smooth operation at the LMCP's to meet increasing production rates. The current OSHA safety requirements for this type of crane are currently not being met.

IMPACT OF DELAY:

Delay in providing these critical SRM manufacturing facilities will prevent attainment of the 24 Shuttle

flight sets per year required by the program. Furthermore, production shortfalls could be further aggrevated by the questionable safety and reliability of cranes. And finally, production cost savings that can be achieved by more efficient cleaning processes and proper case preservation will be denied.

PROJECT:

The proposed work includes additions and/or modifications to Buildings M-111 and M-115 and the rehabilitation of two 50-ton gantry cranes at the Large Motor Casting Pits (LMCP).

Case Segment Washout Facility, Building M-115

This 7,840 square feet by 30 feet high (728 square meters by 9.14 square meters) addition to Building M-115 (Figure 2) will be constructed on the south side of the nozzle washout addition (provided as part of the FY 1979 CoF Project). This new washout addition will have three work positions in addition to an actual 1,000 square feet (92.9 square meters) washout bay. These positions are: 1) Receiving and preparation bay - 800 square feet (74.2 square meters); 2) Manual washout bay for removal of the systems tunnel, external joint and and internal joint seal - 1,000 square feet (92.9 square meters); and 3) preservation and shipping bay - 800 square feet (74.2 square meters). In addition to the operational positions, there will be an 1,800-square foot (167.2-square meter) equipment storage and control room area. Also included are a pump room, work platforms, utility services, bridge cranes, track and conveyor system; and a new settlement pond. Provisions for a future additional washout bay will be incorporated into the structure.

Glass Bead Blast Room, Building M-111

Building M-111 will be modified to add a glass bead blastroom located in the south end of the West Bay of the building. The blastroom will be 400 square feet by 15 feet high (37.16 square meters by 4.57 square meters high) to allow the installation of a pre-engineered structure. Included will be a pit which provides access to the area of the case (the clevis joint) to be blasted. A recycling system will be installed for collecting spent beads and removing fines. A negative pressure will be maintained in the blastroom to prevent glass particles and dust from migrating to other operations in the building. All necessary utility services will also be provided (Figure 3 and 4).

Case Segment Preservation Application Room, Building M-111

A 400-square foot (37.16 square meter) preservation station will be added at the north end of the building. This station will have a covered access area with a monorail crane for lifting case segments, and a pit in the floor for access to the outside surface and the inside surfaces of the case segments. A personnel hydraulic

lift will be installed in the access pit. This lift will be capable of moving back and forth under the case so that both the outside and inside surfaces can be reached with preservative. The case will be positioned on powered rollers which will rotate the case during application of preservatives (Figures 3 and 5).

Rehabilitation of 50-ton Gantry Cranes:

The two Government-owned 50-ton cranes at the Large Motor Casting Pits (LMCP) will be completely rehabilitated. This will include diesel engine overhaul, electrical generator overhaul, overhaul of the brake system and addition of a secondary braking system, replacement of controls and electrical cabling, installation of new lifting cables, replacement of all wearing points such as wheel bearings, replacement of clutches and replacement of gearing (Figure 6).

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	2,700,000
Case segment washout facility, building M-115	---	---	---	1,800,000
Site work	LS	---	---	(56,000)
Paving	SY	2,000	8.00	(16,000)
Foundations and slab	CY	1,000	453	(453,000)
Building structure	SF	7,840	70.16	(550,000)
Mechanical systems and equipment	LS	---	---	(625,000)
Electrical (interior and exterior)	LS	---	---	(100,000)
Glass bead blast room, building M-111	---	---	---	200,000
Demolition	LS	---	---	(15,000)
Foundation and pit	LS	---	---	(22,000)
Building structure	LS	---	---	(82,000)
Mechnical and equipment	LS	---	---	(60,000)
Electrical	LS	---	---	(21,000)

	Unit of Measure	Quantity	Unit Cost	Cost
Case segment preservation application facility building M-lll.....	---	---	---	300,000
Site preparation	LS	---	---	(10,000)
Foundation and storage pad.....	LS	---	---	(30,000)
Building structure and canopy.....	LS	---	---	(120,000)
Mechanical/equipment	LS	---	---	(125,000)
Electrical	LS	---	---	(15,000)
Rehabilitation of 50-ton gantry cranes.....	LS	---	---	400,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total.....				2.700 ,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Case Segment Washout Facility
Figure 3 - Site Location Projects Building M-111
Figure 4 - Glass Bead Blast Room, Building M-111
Figure 5 - Case Segment Preservation Application Facility, Building M-111
Figure 6 - Rehabilitation of 50-ton Gantry Cranes

OTHER EQUIPMENT SUMMARY:

Special tooling and equipment will be needed to support production. This Government-furnished tooling and equipment will be funded from R&D resources and is estimated to cost $645,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Additional resources may be required for SRM facilities to support flight rates that exceed 24 per year. Details of the potential requirements cannot be validated at this time.

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION FOR SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH

SRM CASE WASHOUT FACILITY ADDITION BLDG M-115

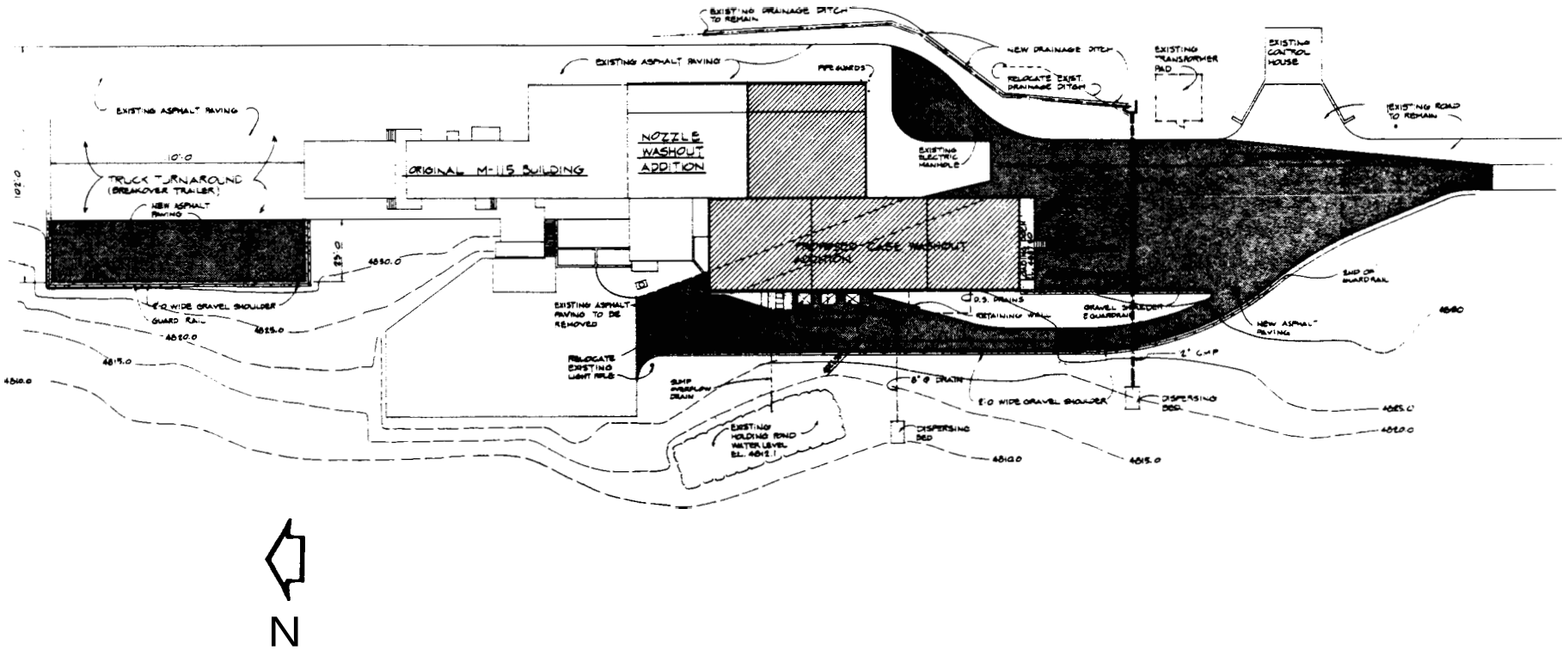


FIGURE 2

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATE
MODIFICATION FOR SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH
SITE LOCATION PROJECTS – BUILDING M–111

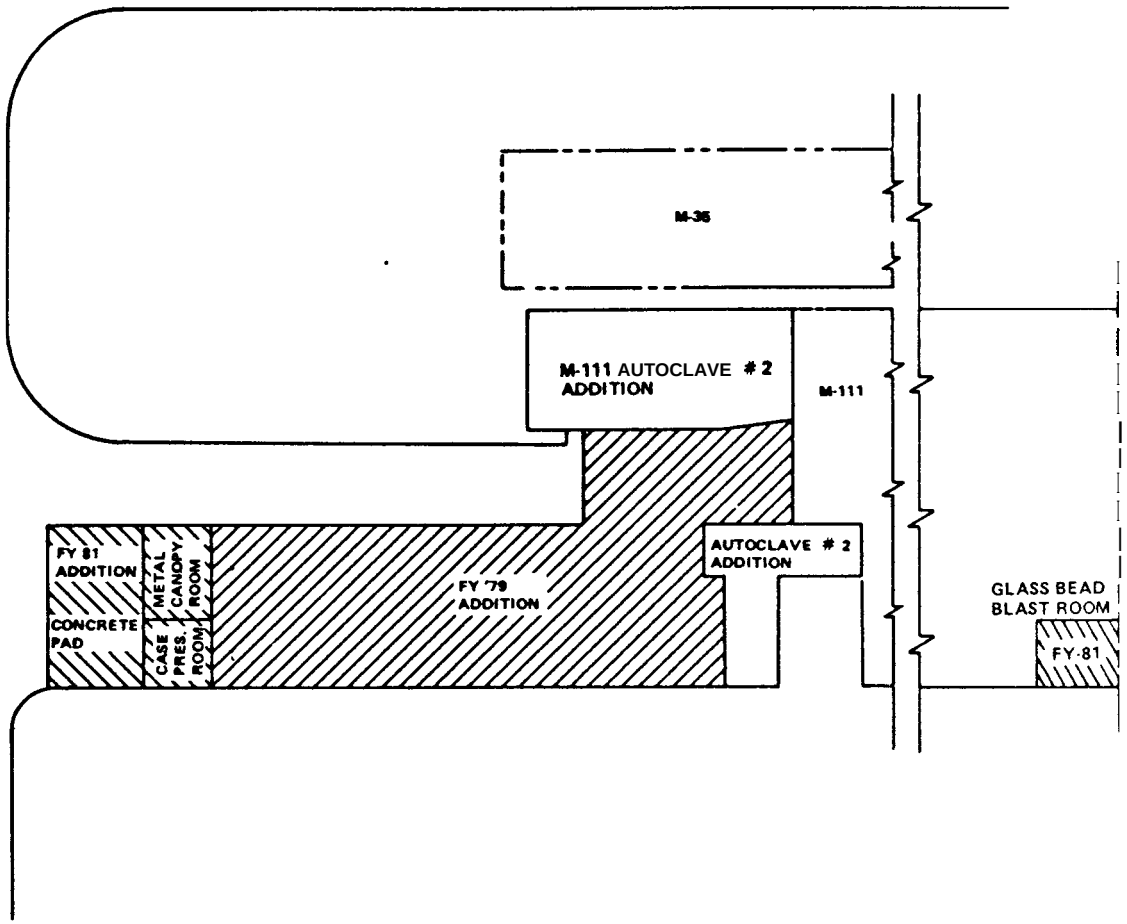


FIGURE 3

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION FOR SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH

GLASS BEAD BLAST ROOM–BUILDING M–111

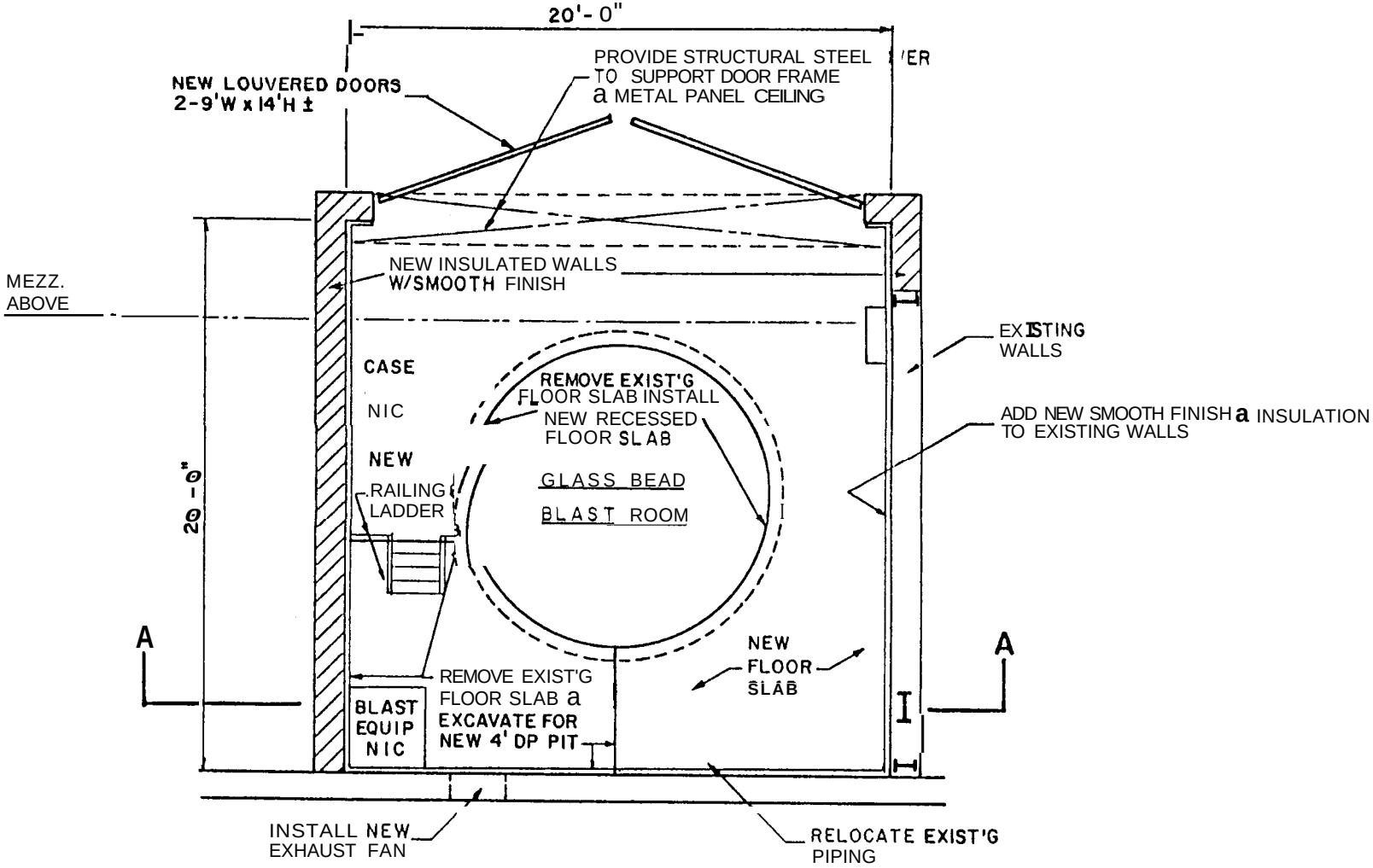


FIGURE 4

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATES
MODIFICATION FOR SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH
CASE SEGMENT PRESERVATION APPLICATION FACILITY – BUILDING M–111

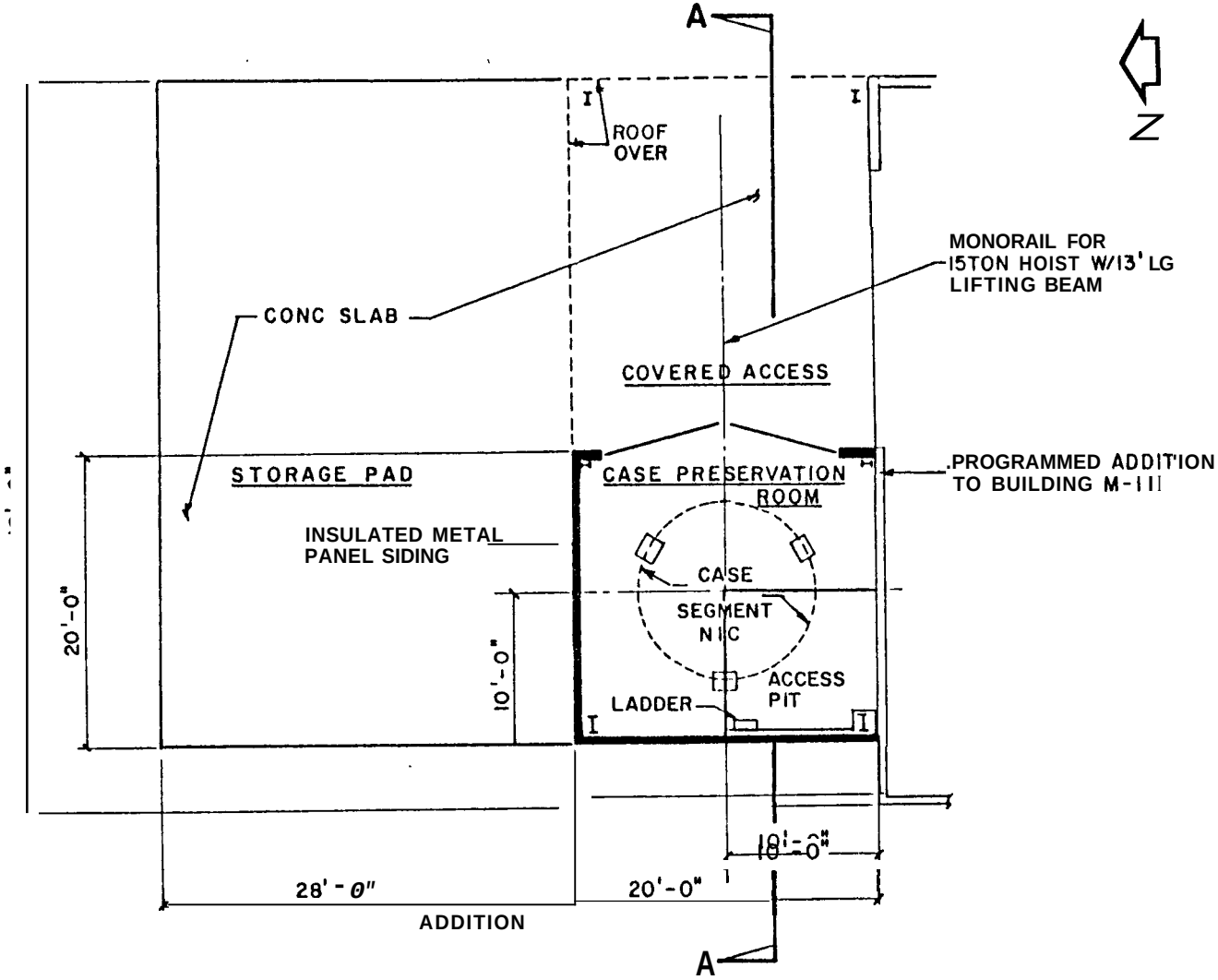


FIGURE 5

THIOKOL/MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1981 ESTIMATE
MODIFICATION FOR SOLID ROCKET MOTOR MANUFACTURING AND ASSEMBLY FACILITIES
THIOKOL, WASATCH, UTAH
REHABILITATION OF 50- TON GANTRY CRANES

FIGURE 6

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Minor Shuttle-Unique Projects

INSTALLATION: Various Locations

FY 1981 CoF ESTIMATE: $2,000,000

LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Space Transportation Systems

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	752,000	*8,710,000	9,462,000
Capitalized investment	N/A	**1,565,000	1,565,000
Total	752,000	10,275,000	11,027,000

*CoF Minor Shuttle-Unique Projects
**R&D/R&PM Minor Shuttle-Unique Projects

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide minor rehabilitation and modifications and construction of facilities necessary for support of the Space Shuttle Program at various NASA field installations. Included in this funding request are facility projects estimated to cost not in excess of $500,000 each. These projects respond to unique requirements of the Space Shuttle Program and are needed to achieve initial operational capability or to meet the program milestones.

PROJECT JUSTIFICATION:

Space Shuttle development, assembly, and test requirements are being accomplished to a large extent in Government facilities at various NASA installations and industrial plants. Any major modifications or new construction required at these locations is described as a major project elsewhere in this budget request. This project includes only those Shuttle-unique facility rehabilitation and modification and construction projects estimated to cost not in excess of $500,000. Each item of work listed under "PROJECT DESCRIPTION" is necessary to support a specific Shuttle requirement, insure continued reliability, provide a safer environment, and/or improve the efficiency and economy of individual facilities supporting the Space Shuttle Program. It is recognized, however, that during project planning and implementation some rearrangement of priorities may be necessary. These changes will be accomplished within the available resources.

For clarity, full disclosure purposes, and better fiscal and technical control, all Space Shuttle facility costs for both major and these minor facility projects, are summarized under "Space Shuttle Facilities - Various Locations". The cost of these minor projects are thus charged against the total Space Shuttle facilities commitment.

PROJECT DESCRIPTION:

The justifications, descriptions, and cost estimates for all elements of the Shuttle-unique minor projects are listed below:

A. Dryden Flight Research Center (DFRC) 490.000

1. Rehabilitation of Microwave Scanning Beam Landing System Cabling 490,000

Permanent installation of the Microwave Scanning Beam Landing System (MSBLS) at Edwards Air Force Base is required in mid-1981 to support the Secondary Landing Site concept for contingency Space Shuttle landings. After the early Space Shuttle developmental test flights are completed, the MSBLS equipment will be relocated from runway 17/35 at the dry lakebed to runway 04/22 for permanent installation. The present control and monitoring cabling has been subjected to vehicular traffic and the debilitating effects of a desert-like environment. This cabling was not planned as a permanent installation, and is not direct burial cable. Project resources will be used to procure and install approximately 30,000 linear feet (9,144 meters) of audio wide-band cabling for control and monitoring of the MSBLS. This project was deferred from FY 1980 in order to accomplish work of higher priority.

B. Johnson Space Center (JSC) 580,000

1. Modications for Relocating Software Development Laboratory, Mission Control Center Building 30 490,000

The Software Development Laboratory (SDL), presently located in the Mission Operations Wing, is to be relocated to the Administration Wing of the Mission Control Center (MCC) at Johnson Space Center (JSC). It must be reconfigured from its existing capability which supports singular software system development, integration, and verification to a facility capable of mass production of software systems to support Shuttle operations. Increasing flight rates during Shuttle operations will require the SDL to simultaneously manage up to 30 software systems in various stages of development. This expanded requirement necessitates an increase in the SDL's capability, thus, requiring more floor space than presently allocated. The work includes various interior modifications within an area of approximately 6,800 square feet (632 square meters) which will reconfigure the core area on the first floor of the MCC. Relocation of interior partitions and doors, installation of raised flooring, and minor changes to the lighting will be accomplished to suit program needs. Also included are modifications to the electric power distribution, modification and rebalancing of the air-conditioning, installation of additional electric power and air-conditioning, and installation of a chilled water cooling system required for computer equipment. This project will also provide changes to the fire detection system and for the extension of the fire suppression system into the new computer complex.

2. Modifications for STS Operations, Mission Operations Wing, Building 30 90,000

This project is phase III of a multiyear program to reconfigure the Mission Operations Wing (MOW) of Building 30 at the Johnson Space Center (JSC) for the Shuttle era. The MOW is presently configured for single mission capability. To support Shuttle operations, the third floor of the MOW must be reconfigured to simultaneously support multiple Shuttle flights. If this project is not accomplished, the existing facility configuration could not support the Shuttle flight schedule, once the space transportation system becomes fully operational.

This phase provides for various modifications on the third floor of the MOW to reconfigure seven rooms. In general, work includes removal of partitions and doors, installation of new partitions and doors, and replacemnt of damaged suspended ceiling and raised flooring. Also included are modifications to the lighting, electric power distribution, air-conditioning, and fire detection/suppression systems.

C. Marshall Space Flight Center/Michoud Assembly Facility (MSFC/MAF) 930,000

1. Modification of Building, 103, Production Support and Maintenance Area..... 490,000

This modification is required to provide logistics support for the thermal protection system (TPS) activities performed in the Vertical Assembly Building (110) and the High Bay Addition (114). The current use of trailers, and remote offices and cleaning facilities is costly, time consuming, and will create management difficulties as production rates increase. This project provides for modification of an area 50 feet (15.2 meters) by 90 feet (27.4 meters) in Building 103 to provide a maintenance area and to accommodate forty-two people for production support. As part of this modification, two rooms for cleaning TPS application guns will be provided. Related fencing and security devices are also included.

2. Modification to Thermal Protection System (TPS) Cells B&C, Building 110..... 440,000

The continuing development of the TPS spray process has highlighted a need to prevent contamination of external tank components prior to spraying. Experience has shown that spray activities cause deposits to collect on cell walls. These deposits often contaminate the surface of the next article to be sprayed. Such contamination prevents a satisfactory spray application bond, thus, making the TPS coating unacceptable. The current rough, uncoated concrete surfaces of the cells are highly susceptible to contamination and must be cleaned after each spraying process. This cleaning costs approximately $15,000 for each tank and requires about seven days to accomplish, during which time other work cannot be performed in the cells. A high-gloss ceramic-like coating will be applied to the cells which will be less susceptible to contamination and will reduce the time and cost for cleaning by about one-half. The coating will cover approximately 31,000 square feet (2,800 square meters) of the interior walls of Cells "B" and "C". Doors and support structures will also be coated. All holes and pores will be grouted prior to coating in order to provide a smooth surface and to eliminate areas and pockets where overspray could build up and induce contamination. This work is required to support planned ET production rates.

SPACE SHUTTLE PAYLOAD FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

SPACE SHUTTLE PAYLOAD FACILITIES

	Amount	Page No.
Office of Space Science:		
Rehabilitation and Modification for Payload Ground Support Operations (KSC).....	1,617,000	CF 9-1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION AND MODIFICATION
FOR PAYLOAD GROUND SUPPORT OPERATIONS
LOCATION PLAN

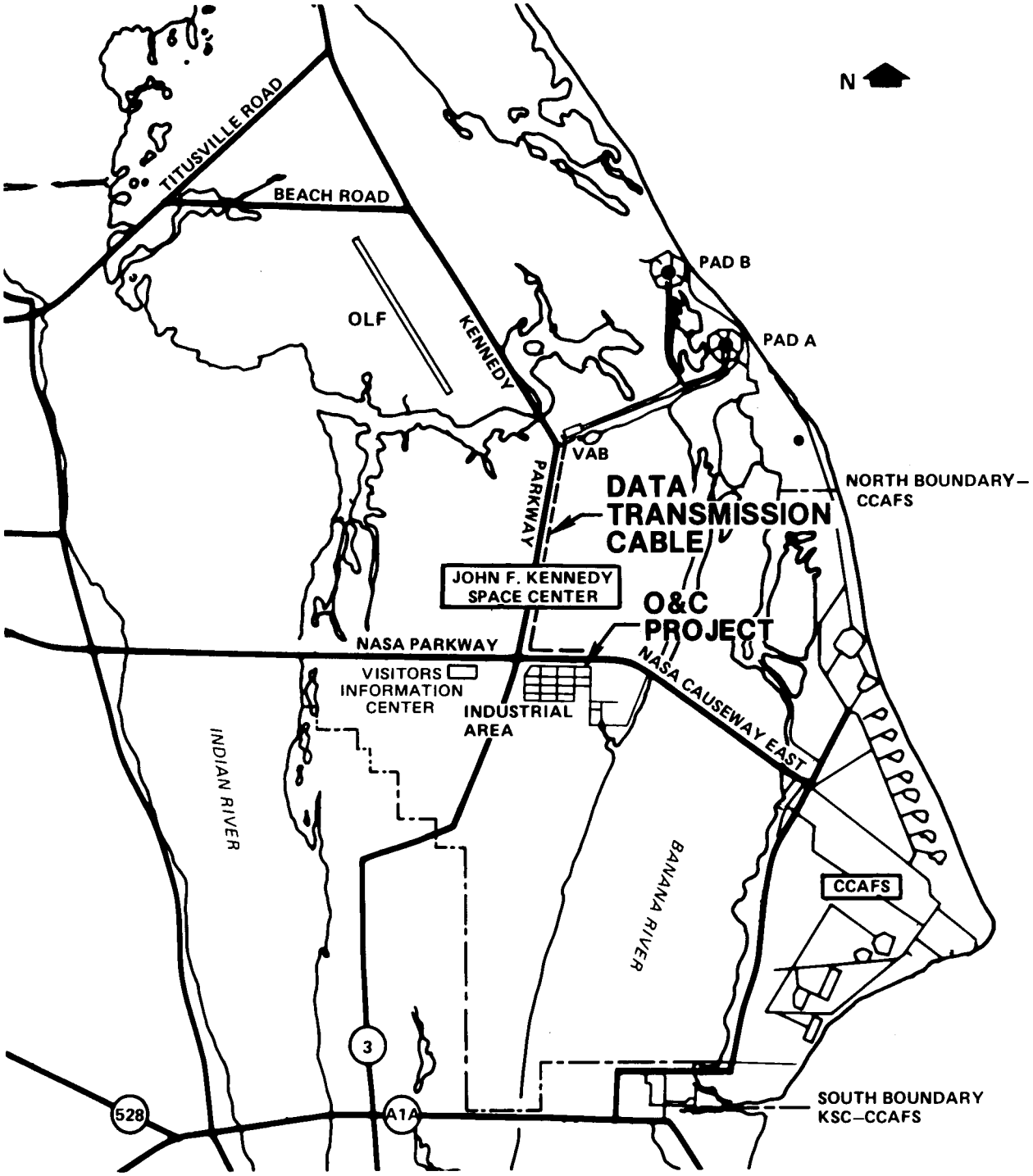


FIGURE 1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: Rehabilitation and Modification for Payload Ground Support Operations

INSTALLATION: John F. Kennedy Space Center

FY 1981 CoF ESTIMATE: $1,617,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science

FY 1980 AND PRIOR YEARS FUNDING: The following prior years funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding	1,351,000	12,590,000	13,941,000
Capitalized investment	N/A	48,363,000	48,363,000
Total	1,351,000	60,951,000	62,304,000

SUMMARY PURPOSE AND SCOPE:

This project continues construction, and rehabilitation and modification of facilities necessary to support Space Shuttle payload ground operations at the NASA launch site, Kennedy Space Center (KSC), begun with prior year resources. This year's request provides for modifying an area in the Operations and Checkout (O&C) Building to house instrumentation, control equipment, and data distribution hardware to enable payload users to monitor and control their payloads as they progress through the O&C Building to the Orbiter Processing Facility (OPF). The work includes modifying approximately 7,500 square feet (697 square meters) of existing

control room space and installing data transmission cables in the O&C Building, and installing approximately six miles (9.66 kilometers) of data transmission cable between the O&C Building and the OPF (See Figure 1).

PROJECT:

Space Shuttle payload ground support operations will be conducted at NASA's launch site, KSC. Many different facilities, requiring both major and minor construction, and rehabilitation and modification, will be involved in payload support operations. For the purposes of clarity, full disclosure, and better technical and fiscal control, all payload ground support projects at KSC are included in one budget estimate category.

The Space Transportation System (STS) operational phase of the Space Shuttle program will commence after the first four development flights beginning in CY 1980. After those initial development flights, the primary purpose of the STS will be in the support of payload operations. In prior years, resources were provided for payload activities which established the O&C Building as the location for horizontal processing and buildup of Spacelab payloads and other classes of horizontal payloads. In addition, the Vertical Processing Facility (VPF) was modified to provide facilities for the vertical processing and buildup of payloads to be handled in this configuration. In FY 1980, the first increment of resources was provided for payload ground support operations. Included in the FY 1980 project were modifications for Spacelab Level IV integration in the O&C Building, upgrading payload handling capability in the VPF, and modifications for a life science support facility. As a result, many of the planned activities in the O&C Building, the supporting assembly and checkout stands and subsidiary stands for pallets and racks currently occupy all the available floor space in the assembly and checkout area which leaves minimal maneuvering space for flight hardware.

This project will alleviate congestion in the assembly and checkout area and allow payload users to monitor their payloads as they flow through the O&C Building to the OPF. The project includes modifications to an area adjacent to the assembly and checkout area to house payload users' instrumentation and control equipment, and the installation of data transmission cabling through the O&C Building to the OPF. The O&C to OPF data transmission cable, approximately six miles (9.66 kilometers) long, is necessary to accommodate the high-rate data (50 megabits per second) required by Spacelab subsystems. The existing cable transmission system has a limitation of 4.5 megabits per second and has a reliable life expectancy only until 1982.

IMPACT OF DELAY:

As the Shuttle moves into its operational phase in CY 1981, increasing numbers of payloads will be processed through the O&C Building and the OPF. The first Spacelab mission is scheduled for launch in the second quarter of CY 1982. Payloads flying on this mission will begin processing and integration in the O&C Building approximately twelve months prior to this launch date. To monitor payload functioning, the payload users'

rooms, with associated data transmission systems, are required to be operational at that time. It is only through such a complete payload monitoring system that malfunctions can be identified and timely corrective measures taken to repair or replace defective payloads. In order to satisfy this vital requirement when it is needed, FY 1981 funding is essential. Without the capability to monitor individual payloads, the possibility exists that certain individual payloads within a Spacelab or other cargo could be functioning improperly and, if not corrected, would result in lost mission capability.

PROJECT:

This project modifies approximately 7,500 square feet (697 square meters) in the O&C Building to provide two payload user rooms and an area to house data processing and distribution equipment (Figure 3). The work will include: modification of the raised tile flooring, electrical lines, and air-conditioning ducts in rooms 4239, 4245, 4249, 4255, and 1263; and installation of fire protection systems. Also included is a data transmission cable system in the O&C Building consisting of cabling and associated hardware connecting the test stands in the High Bay area, room 1263, and the payload user rooms. To transmit data from the OPF to the O&C Building, approximately six miles (9.66 kilometers) of data transmission cable will be installed (Figure 2).

PROJECT COST ESTIMATE:

The basis of this cost estimate is a Preliminary Engineering Report and related studies.

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	1.617.000
Modify O&C building	---	---	---	645 ,375
Demolition	SF	7,500	4.30	(32,250)
Architectural/structural	SF	7,500	29.00	(217,500)
Mechanical systems	SF	7,500	31.00	(232,500)
Fire protection	SF	7,500	10.75	(80,625)
Electrical systems	SF	7,500	11.00	(82,500)
O&C cabling system	LS	---	---	524,625
Cables	LS	---	---	(102,120)
Associated hardware	LS	---	---	(422,505)
O&C to OPF cabling system	LS	---	---	447,000
Equipment	---	---	---	-A-
Fallout Shelter (not feasible)	---	---	---	--
Total				1.617 ,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location plan
Figure 2 - Site plan
Figure 3 - Pictorial of O&C

OTHER EQUIPMENT SUMMARY:

Certain noncollateral equipment, such as payload data transmitters, receivers and processing systems to be funded from R&D resources (estimated to cost approximately $1 million), will be required to support initial operations.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is anticipated that future modification work will be necessary to support additional processing tasks at KSC. The requirement for such work and its scope cannot be validated at this time.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1981 ESTIMATES
REHABILITATION AND MODIFICATION FOR PAYLOAD GROUND SUPPORT OPERATIONS
SITE PLAN

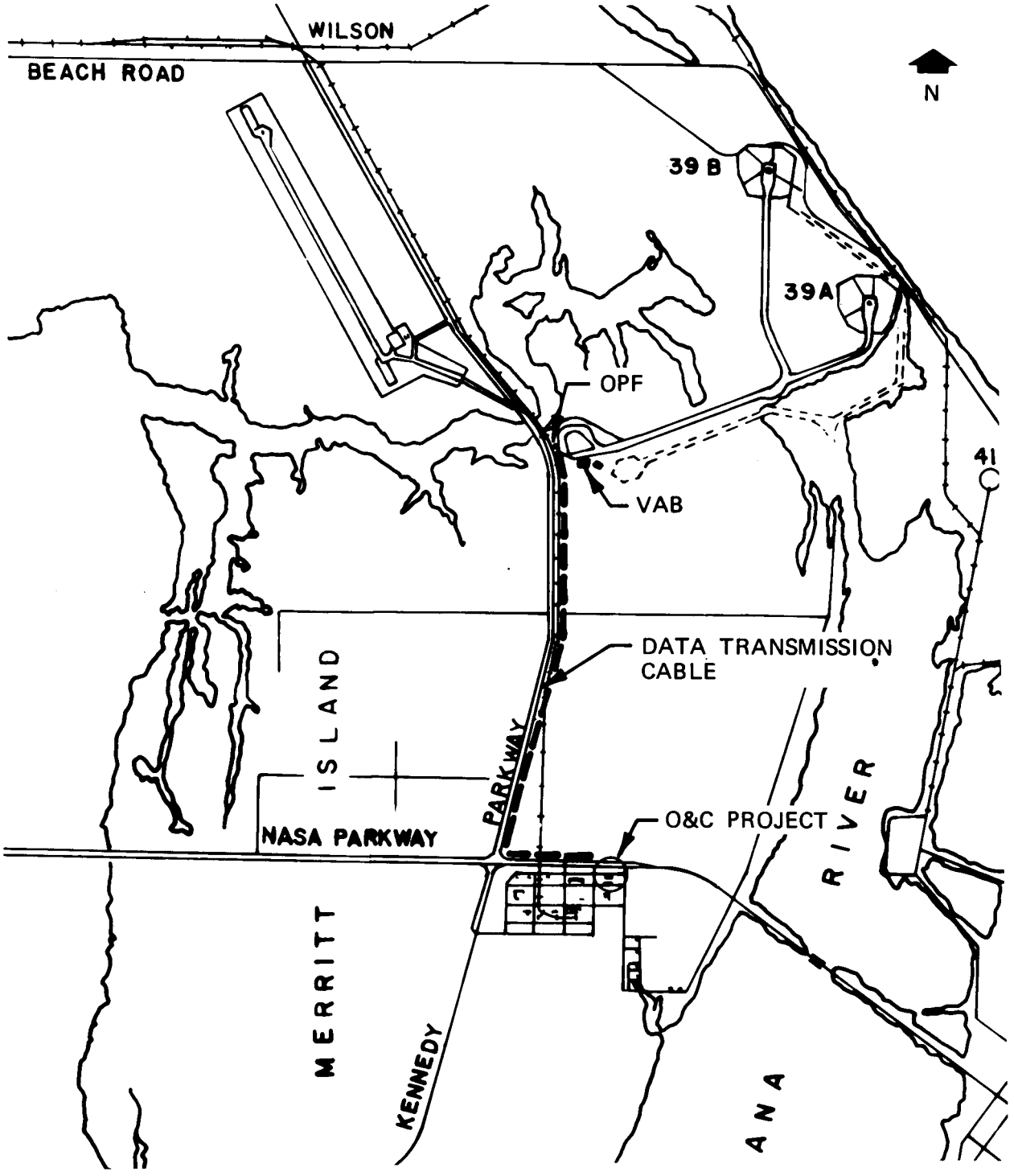


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1981 ESTIMATES

REHABILITATION AND MODIFICATION FOR PAYLOAD GROUND SUPPORT OPERATIONS

PICTORIAL VIEW – O&C BUILDING

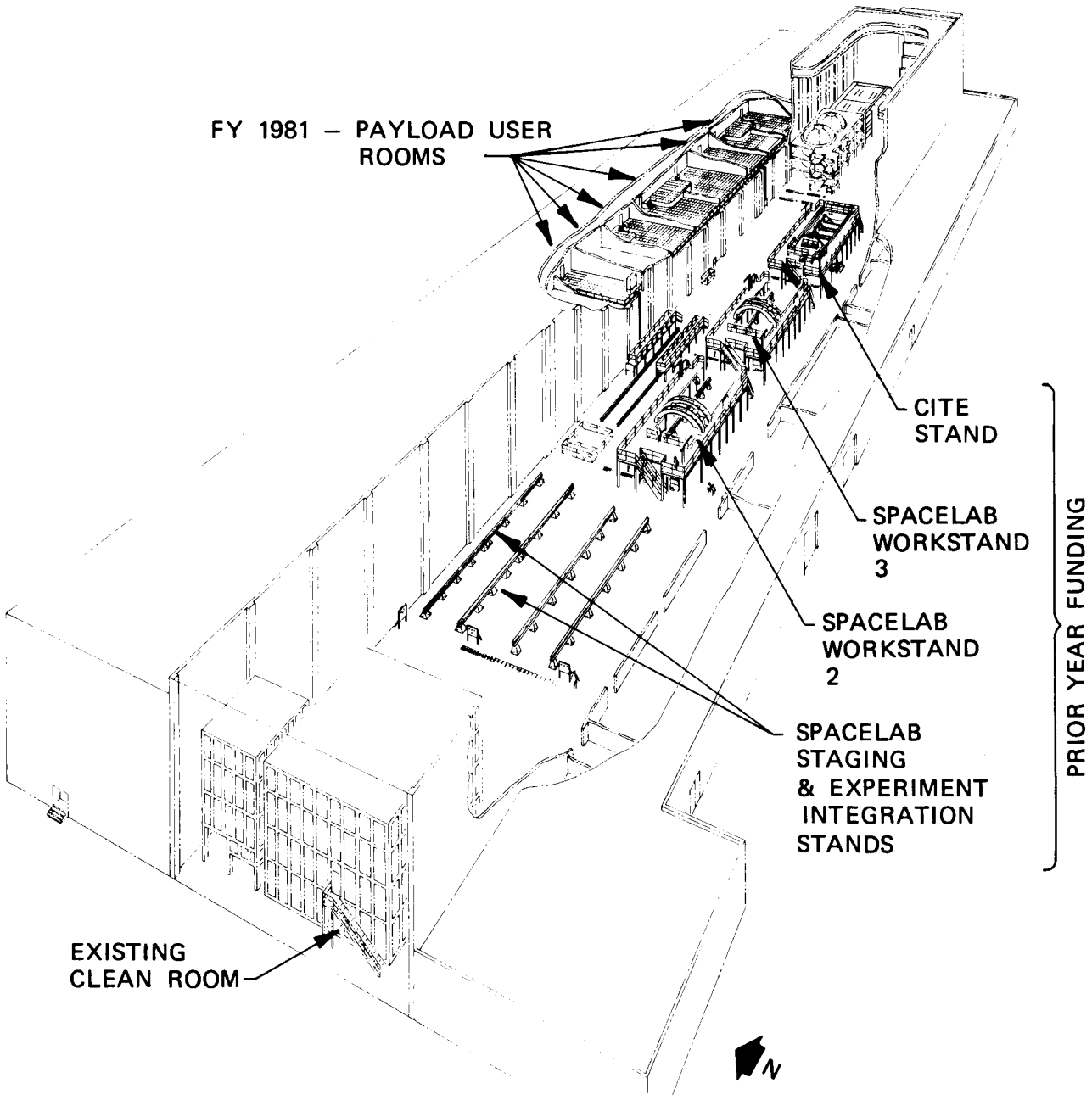


FIGURE 3

REPAIR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

REPAIR

Summary of Project Amounts by Location:	Amount	Pane No.
Ames Research Center	310.000	CF 10-3
Goddard Space Flight Center	985,000	CF 10-3
Jet Propulsion Laboratory	1.120.000	CF 10-5
Johnson Space Center	1,730,000	CF 10-6
Kennedy Space Center	1,640,000	CF 10-8
Langley Research Center	1,190,000	CF 10-10.
Lewis Research Center	1,645,000	CF 10-11
Marshall Space Flight Center	2.310, 000	CF 10-13
Michoud Assembly Facility	1.470. 000	CF 10-15
National Space Technology Laboratories	870,000	CF 10-17
Wallops Flight Center	965,000	CF 10-19
Miscellaneous Projects less than $150.000 each	765.000	CF 10-20
Total	15,000,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Repair of Facilities, Not in Excess of $500,000 Per Project
INSTALLATION:	Various Locations
	FY 1981 CoF ESTIMATE: $15,000,000
FY 1979: None	FY 1980: $12,000,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller

SUMMARY PURPOSE AND SCOPE:

These resources will provide for large repairs to facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in the request are those facility repair needs for FY 1981 that can be foreseen at the time of the submission of these estimates, and that are estimated not to exceed $500,000 per project. The thrust of this program is to provide a means to restore facilities or components thereof, including collateral equipment, to a condition substantially equivalent to their originally intended and designed capability. It includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. This work also includes major preventive measures which are normally accomplished on a cyclic schedule of greater than one year.

PROJECT:

A major portion of the Agency's facilities inventory is in the 15 + year-old bracket and increases in repair requirements are to be expected. Maintenance and repair costs for mechanical and electrical systems in a typical building are almost three times higher during the 16- to 30-year period of a building's life than they

are during the initial 15 years of beneficial occupancy. At about the 15-year point many electrical and mechanical components reach the end of their serviceable or economic life and should be replaced in the interest of long-term economy. Continued piecemeal repair of these components usually requires more resources in the long run than replacement after the end of the economic life of the original components. This condition is now being encountered at locations such as Goddard Space Flight Center (GSFC) and Johnson Space Center (JSC). The sheer age of other portions of the plant, such as at Langley Research Center (LaRC) and Lewis Research Center (LeRC), highlight the need for an aggressive repair program. Some 75 percent of the physical plant is in the 16 to 30-year old bracket.

The major thrust of this repair program as well as the rehabilitation and modification program is to preserve the Agency's $6.4 billion (September 31, 1979) physical plant. However, the major distinction between these classes of work is whether or not the intended work is to bring the "facility and its components to a condition substantially equivalent to its designed capacity, efficiency and capabilities." If such is the case, the work is properly classed as "repair." An analysis of each of the projects which follows indicates that this is the type of work which must be addressed and progressively accomplished. Unless this is done, resultant risks are increased, and future costs of the specific work will be greater. More importantly, there will be increased breakdown and costly emergency repair required.

This project includes only facility repair work having an estimated cost not in excess of $500,000. The work 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 that are provided for in other than CoF estimates. Each repair project estimated to cost more than $500,000 is reflected elsewhere as a separate major CoF line item project.

PROJECT:

Proposed repair projects for FY 1981 totaling $15,000,000 are described under "PROJECT COST ESTIMATE". Only those projects estimated to cost less than $150,000 have not been individually described or identified by center. The total cost for these miscellaneous projects is $745,000. This program has been distilled from requests totaling $27,364,000 and thus represents a modest request in relation to the backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are considered to be of the highest priority. Deferral of this mission essential work would adversely impact the availability of critical facilities and program schedules.

During the course of the year, some rearrangement of priorities may be necessary. This may force a change in some of the items to be accomplished. Any such change, however, will be accomplished within available resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE".

a.	Utility Systems..	5,600,000
b.	General Purpose Buildings	475,000
c.	Technical Buildings/Structures	1,530,000
d.	Pavements and Drainage	2,910,000
e.	Building Exteriors and Roofs	4,075,000
f.	Fire Protection	410,000

PROJECT COST ESTIMATE:

A. Ames Research Center (ARC) 310.000

1. Repair of Roofs, Buildings N-204, N-210, N-223 and N-235 310,000

This project replaces mineral surfaced roofs on Buildings N-204, N-210, N-223, and N-235. Approximately 60,000 square feet (5600 square meters) of new roofing will be applied to these buildings. As part of this repair, two inches of rigid foam thermal insulation will be installed. The roof on Building 204 is 24 years old; Building N-210's is 39 years old; Building N-223's is 24 years old; and Building N-235's, although only 15 years old, continues to leak. This work is necessary to prevent water damage to the interior of these buildings.

B. Goddard Space Flight Center (GSFC) 985.000

1. Repair Roofs of Payload Testing Facility, Building 7, and Environmental Test Laboratory, Building 10 280,000

These resources provide for repair of approximately 90,000 square feet (8,400 square meters) of roof surfaces on Buildings 7 and 10. This work includes the removal of the deteriorated roofing material and insulation, and the installation of a 5-ply system with new insulation. Flashing will be installed as necessary.

This project results from a survey of the roof conditions at the Center and is a portion of a planned program for corrective action. An inspection of the roofs of Buildings 7 and 10 indicated blistering of the roofing felts due to moisture penetration, cracks, alligatoring, and a loss of gravel. Extensive deterioration of the roofing of these buildings dictates the need for total replacement. Also, the underlying insulation requires replacement as it has become moisture saturated and has lost its insulating effectiveness. These conditions have resulted in extensive leaks and maintenance, and threaten building research equipment. For these reasons, Buildings 7 and 10 were selected for repair at this time. The remaining buildings surveyed were in better condition and repairs can be deferred to future years.

2. Repair Paved Surfaces 380,000

These resources provide for the initial portion of work in a planned repair program to improve the paved surface areas of the Center. This work will include resurfacing with 2.5 inches (6.4 centimeters) of asphalt paving, approximately 26,000 square yards (21,700 square meters) of parking lots serving Buildings 2, 12, and 21. Drainage, curbing, patching and related repair work will also be included. These parking lots, selected from a study of the conditions of the paved surfaces, are in the most urgent need of repair. In future years, the remaining paved surfaces will be considered for repair. Originally constructed in the early 1960's, they have deteriorated due to heavy usage. The severity of the past two winters, has caused numerous potholes and depressions to develop resulting in accelerated deterioration and poor surface conditions. Further roadway deterioration, with attendant rise in costs will occur if this work is delayed.

3. Repair Building Exterior Surfaces 165,000

These resources will provide for repair to the window caulking of some 5,000 windows in 18 major buildings of the Center. Buildings included in this project are 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 16, 17, 18, 19, 20, 21, 25, and 26. This work will include the removal of the deteriorated material around the window frames, replacement with commercial-grade sulfide caulking and painting. A survey of the window conditions of the Center surfaced the need for this work. These buildings are 15 years old and the deterioration is the result of the aging and weathering process. Window drafts contribute to energy loss in the buildings.

4. Repair Parkway Bridge 160,000

These resources provide for necessary repairs to the two-lane, 380-foot (116 meter), highway bridge over the Baltimore-Washington Parkway. Work includes replacement of concrete drainage gutter sections, removal and replacement of portions of concrete toe walls, and the sand blasting and repainting of steel surfaces. Also included is the resealing of the cracks in the wearing course of the bridge and approach roadway and other related work. This bridge was built in 1966 to provide the primary employee access to the Center from the

Baltimore-Washington Parkway. An inspection of the bridge reveals that poor joint design and lack of maintenance has allowed leakage of water and salt brine on the outside lanes of the bridge. This has resulted in corrosion of the steel. Also, the concrete surfaces are cracking and spalling. Further costly deterioration of the bridge structure will result if the work is delayed.

C. Jet Propulsion Laboratory (JPL) 1,120,000

1. Repair UPS Battery Station in Space Flight Operations Facility 230 215,000

These resources provide for the replacement of the 15-year old battery bank of the uninterruptible power supply (UPS) with a system consisting of 184 cells with an 8-hour rating of 1950 ampere hours, and an associated main fused disconnect switch rated at 2,000 amperes, 600 volts. This will result in a system of two complete battery banks, normally operating in parallel, but separable for necessary maintenance or other downtime. The UPS supplies the computer equipment for the Space Flight Operations Facility, Building 230, and accommodates transfer of load between normal and emergency supply without the loss of computer service. The present UPS system is of redundant design which allows for the failure of any single component without loss of the system. The backup battery bank, however, is 15 years old and the batteries are approaching the end of their useful life. Deterioration is occuring and batteries are beginning to fail. The bank is no longer fully rated and can now supply only a portion of the total UPS requirement. Therefore, it cannot adequately backup the system when the main battery bank is being serviced. The proposed replacement will result in two battery banks of equal capacity, each with its own disconnect, to allow for servicing and emergency back-up of one bank with the system fully operational.

2. Repair Below Grade Waterproofing at Physical Science Lab 183 420,000

These resources provide for the repair of below grade waterproofing along the entire north side and parts of the east and west sides of Building 183. This project includes the removal and replacement of 3,570 square feet (330 square meters) of ground cover, shrubs, specimen trees, and irrigation lines. Concrete walks, stairs, stair foundations, and paving will also be removed and replaced. Earthfill will be removed from around the building, exposing all surfaces of below grade concrete walls and footings, including concrete roof beams of the basement level particle accelerator room. A 5-ply built-up waterproofing system will be installed along with a foundation level perimeter perforated drainage system. The excavated earth, stockpiled on the site, will be backfilled and compacted. All walks, stairs and plant material will be reinstalled. Water leaks and damage to interior surfaces of the north side of Building 183 have been a problem for over 10 years. Attempts have been made to seal joints with epoxy pressure grout but without success. Water penetrates the interior stairways, offices and laboratories which are two floors below grade. Of particular concern is water penetration and damage to the concrete radiation shields of the particle accelerator.

3. Repair Roofs of Various Buildings (156, 161, 186, and 248) 485,000

These resources provide for the replacement of all the 4-ply built-up roofing and rigid board insulation on Computer Program Office Building 156, Telecommunications Laboratory Building 161, and the 10-Foot Space Simulator, Building 248. All deteriorated gravel guards, coping, and built-up parapet wall flashing will be replaced. A total of 34,700 square feet (3,200 square meters) of roof will be replaced. The Space Sciences Division Building 186 will have 20,200 square feet (1,900 square meters) of blistered urethane foam, built-up roofing and rigid insulation replaced with a new 5-ply composition and gravel roof. Ten new roof drains will be added to Building 186 to improve the drainage system. The roofs on Buildings 156 and 161 are 25 years old; they have exceeded their useful life, are badly deteriorated and should be replaced now. The roof on Building 186 was covered with urethane foam in 1973 to provide protection for the deteriorated built-up roof and to eliminate excessive ponding of water. The urethane foam system has failed. Building 248 sustained severe damage from oil spilled during a solar energy experiment.

D. Johnson Space Center (JSC) 1,730,000

1. Repair of Roofs, Various Building 315,000

This project is Phase III of a multiyear program to repair the roofs of various buildings at JSC. This phase provides for work on Buildings 16, 24, and 32. In general, the work will consist of removing and replacing roofing material at blisters, roofing insulation board and flashing, and resealing and caulking perimeter flashing. Moisture relief vents will be provided where inspections have revealed that excessive moisture collects. Approximately 40,000 square feet (3,700 square meters) of roofing, 3,500 square feet (325 square meters) of insulating board, and 1,100 linear feet (335 meters) of perimeter flashing will be replaced on Building 16. On Building 32, approximately 20,000 square feet (1,900 square meters) of roofing, 1,500 square feet (140 square meters) of insulating board, and 900 linear feet (275 meters) of perimeter flashing will be replaced. On Building 24, approximately 25,600 square feet (2,400 square meters) of roofing, 10,200 square feet (950 square meters) of insulation board, and 750 linear feet (230 meters) of perimeter flashing will be replaced. This project is essential to the continued operation of these JSC facilities. A recent roof survey indicated that the roofs of these buildings now require extensive repair. Over the past 15 years, the normal aging process, together with various building modifications affecting the roofs and the presence of many roof penetrations, have resulted in numerous leaks and moisture accumulations in roofing materials. This project is needed to preclude damage to the building structures, as well as damage to interior ceiling panels and equipment. Normal routine maintenance no longer can keep up with increasing rates of roof deterioration; therefore, this project is now necessary.

2. Repair of Heating, Ventilating, and Air-conditioning Systems, Various Buildings 475,000

This project is part of a multiyear program to repair heating and cooling equipment in various buildings at JSC. The work in this phase includes the repair or replacement of air handler casings and structures, compressors, condensors, controls, valves, pumps, condensate units, and fan/scroll assemblies. In addition, tasks of coil cleaning, damper and duct repair, suspension replacement, piping replacement or repair, instrumentation calibration, insulating, and painting of all components and ancillary equipment will be performed. This work will be accomplished in Buildings 11, 14, 17, 25, 32, 36, 37, and in the 200 Area. It includes the repair and/or replacement of 96 chilled water air handlers and ancillary equipment, the replacement of 10 direct expansion air handlers totalling approximately 80 tons, and the replacement of three water heaters. Age, high humidity, and salt/chemical content of the air in the JSC region has caused serious deterioration of the coils, fans, and casings of air handling units. Also, the various heating and cooling system components are approaching the end of their useful life.

3. Repair Steam and Chilled Water Systems, Building 24 Complex 180,000

This project is part of a multiyear program to repair various components of the Center's primary utilities generation and distribution systems which are located in the Central Heating and Cooling Plant (Building 24) and its associated facilities (cooling tower 24a and the utility tunnel system). The work in this phase includes the repair of two heat exchangers and controls. It also includes replacement of approximately 10 expansion joints, repair of six valves, and the repair of pipe insulation in the utility tunnel steam and condensate lines. Work on the chilled water system includes repair of 30 chilled water and condenser water valves in the utilty tunnel system, replacement of insulation and repair of one refrigerant condenser. The project also includes repair of three 200-hp condenser water pumps located at cooling tower 24. This project is essential to the continued use and reliable operation of these facilities at JSC.

4. Repair of Various Facilities, White Sands Test Facility 315,000

Repairs will be made to the heating, ventilating, and air-conditioning equipment by replacing deteriorated cooling towers at Buildings 201 and 203 and replacing deteriorated components in the hot and chilled water systems in the 200 Area. The water distribution system will be refurbished by replacing deteriorated water lines and repairing the exterior of the water storage tank. Also included is the replacement of the gates in the 9-foot (2.74 meter) diameter isolation valves at Test Stands 401 and 403 and the installation of a modified seal system. Additionally, 89,300 square yards (74,700 square meters) of 1-inch (2.54 centimeter) thick asphaltic overlay will be applied to the access roadway that extends from U.S. Highway 70 to the WSTF entrance gate. The road will also be restriped. This project is part of a continuing program to repair facilities and systems at WSTF. The cooling towers have been in constant service since 1970 and are badly

deteriorated. The hot and chilled water systems have been in service since 1965 and many of the carbon steel water lines require replacement. The water tank has been in service since 1964 and requires exterior repair. Vacuum chamber isolation valve gates at Test Stands 401 and 403 have warped. This condition reduces the effectiveness of the seal system and makes it difficult to achieve the vacuum required to support test programs. The access road was constructed during 1964 and 1965 and was last sealed in 1971. These proposed road repairs are now required to prevent further deterioration.

5. Repair of Various Facilities, NASA Industrial Plant, Downey, CA..... 445,000

These resources provide for the repair of various buildings and systems at the NASA Industrial Plant, Downey, California. The work includes repair and/or replacement of coils, condensate drain pans, motors, blowers, and controls of 17 of the 29 air handling units located on the roof of Building 006; and the replacement of 165,000 square feet (15,300 square meters) of the saw-toothed portion of the Building 001 roof. The buildings included in this project house Shuttle Orbiter manufacturing functions. The air handlers were installed in 1956 and have been in almost continuous operation for 24 years. The chilled water coils, the control valves and operators, and the blower shafts are now badly deteriorated. Because of the condition of the existing equipment, the efficiency of each system is greatly reduced, and routine maintenance cannot achieve satisfactory results. Building 001 was constructed in increments between 1928 and 1940 and has a roof system which is a combination of wood, steel, and transite decking. This roof has had a history of numerous leaks and now requires continuous repairs and patching. The condition of the roof has now reached a state where, if this repair work is not performed, water from the leaks will cause considerable damage to ceilings, floors and building contents.

E. Kennedy Space Center (KSC) 1.640.000

1. Repair Roofs, Various Buildings 475,000

These resources provide for the repair/replacement of approximately 26,600 square feet (2,500 square meters) of the high bay and fifth floor roof of the Operations and Checkout Building, M7-355; 54,000 square feet (5,000 square meters) of the roof on the Supply, Shipping and Receiving Building #1, M7-505; and approximately 25,000 square feet (2,300 square meters) of the roof on the Utility Annex, K6-947. The work includes repairs to blisters, cracks, and splits; flashing repairs; pitch pocket repairs; and removal and replacement of aggregrate and resaturation with asphalt. Repair is required due to accumulated deterioration of the built-up roof systems since they were built in the mid-1960's. Failure to perform this repair will result in damage to ceilings, walls, and equipment in these buildings.

2. Repair of Hot Water Heating Systems, Various Building 445,000

These resources provide for the repair of hot water heating systems in four buildings: Automotive Maintenance and Service Building M6-688; Supply Warehouse #1, Building M6-794; Central Supply Building M6-744; and Supply Warehouse #2, Building M6-698. The work to be performed in these facilities includes the replacment of piping, insulation, and miscellaneous plumbing components serving each individual heater; descaling of each heater core; and the painting of all heater housings. In addition, fan motors will be replaced in Buildings M6-744 and M6-698. This work is necessary to remedy accrued deterioration'which is causing increasingly higher maintenance and utility costs. The hot water heating systems are closed-loops. For long periods of time the water lays dormant in the pipes. This causes the pipes to rust internally and also causes scale to build up in the heating units. These systems have been in operation for nine to twelve years without refurbishment. Unless the corroded and deteriorated components are replaced and the heaters descaled, unscheduled breakdowns are inevitable.

3. Repair of Banana River Bridge 240,000

These resources provide for sandblasting and painting the bascule bridge over the Banana River. This bridge provides access for motor vehicles between Merritt Island and Cape Kennedy. It passes over a channel for barge traffic between the Atlantic Ocean and Launch Complex 39 via Port Canaveral. The bridge is a two-lane structure, 31 feet (9.4 meters) wide and 660 feet (201 meters) long. It has spans consisting of a double leaf trunnion bascule main span of structural steel 138 feet (42.1 meters) long between two supporting bascule piers. The other 12 sections are of prestressed concrete pupported by concrete piles. Approximately 25,000 square feet (2,300 square meters) of steel will be sandblasted and coated with zinc rich primer. All open joints and skip welds will be caulked prior to priming. Although this bridge was coated with a zinc rich primer in 1966, corrosion can now be seen on the steel surfaces. This corrosion, accelerated by the salt atmosphere, will eventually cause structural damage to the bridge. Failure of this bridge would not only affect access to the space center and the air force station but would affect barge delivery of space hardware to Launch Complex 39.

4. Repair of the Indian River Bridge 480,000

These resources provide for sandblasting and painting of the Indian River Bridge which links the Merritt Island Industrial Area with the Florida mainland. Spanning the Intracoastal Waterway, the bridge is a four lane structure consisting of two separate bridges each of which is 2,933 feet (894 meters) long. It is comprised of 55 prestressed concrete spans, and one double leaf trunnion bascule main span of structural steel, 143 feet (43.6 meters) long, between two supporting bascule piers. Approximately 50,000 square feet (4,650 square meters) of steel is to be sandblasted and coated with zinc rich primer. All open joints and skip welds will be caulked prior to priming. This bridge was constructed in 1964 and, at that time, a zinc rich primer was applied for protection of the steel surfaces. The salt atmosphere has deteriorated this coating during this 15-year period and exposed the steel surfaces. Unless a new coating is properly applied, deterioration will eventually cause structural damage. Failure of this bridge would not only affect access to the space center but would also interrupt Intracoastal Waterway traffic.

F. Langley Research Center (LaRC) 1,190,000

1. Repair of Electrical Power Distribution System, Building 642 465,000

This project replaces the outdoor exposed 2,300 volt "G" bus in Building 642. Also included is the replacement of the exposed disconnect switches, obsolete 2,300 volt switchgear and auxiliary items in the substation. The new switchgear will be located on elevated foundations above the storm flood zone. The existing substation, which was installed in 1941, is subject to flooding and does not comply with current safety standards.

2. Repair of Roof, Building 643 360,000

These resources provide for replacement of the 45,000 square foot (4,200 square meter) roof on the Full Scale Wind Tunnel, Building 643. The corrugated asbestos roof will be replaced with a metal roof. Downspout and drains located in the roof valleys will be enlarged, and other necessary repairs will be made. Most of the roof on this building is the original roof put on in 1931. The roof panels have become so brittle with age that many panels and water seals have broken. A heavy sneet of roofing has already broken off in high winds. In addition, the roof drain capacity is inadequate, resulting in water backup and heavy roof loads during storms.

3. Repair of Potable Water Lines, West Area..... 365,000

These resources provide for replacement of approximately 4,000 linear feet (1,220 meters) of the 6-inch (15 centimeter) and 8-inch (20 centimeter) cast iron water main along Gregg Road to Building 1221, and along Stratton Road to Durand Road and Building 1232A. In addition, the water main from Building 1232A to Building 1231 will be replaced. This cast iron pipe is unlined and has been in the ground in excess of 30 years. Corrosion nodules have formed within the pipe. Drinking water analysis indicates that maximum permissible levels of physical and chemical contaminants have been exceeded. Repair of these lines is necessary to insure that the quality of the drinking water is brought up to required standards.

G. Lewis Research Center (LeRC)..... 1,645,000

1. Repair of Flight Research Building Apron, Building 4..... 470,000

This project will repair a major portion of an active paved aircraft apron on the south side of the Flight Research Building. The work includes replacement of approximately 6,000 square yards (5,000 square meters) of deteriorated pavement with 12-inch (31 centimeter) thick concrete. Also included is the installation of new drainage and subdrainage systems which discharge into the Lewis Research Center's industrial waste system. The existing pavement is composed of the original concrete pavement installed in 1942 and a 3-inch (7.6 centimeter) thick asphaltic overlay installed in 1960. Weather and heavy usage over the years have caused this pavement to fail. Inadequate for today's heavy aircraft, the pavement has cracked in many places and water seeps through to saturate the subgrade. Aircraft movement on the apron causes a pumping action which forces this water saturated subgrade material to the pavement surface. This material and spalled pavement is a safety hazard. It can be ingested by aircraft engines and cause serious damage.

In addition, debris blown about by operating aircraft is hazardous to personnel in the immediate vicinity. This project will minimize the debris hazard and provide an apron capable of accommodating today's heavy aircraft.

2. Repair of Steam Condensate System, Various Buildings..... 160,000

This project replaces steam condensate piping in three buildings. The work includes replacement of various sizes of pipe, valves, strainers, traps and condensate pumps ranging from three-quarter inch (1.9 centimeter) through three and one-half inch (8.9 centimeter) pipe size. Insulation of all exposed pipe is included to protect personnel from the hot piping. Approximately 1,300 feet (400 meters) of piping in Building 4, 1,600 feet (490 meters) of piping in Building 14, and 900 feet (275 meters) of piping in Building 50 are to be replaced. Also, all heating equipment no longer in service will be removed. This system is part of the

steam system for space heating of these and other buildings at the Lewis Research Center. The piping in these three buildings has been in service for over 29 years. Corrosion and plugging have reduced the integrity of this piping and have seriously hampered its ability to provide adequate building heating. This work will reduce maintenance of this piping and restore required operational capability.

3. Repair of Domestic Water Systems, Buildings 5 and 6..... 270,000

This project replaces the 35-year old domestic water piping in Buildings 5 and 6. The work includes replacement of main building header piping, building branch piping, and individual room supply piping. Piping in Building 5 will be replaced with 5,200 feet (1,585 meters) of pipe ranging in diameter from I-inch (2.5 centimeter) to 8 inches (20 centimeters). Piping in Building 6 will be replaced with 1,300 feet (395 meters) of pipe ranging in diameter from three-quarters of an inch (1.9 centimeters) to 4 inches (10 centimeters). The existing piping is severely rusted. This is particularly true where deteriorated insulation has permitted condensation to form on the piping. Leaks continually develop and in many cases are difficult to repair due to the condition of the piping. The new piping will be insulated to minimize this condensation problem. Also, scale build-up has substantially reduced the flow capacities of the piping to be replaced. This project will eliminate the present heavy maintenance requirement and restore the needed flow capacity to these domestic water systems.

4. Repair of Service Air System..... 175,000

This project replaces approximately 2,200 feet (671 meters) of 8-inch (20-centimeter) diameter underground service air distribution piping. This piping supplies clean, dry, compressed air at 125 pounds per square inch (86.2 Newtons per square centimeter) to more than 20 buildings at the Lewis Research Center. The service air system operates continuously to provide air for instruments, safety devices, controls, and small endurance testing research equipment. Installed approximately 30 years ago, this piping is located approximately four feet (1.2 meters) below grade and is routed beneath roads, driveways, lawns and plants. Corrosion of this piping has greatly reduced its integrity and leaks are common. The weld areas, in particular, are deteriorating rapidly. Since this system is always pressurized, loss of air through leaks significantly increases compressor operation and energy consumption. This project will restore the integrity of this service air system piping and eliminate the increasing maintenance disruptions to this essential service.

5. Repair of Roofs, Various Buildings..... 265,000

This project repairs approximately 73,500 square feet (6,800 square meters) of roof on eight buildings at the Lewis Research Center. The work includes major repairs to the roofs of buildings 4, 6, 15, 49, 51, 55, 100, and 203. Equipment that is no longer in service will be removed from these roofs and necessary roof

penetrations will be brought up to current standards. Unnecessary penetrations will be removed wherever possible. Roof surfaces exposed to pedestrian traffic will be protected with roof walkways. The roofs on these buildings are over 20 years old and require extensive maintenance to prevent water from damaging the building structure and equipment. Normal weathering, deterioration, and pedestrian traffic have reduced the integrity of these roofs to the point that major repairs are now necessary.

6. Repair of Roads..... 305,000

This project provides for the repair of deteriorated road surfaces at the Lewis Research Center (LeRC). The West Area Road will be repaired between Walcott Road and Guerin Road. The existing paved surface of this two-lane road will be leveled, a 4-inch (10 centimeter) lift of asphaltic concrete will be placed, and 880 feet (270 meters) of new subsurface drainage will be installed. A 2-inch (5-centimeter) thick layer of asphaltic concrete will be placed on the berms. Walcott Road will be repaired between Building 135 and Building 20. The work includes the replacement of approximately 1,230 linear feet (375 meters) of deteriorated concrete curbs and sidewalks and also preparation and resurfacing of 13,000 square yards (10,900 square meters) of asphaltic concrete pavement. In addition, pavement in the Rocket Laboratory Complex (35) will be repaired to include replacement of 1,000 square yards (840 square meters) of road base and resurfacing of 4,200 square yards (3,500 square meters) of pavement. Normal weather conditions, including winter freezing and thawing in the Cleveland, Ohio area, are extremely damaging to roads. This, along with subbase deterioration, inadequate subsurface drainge, and normal wear have severely damaged these 15 to 20 year old roads. In addition, steep grades have caused creep type slippage of the West Area's pavement. Major repair of these roads is necessary at this time to prevent extensive pavement failure and to arrest progressive deterioration of the subbase. This work will also improve the condition of sidewalks for safe pedestrian traffic.

H. Marshall Space Flight Center (MSFC)..... 2,110,000

1. Repair Overhead Piping, Various Buildings..... 200,000

These resources provide for the repair of plumbing in equipment rooms and attic areas of 14 MSFC buildings to correct deteriorating conditions. The work consists of replacement and/or insulation of overhead water lines, steam lines, condensate and sump pump lines. Buildings included in this project are 4353, 4471, 4481, 4485, 4487, 4491, 4493, 4494, 4498, 4499, 4612, 4663, 4707, and 4708. These buildings have been in continuous operation for the past 20 to 35 years and it is planned to continue using these buildings in the future. Normal, routine maintenance can no longer keep pace with necessary repairs; thus, this project is required.

2. Repair Heating, Ventilating and Air-conditioning Components 300,000

These resources provide for the repair or replacement of heating, ventilating and air-conditioning (HVAC) equipment in various MSFC buildings to correct severe deteriorating conditions now developing. Deficient equipment includes cooling towers, coils, chillers, pumps, fans, converters and a boiler in Buildings 4200, 4202, 4491, 4663, and 4567. This equipment ranges in age from 15 to 30 years, but had an original design life of only 15 years. This effort is being undertaken in order to provide more reliable support of program requirements, to minimize non-routine maintenance effort, and to conserve energy. All of the affected facilities directly support the Space Shuttle and Spacelab programs and other significant research and development programs.

3. Repairs to Roofs, Various Buildings 460,000

This project provides for the repairs of roofs on five buildings at MSFC. Repairs are required to rectify blisters, soft spots, and general deterioration. Repairs include 143,100 square feet (13,300 square meters) of roofing, 150,000 square feet (13,900 square meters) of insulation and 4,470 linear feet (1,360 meters) of damaged flashing; and resaturating 75,500 square feet (7,000 square meters) of roof to provide a firm, smooth finish. Also included is the replacement of 2,350 linear feet (715 meters) of gutters and downspouts and the replacement of roof drains. The buildings to be repaired are 4471, 4643, 4650, 4707, and 4674. These roof repairs are essential to prevent leaking and damage to building systems and equipment. The expected roof life at MSFC is 15 years. In recent years, normal maintenance has not been able to keep pace with rapidly deteriorating conditions. Thus, this project is urgently needed.

4. Repair of High Pressure Gas Distribution System 450,000

These resources provide for the repair/replacement and certification of the 5,000 pounds per square inch (34,500,000 Newtons per square meter) gaseous nitrogen and 3,500 pounds per square inch (24,100,000 Newtons per square meter) air systems servicing the test and industrial areas at MSFC. The work will include the repair or replacement of some 50,000 linear feet (15,200 meters) of 1-1/2 to 3 inch (3.8 to 7.6 centimeter) high pressure piping and abandonment of 10,000 linear feet (3,050 meters) of unneeded piping in 14 buildings. Also included will be the overhaul of a pressure reducing station, replacement of a manifold and repair of 10 storage batteries. The systems have deteriorated through age and heavy cyclic use and are near the end of their design life of twenty years. Radiographic inspection of the system has revealed serious deterioration of the welds.

5. Repairs to Exteriors of Various Buildings 450,000

These resources provide for the maintenance, painting, and preservation of exterior walls and other surfaces of selected MSFC buildings and structures. Work includes surface preparation and application of a protective coating of high-quality paint to 403,000 square feet (37,400 square meters) of exterior surfaces. Priority for this repair work has been given to those facilities determined to be in greatest need, as identified by a detailed field investigation. Buildings included in this project are 4481, 4483, 4487, 4704, 4705, 4471, and 4712. This project is required to protect MSFC facilities against the cumulative damaging effects of wear, deterioration and weather, and to preserve the facility capabilities for continued operation.

6. Repairs to Test Facilities 450,000

This project provides for the repair, preservation and downmoding of thirteen (13) test facilities in the East and West Test Areas of MSFC. Upon completion of the Shuttle structural testing, these test facilities will not have an immediate follow on mission. However, the facilities must be preserved for future potential uses. The facilities to be downmoded will range from large (360 feet high (110 meters) test stands to small isolated hazardous test cells. The systems included in the preservation effort are high pressure gas systems, pumping stations, cryogenic systems, electrical and electronic equipment, heating, air-conditioning and plumbing systems, special test equipment, and control and instrumentation systems. The facilities to be preserved are: 4572, 4573, 4574, 4630, 4667, 4668, 4669, 4670, 4671, 4672, 4673, 4674, and 4699. These facilities have a potential use in support of future programs. It will be necessary to prepare them for long duration storage of at least 5 years to insure that it will be economically feasible to reactivate them at some future time. This work will provide for a mixture of preserving in place; disconnecting and abandoning in place; and removal and storage, depending on an economic analysis of the life cycle preservation cost over this five year period for each system and item of equipment. Some test facilities, however, must be down-moded in such a manner as to minimize reactivation time in the event that Shuttle inflight anomalies necessitate their use for problem solving.

I. Michoud Assembly Facility (MAF) 1,470,000

1. Repair Roads and Parking Lots 240,000

These resources provide for repair of various roadways and parking areas at MAF. Work consists of preparing, patching and leveling, and overlaying approximately 58,000 square yards (48,500 square meters) of roadways and parking areas with a 1 1/2 inch (3.8 centimeter) layer of bituminous asphaltic concrete. Prime coats are to be applied to all existing surfaces to be overlaid. Overlaid surfaces will receive a slurry seal coat of sand and asphalt. Roads and parking lots included in this project are roadways south of Building 103

from Mars Drive west to the taxi-strip; the roadway east of Building 420 from Saturn Boulevard to Building 404; and parking lots "B", "H", and "N". Repair of these areas is required to correct the deteriorated condition of the bituminous surfaces. The unstable soil conditions in the New Orleans area have resulted in settlement, ponding of water, pitting, and rolls in the roadway. Resurfacing and repair are necessary to prevent further deterioration and more expensive rehabilitation resulting from base failure.

2. Repairs to Electrical Feeders #14 and 15..... 200,000

These resources provide for the removal and replacement of electric feeders #14 and 1/15. The existing feeders are each composed of three paper insulated lead covered cables. They extend 800 feet (244 meters) from the East Master Substation to Substation 1/12 at Building 103, and 700 feet (213 meters) from Substation #12 to Substations 1/13 and #16 at the Boiler Plant, Building 207. The new feeders will each be three ethylene propylene polymer insulated cables, shielded with a polyvinyl chloride jacket. The work includes high voltage testing of the completed installation, cleaning of the underground ducts and reconditioning of eight oil switches. Feeders 1/14 and 1/15 are now 36 years old and have reached the end of their expected useful life. They are critical to external tank (ET) production since they service Substation 1/12 (chilled water pumps) and Substations 813 and #16 (condenser water pumps, cooling tower fans, refrigeration equipment). Each of these substations aids in providing the essential environmental conditions inside Building 103. Failure of these feeders represents an unacceptable risk to the ET manufacturing program.

3. Repair Sewer Line in Roof Truss, Manufacturing Building 103..... 440,000

These resources provide for replacement of approximately 2,000 linear feet (610 meters) of 8- and 10-inch (20 and 25 centimeter) diameter steel pressure sanitary sewer pipe located at the 40-foot (12 meter) level in the roof truss of Building 103. This overhead line runs between sewer lift stations No. 4 and 8 in a North-South direction in the building, and between sewer lift station t6 and the East wall of the building, in an East-West direction. Fittings, hangers, valves, and valve boxes will be replaced. Also, this project includes pressure and leakage testing. The overhead location of this work and the easily damaged equipment and space hardware below makes this repair work particularly difficult. Five leaks have been repaired in this line in the past year. During recent repair efforts the severely deteriorated condition of the piping was highlighted. This piping is located above critical External Tank production activities. Future failures will disrupt work activities, and could result in interruption of production schedules and contamination of the manufacturing parts.

4. Repairs to Fire Water Piping 410,000

This project is the initial phase of repair for the underground fire water piping network at MAF. Phase I provides for the repair of 12,700 linear feet (3,870 meters) of pipe. Installed in 1943, the fire protection system consists of 8, 10, 12, and 16 inch (20, 25, 30, and 41 centimeter) diameter pipe. All underground pipe outside building walls is steel pipe with flexible couplings. Pipe laid under railroad tracks is encased in a 12-inch (30-centimeter) inside diameter wood stave pipe. Minimum cover over the underground piping is 2.5 feet (0.76 meters). The project includes renewing and rebolting pipe and rehabilitation of concrete thrust blocks at the intersections and corners of the underground loop main. Numerous leaks have been repaired in the underground piping network over the past several years. All buildings at MAF are protected by this system, with the exception of Buildings 320, 350, and 404. The buildings serve NASA's External Tank contractor personnel, equipment, hardware, materials, and tenant government agencies. System failure during a fire could result in loss of lives and extensive damage to buildings, equipment and hardware.

5. Repairs to Michoud Slip Channel..... 180,000

This project provides for dredging the Michoud Slip Channel to a uniform depth of 22 feet (6.7 meters) below mean sea level. Work includes a sounding study to determine the volume of spoil to be removed, removal of subsurface material/debris, and disposal of excavated material to spoil areas on the MAF site. Also included is the removal from MAF of all debris resulting from the dredging operations. The Michoud Slip Channel was last dredged in 1966. Since that time, silt and debris from the adjacent Intracoastal Waterway has gradually been deposited in the slip, thereby reducing water depths. MAF barge movement will be restricted in the near future if this deposited material is permitted to continue to accummulate. The design slip depth is required to accommodate sea going vessels transporting the External Tank, materials, and hardware.

J. National Space Technology Laboratories (NSTL) 870,000

1. Repair of High Pressure Gas System Components 470,000

This project provides for the removal, replacement and/or repair of selected critical components of the NSTL high pressure gas systems. These systems serve the Space Shuttle Main Engine (SSME) test complex as well as base facilities which are required to support the Shuttle program. To be replaced or repaired during the accomplishment of this project are pressure regulators; bleed/drain, manual and hand valves; and vacuum pumps. The activity is necessary due to the obsolescence and extreme deterioration being experienced in large numbers of high pressure gas systems components. The components are 12-13 years old and have been subjected to severe use during this period from pressure cycling, submersion, electrolytic corrosion, and periodic removal for chemical cleaning during system maintenance. These components are subjected, in their operating environment,

to extremely high pressure service (up to 6,000 pounds per square inch (41,400,000 Newtons per square meter), and have suffered continued deterioration through normal wear and tear. This condition constitutes a hazard to personnel and equipment safety. A potential for compromise of the mission assurance for support of the SSME Program exists with continued use of components in their current condition.

2. Repair of High Temperature Hot Water Circulating Pumps 160,000

This project will provide for the replacement or overhaul of 13 high temperature hot water (HTHW) circulating pumps. These pumps are located within the Central Heating Plant, Building 3204, and the High Pressure Industrial Water Plant, Building 4400. HTHW is circulated by these pumps to the various buildings for use in the heating and hot water absorption cooling systems. The pumps will receive a major overhaul at which time internal rotating parts will be replaced. The electric motor will be overhauled or replaced and the bearings, sleeves, stuffing box, coupling alignment, and motor amperage draw will be checked for compliance with manufacturers' specifications. These pumps have been in operation for approximately 14 years with minor overhaul on an as required basis. These pumps supply hot water for environmental control within critical areas in both the Test Area and the Base Area. Failure of the pumps within the Test Area would severely affect the Space Shuttle Main Engine (SSME) program goals. Failure of the pumps 'within the Base Area would severely affect the overall goals of those operations requiring continuous environmental control. Returning these pumps to peak operating condition will improve the efficiency and reliability of the systems, resulting in an energy savings and preventing continuous costly repair to keep the pumps operational.

3. Repair of Absorption Water Chillers..... 240,000

This repair provides for the replacement or overhaul of nine absorption water chilling systems serving the engineering, industrial and shuttle test complexes. These systems maintain the environmental control within offices and electronic equipment areas on a continuous basis. The absorption systems require rehabilitation on a periodic basis. Overhaul shall consist of removal of the heads, replacement of damaged tubes, replacement of the lithium bromide solution where analysis indicates its deterioration, and pump overhaul. Those units found to be uneconomical to overhaul will be replaced with energy efficient equipment. These absorption systems were procured and installed in 1963 through 1965. During the past three years requirements for corrective maintenance and incidents necessitating system downtime have increased due to equipment age.

These systems support the Space Shuttle Main Engine (SSME) and other NSTL operations. Therefore, any downtime severely affects major NSTL programs. Rehabilitation and/or replacement with new equipment will restore the operating efficiency and reliability, thereby resulting in energy and maintenance savings. Potential adverse impact on program activity at NSTL will be prevented.

K. Wallops Flight Center (WFC) 965,000

1. Repair of Airfield Pavement 425,000

These resources provide for urgently needed repair of the aircraft parking and taxi ramp from the A-1 Tower to the E129 area. The work will include removing and replacing approximately 2,200 square yards (1,840 square meters) of failed concrete pavement and the placement of approximately 30,000 square yards (25,100 square meters) of two-inch (5-centimeter) bituminous concrete overlay on the ramp areas. Also included are related repairs, patching, curbing, shoulder grading, and seeding. Repair of this aircraft parking and taxi ramp is necessary to maintain an acceptable surface quality for aircraft operations. The existing surface has failed in areas and spalling is occurring throughout. There is a serious potential for damage to conventional and research aircraft. If this work is delayed, further pavement deterioration will result in more extensive and costly future repairs and will have an unacceptable impact on research aircraft operations.

2. Repair Roofs, Various Buildings 350,000

These resources provide for the necessary repair of the roofs of Buildings F-1, F-2, F-4, F-5, M-15, M-16, M-20, and other smaller buildings. Repairs include the removal of the deteriorated roofing material and the installation of new roofing, insulation, and related work on approximately 85,000 square feet (7,900 square meters) of roof surface. This repair proposal is the result of a survey of the roof conditions at the Center which revealed leaks and chronic cracking and blistering of roofing felts. These 20-year old roofs now require extensive repair work to restore them to serviceable condition.

3. Repair Paved Surfaces 190,000

This project provides for repair of roads, sidewalks, and paved areas at Wallops Flight Center (WFC). Included is the replacement of approximately 600 square yards (500 square meters) of 8-inch (20-centimeter) concrete roads that have failed and the replacement of approximately 500 square yards (420 square meters) of 4-inch (10-centimeter) concrete sidewalks on portions of Anderson, O'Reily, Bliss, Price, Rickett, Anglin, and Fulton Streets; N-161 Road; and the F-10 parking area. In addition, this work includes related repair of the curbs and shoulders of these paved areas and sealing of about 54,000 linear feet (16,500 meters) of pavement joints and cracks. These repair requirements resulted from a study of the primary road conditions at the

Center . Since 1959, maintenance of the primary heavy traffic roads at WFC has been accomplished by sealing and other short-term measures. Major repairs are needed at this time to correct pavement failures and settlement, protect the subgrade, and provide adequate drainage. Accomplishment of this work now will prevent further pavement deterioration which would result in more extensive and costly repairs in the future.

MISCELLANEOUS PROJECTS LESS $150.000 EACH	765,000
TOTAL	15,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated $12 million to $16 million each year will be required for the continuation of this repair program.

REHABILITATION AND MODIFICATION OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

REHABILITATION AND MODIFICATION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	950,000	CF 11-3
Dryden Flight Research Center	750,000	CF 11-4
Goddard Space Flight Center	2,230,000	CF 11-5
Jet Propulsion Laboratory	1,310,000	CF 11-7
Johnson Space Center	2,945,000	CF 11-9
Kennedy Space Center	820,000	CF 11-12
Langley Research Center	2,115,000	CF 11-13
Lewis Research Center	1,740,000	CF 11-15
Marshall Space Flight Center	1,575,000	CF 11-17
Michoud Assembly Facility	540,000	CF 11-19
National Space Technology Laboratories	1,395,000	CF 11-20
Wallops Flight Center	2,095,000	CF 11-22
Various Locations	725,000	CF 11-24
Miscellaneous Projects Less than $150,000 each	1,140,000	CF 11-25
Total	20,000,000	

CONSTRUCTION OF FACILTTIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Rehabilitation and Modification of Facilities, Not in Excess of $500,000 per Project
INSTALLATION:	Various Locations
	FY 1981 CoF ESTIMATE: $20,000,000
FY 1979: *$15,300,000	FY 1980: $19,790,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller

SUMMARY PURPOSE AND SCOPE:

These resources will provide for the rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in this request are those facility rehabilitation and modification needs for FY 1981 that can be foreseen at the time of the submission of these estimates, and that are estimated not to exceed $500,000 per project. The purpose of this program is to restore or enhance the condition of a facility so that it will accomplish its designated purpose more effectively or increase its functional capability.

As part of the rehabilitation and modification work, the Agency continues to emphasize those projects that relate directly to the conservation of energy at the various field installations. The energy related projects constitute $2,385,000 of the total $20,000,000 requested for FY 1981 and include both institutional and programmatic energy reduction initiatives. Each initiative has a simple payback period of five years or less.

*Authorized, P.L. 95-401

PROJECT:

At its initial cost, the existing NASA physical plant totals approximately $6.4 billion (September 30, 1979). A continuing program of rehabilitation and modification of these facilities is required to:

a. Protect the capital investment in these facilities by minimizing the cumulative effects of wear and deterioration.

b. Ensure that these facilities are continuously available and that they operate at peak efficiency.

c. Improve the capabilities and usefulness of these facilities and thereby mitigate the 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 including improved utility control systems.

This program includes only facility rehabilitation and modification work having an estimated cost not in excess of $500,000. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance or by related routine facility work efforts that 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 project.

PROJECT:

Proposed rehabilitation and modification projects for FY 1981 totaling $20,000,000 are described under "PROJECT COST ESTIMATE." Only those projects estimated to cost less than $150,000 have not been individually described or identified by center. The total cost for these miscellaneous projects is $1,140,000. The $20,000,000 of requirements has been distilled from requests of over $43 million and represents a modest request in relation to the current backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are considered to be of the highest priority. Deferral of this mission essential work would adversely impact the availability of critical facilities, program schedules, and energy conservation goals.

During the course of the year, some rearrangement, of priorities may be necessary. This may force a change in some of the items to be accomplished. Any such change, however, will be accomplished within available resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE."

a.	Utility Systems	4,360,000
b.	Fire Detection/Protection Systems	2,985,000
c.	General Purpose Buildings	3,590,000
d.	Technical Buildings/Structures	8,580,000
e.	Pavements and Drainage	485,000

PROJECT COST ESTIMATE:

A. Ames Research Center (ARC) 950.000

1. Modification of the Central Computer Facility, N-233 465,000

This project modifies approximately 4,000 square feet (370 square meters) of space in rooms 165 and 170 of the Central Computer Facility, Building N-233, to accommodate the installation of a new computer system. It includes modifications to the heating, ventilating and air-conditioning (HVAC) system, the electrical and power conditioning system, and the fire protection systems. Building N-233 houses ARC's main large scale computer, computer support equipment and data communications center. Approved FY 1981 automatic data processing (ADP) plans include the acquisition of a new computer. The new system will provide high speed interactive computing and data base management services associated with wind tunnel and computational fluid dynamics investigatons.

2. Modification of Computer Communication System 485,000

This project modifies the ARC Underground cable complex used for computer data communications. It includes the installation of additional cables in existing ducts and the installation of additional underground communication ducts. Approximately 4,500 linear feet (1,400 meters) of new duct banks will be installed. The main underground duct lines will consist of polyvinyl chloride (PVC) ducts encased in a reinforced concrete envelope. The main underground duct lines shall be routed along McCord Avenue, Durand Road and Arnold Avenue. Buildings N-207, N-213, N-215, N-221, N-227, N-233, N-239, N-240, and N-242 will be connected to the system by

this work. The exisiting communications distribution system is not adequate to link all the major users into the current large scale computer system. In addition, center ADP plans have been approved for a major new large scale computer system for FY 1981. Thus, an expanded communications system is necessary. The existing underground cable system is overcrowded and inadequate to meet current and future needs.

B. Dryden Flight Research Center (DFRC) 750,000

1. Rehabilitation of Laboratory Building 4800 260,000

These resources provide for architectural, structural, mechanical, and electrical rehabilitation and modification work to approximately 50,000 square feet (4,600 square meters) of space on the first floor in Building 4800. The interior work will consist of rehabilitation of floors, walls, ceilings, lighting fixtures and miscellaneous hardware. Air-conditioning and ventilation duct work will be modified where required, and door hardware will be replaced, mainly on heavy traffic doors. Weatherstripping of exterior doors will be provided. A general rehabilitation of the utilities in the building will be accomplished. Exterior work will consist of minor rehabilitation of building concrete damage such as sealing cracks, chipped surfaces, etc. and rehabilitation and painting of metal sunshades, metal seismic joints, and exterior doors and windbreaks. Also, rehabilitation of exterior door concrete entrance walks which have cracked and spalled will be accomplished. This building has been in constant use over the past 25 years and with the exception of air-conditioning modifications in 1972 has received no major upgrading. The building appearance reveals years of aging and requires a considerable amount of interior rehabilitation. Additionally, a survey of the attic spaces indicates a clear need to upgrade the electrical wiring, ductwork, and piping.

2. Modification of Fire Protection System 180,000

These resources provide for modifications to existing facilities for fire protection and safety. They include the installation of wet-pipe sprinklers in the Integrated Support Facility, Building 4825. In addition, eight fire hydrants with associated piping will be installed, and a two-hour fire rated separation wall will be built between the mezzanine mechanical room and the computer area in the Aircraft Construction and Modification Hangar, Building 4801. These facility modifications will improve fire protection systems at DFRC and thereby enhance the safety of personnel and the protection of mission essential and high value equipment. A fire protection survey of DFRC validated the need for this work.

3. Modifications to Various Buildings for Energy Conservation 310,000

These resources provide for modifications to the heating, ventilating and air-conditioning systems in fourteen buildings to improve their energy efficiency. The buildings to be modified include 4800, 4801, 4803,

4806, 4807, 4808, 4809, 4810, 4820, 4823, 4826, 4832, 4833, and 4834. Modifications will include the installation of evaporative coolers, night setback controls, automatic temperature controls and building modifications to reduce outside air infiltration. This work will result in more efficient use of energy and produce an annual savings of 1,900,000 BTU resulting in a simple payback period of approximately 5 years.

C. Goddard Space Flinht Center (GSFC) 2,230,000

1. Modification of Meterological Systems Development Laboratory, Building 21.. 480,000

These resources provide for modifications to approximately 10,500 square feet (975 square meters) of space on the ground floor of the Meterological Systems Development Laboratory (21) for the Space Telescope Science Operations Center (STSOC). Work will include installation of approximately 6,200 square feet (580 square meters) of raised flooring for computers. In addition, partitions will be modified and new ceilings will be installed. Related modifications to the electrical power, lighting, HVAC, and fire protection systems will also be included. These modifications are necessary at this time to support the Space Telescope Program, and to provide space for the Spacecraft Operations Control Center, and the Scientific Control Center.

2. Modification of Central Flight Control and Range Operations Laboratory, Building 3..... 320,000

These resources provide for modification of approximately 10,000 square feet (930 square meters) of space in the Central Flight Control and Range Operations Laboratory (3). This work will include modifications to the electrical power and HVAC systems for the installation of a replacement computer system. Also included is the installation of an on-hand Uninterruptible Power Supply and related equipment to permit the computers to operate from commercial or emergency power systems. Modification of this facility will permit the installation of a new, more energy efficient, computer system for flight dynamics control, orbit determination, and spacecraft command management. Because the present computer system must continue to support spacecraft missions during the activation of the new computer system, duplicate support systems will be required for a six-month period. The new computer system requires a continuous electrical power source for reliability essential to the support of spacecraft programs. This project is required at this time to support the installation of this vital mission related computer system.

3. Modification of Data Interpretation Laboratory, Building 23 for IPF..... 335,000

This project modifies the Data Interpretation Laboratory (23) of the Image Processing Facility (IPF). Work includes the removal and replacement of approximately 12,700 square feet (1,180 square meters) of deteriorated computer flooring on the third floor with vinyl covered panels. The cast iron drainage system in the photographic laboratory will be replaced with a polypropylene pipe system. Also, some 6,000 square

feet (560 square meters) of damaged flooring in the photographic laboratory will be replaced along with damaged ceilings and lighting fixtures on the second floor. The IPF provides support for numerous spacecraft programs that have image sensor experiments. Some of these programs are Landsat, Nimbus G, Heat Capacity Mapping Mission, Multilinear Array, and Cosmic Background Explorer. The computer area flooring and the flooring system in the photographic laboratory have deteriorated through the years such that they have become a maintenance problem. Similar flooring on the first and second floor was replaced six years ago and this work is now required. The drain system in the photographic laboratory has deteriorated, is leaking, and must be replaced.

4. Modifications to HVAC Systems Three Buildings 265,000

These resources provide for modifying the heating, ventilation and air-conditioning (HVAC) systems in the Research Projects Laboratory (2), the Meterological Systems Development Laboratory (21), and the Attitude Control Laboratory (305). These modifications are for energy conservation and provide for converting constant-air-flow, double duct systems to variable-air-flow, single duct systems controled by demand thermostats. Included in the work are: fan air volume control systems, and related equipment and control to vary the air volume to the conditioned space based on the cooling or heating demand. These modifications are estimated to result in annual savings of 385,000 kWh and 33,000 gallons (125,000 liters) of oil with a payback of five years.

5. Modification of Spacecraft Operations Facility for MSOCC, Building 14 220,000

This project modifies approximately 6,000 square feet (560 square meters) of space in the Spacecraft Operations Facility for a Multi-Satellite Operations Control Center (MSOCC). Modification work will include the installation of ten mission operations rooms of about 300 square feet (28 square meters) each along the west corridor of the second floor. The remaining 3,000 square feet (280 square meters) will be modified for the associated data processing equipment. This work will include some modifications to the partitions, ceilings, raised flooring, electrical power, lighting, HVAC, and fire protection systems. All spacecraft whose support does not demand a Payload Operations Control Center devoted exclusively to the full-time monitoring and servicing of their flight will be served by the MSOCC. This concept of shared resources and reuse of equipment has proven to be cost effective, and this project will allow more efficient operations and the capacity to handle additional spacecraft. The MSOCC is currently assigned support responsibilities for 12 operational spacecraft, together with launch vehicle support for all Delta operations.

6. Modifications of Various Buildings 450,000

These resources provide for the interior modification of approximately 31,000 square feet (2,900 square meters) of space at the Goddard Space Flight Center. Modification work Includes some new partitions, ceilings,

and flooring. The electrical power, lighting, fire protection and HVAC systems will also be modified as necessary. This modification work will provide space for data processing and analysis equipment, necessary support activities, and personnel to meet applications support requirements in the 1982 time period. The modification work is needed at this time to relieve crowded conditions and to effectively utilize available facilities to support expanding applications programs.

7. Rehabilitation of Elevator, Central Flight Control and Range Operations Laboratory, Building 3 160,000

These resources provide for the rehabilitation by replacement of the elevator in the Central Flight Control and Range Operations Building (3). Work will include the replacement of the 4,000 pound (1,800 kilogram) passenger elevator with a heavy duty elevator. This rehabilitiation includes the cab, related equipment, and all worn parts. The elevator in Building 3 was installed when the building was constructed in 1961 and has been in constant use for transporting both personnel and equipment in support of mission and data operations in this facility. Due to the unusual wear in transporting heavy equipment, the elevator is frequently out of service and downtime is excessive due to the difficulty in obtaining parts. Replacement of the elevator is necessary at this time to restore proper service and eliminate the impact to the operations of the various mission control centers and computing facilities in the building, currently resulting from the condition of the existing elevator.

D. Jet Propulsion Laboratory (JPL) 1.110.000

1. Modifications in 25-Foot Space Simulator Building 150 310,000

These resources provide for relocation of the 500-horsepower (373 KW) axial compressor from wind tunnel service in Compressor Building 58 to the 25-Foot Space Simulator, Building 150, to provide pumpdown of a 25-foot (7.6 meter) vacuum sphere from atmospheric pressure to 5 millimeters of mercury (670 Newtons per square meter). The new pumpdown period will be two hours or less. The project will also include: relocation of auxiliary equipment such as switchgear and controls; connection to the main vacuum piping header; replacement of an existing worn out muffler; installation of new moisture traps, valves, drains and piping; and, modifications to the operational console. A complete factory service maintenance check of the dismantled axial compressor is also to be performed. Included in this vacuum pumping system modification is the purchase of two new mechanical vacuum pumps, cryogenic baffles and all necessary piping, valves, electrical power and controls.

At present, the rough pumping portion of air evacuation process for the 25-Foot Space Simulator uses the 11,000 horsepower (8,200 kilowatt) wind tunnel compressor plant in Building 58. The wind tunnel compressor plant is being phased out of service leaving the 25-Foot Space Simulator without adequate rough pumping capacity.

Lacking the pumping capability of the compressor plant, the pumpdown time of the Space Simulator will increase from 70 minutes to 12 hours, which will exceed the test articles' operating time limit. 4 reduction in horsepower used for pumpdown will significantly reduce the electrical demand charge. These mechanical pumps together with the axial compressor will provide the full evacuation capability.

2. Modification to a 10-Foot Solar Simulator for Cryogenic Pumping, Building 248 350,000

These resources provide for replacement of three diffusion pumps, presently used to evacuate the 10-foot (3.1 meter) diameter space simulator, with three 36-inch (0.91 meter) diameter cryogenic pumps and will eliminate the need for the high vacuum valve and cryogenic baffle assembly. The vacuum valve body will be converted into a plenum and the 35-inch (0.88 meter) bottom flange will be increased to 36 inches. A new vacuum cryogenic slide gate will be attached to the wider flange. The cryogenic pump will then be attached below the new valve. The cryogenic pump will be of a two-stage closed loop gaseous helium type with a liquid nitrogen shroud and remote compressor. The helium compressor will be an air cooled unit. Electrical power, controls, and cryogenic piping for installation of the cryogenic pumps is also included. In the 10-foot simulator, the final stage of evacuation is done with three standard oil diffusion pumps which have the inherent problem of oil vapor back streaming. The back streaming of oil vapors causes Contamination and disruption of tests which is costly in time and manpower. To provide increased utilization at greater cleanliness levels, the existing facility must be updated with equipment for clean, high vacuum. This requires changing from diffusion pumps to cryogenic pumps.

3. Modifications to Fire Protection System !E-22 and E-321, ETS..... 165,000

This project continues implementation of the fire safety plan that was initiated at JPL in 197211973. The project provides new fire protection systems for Administration and Shop Building E-32, and Control and Recording Center, Building E-22, at the Edwards Test Station (JPL-ETS). In Building E-22, a wet sprinkler system will be added and the detection system modified. The complete system will include valves, piping, alarms, fire department connections, and a fire service main. The computer underfloor area is to be further protected by a modular, Halon 1301 System, which is to be actuated by cross zoned ionization detection. In Building E-32, a new wet sprinkler system will be installed. The extreme fire hazard created by the handling, storage and testing of various types of propellants makes fire protection a particualrly important issue at JPL-ETS. The fire-fighting capability at JPL ETS is provided by fire fighting teams at Edwards AFB which is approximately 10 minutes away. Building E-22 houses expensive electronic computing and recording equipment and is located very close to test stands. Building E-32 houses the entire administrative staff and files of the JPL-ETS activity. The proposed fire sprinkler systems will provide protection to both buildings.

4. Rehabilitation of Central Section Utility Tunnel, ETS..... 485,000

This project provides for the rehabilitation of the central section ofthe utility tunnel at the Edwards Test Station which is badly deteriorated and too small to accommodate future requirements. This work will include the removal of the corrugated metal pipe (CMP) utility tunnel and the installation of approximately 150 feet (46 meters) of 8 x 10 feet (2.4 x 3.1 meters) waterproof concrete utility tunnel from the Control and Recorder Building E-22 to the north-south main utility tunnel. The rehabilitated tunnel will carry all present and projected utility services required in this area. Cable trays will be installed on one side of the tunnel and utilities will be accommodated on the other side. A new "T" at the east end of the new tunnel will be designed to facilitate the crossover of the cables and utilities as they enter the main north-south tunnel and continue in both directions.

E. Johnson Space Center (JSC)..... 2,645,000

1. Modifications for Air-conditioning System, Photographic Technology Laboratory, Building 8..... 475,000

These resources provide for modifications to the mechanical equipment room in Building 8 for replacement of equipment and to eliminate overcrowding of this equipment. This project includes construction of a 2,350-square foot (220 square meter) penthouse mechanical room to be located above the existing mechanical room. Also included is the replacement of six air handlers with two new air handlers which will be located in the new mechanical room. All controls, ductwork, insulation and drain lines will be modified or rehabilitated as required. Also included is the replacement of two small air handlers located above rooms 274 and 275. The primary activity in this building is photographic processing which requires continuous air-conditioning. The photo processing operations create a corrosive and high humidity condition that causes rapid deterioration of the air-conditioning system. As a result, the existing air handlers, which are generally inaccessable for repair in their present location, are in need of replacement. Additional space provided by the new mechanical room will permit easy access to the air handlers so that all of the air-conditioning equipment can be easily maintained in the future. If this project is not approved, there will be a continued increase in maintenance costs and more frequent and lengthy building outages.

2. Modification of Air-conditioning System, Electronic Systems Compatibility Facility, Building 44..... 165,000

These resources provide for modifications to the air-conditioning system in the Checkout Systems Laboratory (CSL) located in the high bay wing of the Electronic Systems Compatability Facility, Building 44. The work consists of isolating the CSL from the high bay area to allow controlling of conditions in this area with an

independent cooling system. The CSL control room is not presently air-conditioned and this will be included. Three existing IO-ton (35 KW) direct expansion air-conditioning units and a cooling tower will be removed and replaced by one 10-ton (35 KW) chilled water unit. In addition, two air handling units totalling 63 tons (220 KW) will be replaced. The existing air-conditioning system serving the CSL was originally designed to provide underfloor conditioned air for a large computer load that has since been removed. In the present configuration the small area cooled by this large capacity system results in short intermittent cooldown periods and unacceptably high humidity conditions in the laboratory. Implementation of these modifications will achieve proper control of temperature and humidity in the CSL and reduce energy consumption.

3. Rehabilitation of Utility Control System 490,000

This project is Phase II of a multiyear program to replace obsolete equipment in the data acquisition portion of the JSC Utility Control System (UCS) with state-of-the-art remote terminal units. The work in this phase includes the replacement of the data acquisition terminals in 9 buildings with new terminal units that have improved data acquisition and control capability. Also included is the connection of terminal units to the existing UCS computer and to the existing sensors in each building. The existing UCS data acquisition units provide marginal performance, with frequent failures resulting in considerable downtime. This low reliability results in a considerable amount of lost data which impedes energy conservation efforts. The existing models are no longer being manufactured, and replacement electronic printed circuit cards must be manufactured in-house at high costs. The proposed new units will be of state-of-the-artdesiqn but functionally similar to the existing units.

4. Modifications to Central Cafeteria, Building 3 485,000

These resources provide for modifications to the Central Cafeteria. The work includes reconfiguration of the serving area to incorporate a "scramble" system and will involve removing old equipment; installing new serving equipment; modifying the walls; reworking utility connections; modifying stainless steel counters and cabinets; and altering lighting, air-conditioning, and exhaust systems. In addition, the existing dish conveyor system will be replaced by portable carts to return soiled dishes to the dishwashing area. The existing equipment is old and obsolete, and must be replaced in the near future. Also, the current serving area configuration is extremely wasteful in terms of manpower utilitization. The proposed new configuration will allow an estimated 36-percent reduction in personnel from 14 to 9 in the serving area with a 10-percent reduction in costs to be passed along to the customer. Further the "scramble" system will increase capacity (20-25 percent) and will reduce employee serving time during the congested lunch period. The cafeteria equipment has been in use for 13 or more years at JSC, and is essentially of 1950 vintage. Replacement parts are costly and extremely difficult to obtain. The proposed modifications will result in a much needed reorganization in the cafeteria's operation, greatly improving the quality of service. In recent years, the inefficient operation

has resulted in declining use of the facility. The cafeterias at JSC provide the primary source for feeding both employees and visitors and therefore should be modified to provide suitable service.

5. Modifications to Various Buildings 485,000

This project provides for modifications to several heating, ventilating and air-conditioning (HVAC) systems at the Johnson Space Center (JSC) to reduce energy consumption. The existing systems were installed during 1964-1967 when energy was plentiful and inexpensive. With energy supplies now very critical and costly, the efficiency of such systems must be improved. The work required consists of: (1) the modification of existing HVAC systems to variable air volume (VAV) operations in Buildings 37 (Life Sciences Laboratory) and 45 (Project Engineering Facility); (2) modifications of air-conditioning systems in Buildings 9 (Technical Services Facility) and 32 (Space Environmental Simulation Laboratory) to provide economizer cycle operations; and (3) modification of computer environmental support systems in Buildings 17 (Engineering Building) and 29 (Water Immersion Facility) to reduce energy consumption. Modification to provide VAV systems reduce the amount of energy consumed by automatically adjusting the air handler horsepower to match the actual sir volume required. These VAV modifications have a project payback period of 2.6 years. Economizer cycle (enthalpy control) operation of HVAC systems uses outside air when the enthalpy (temperature and humidity) of the outside air makes it suitable for direct cooling. Modifications to provide economizer cycles are especially attractive energy savings initiative because 24-hour operation permits frequent opportunities to draw in outside air when its temperature and humidity are sensed to be acceptable for the conditioned space. This modification has a payback period of 4.4 years. Modification of the environmental support systems in computer areas will eliminate infiltration of heat and humidity into conditioned areas, resulting in energy savings. Computer facilities in these buildings are environmentally controlled by separate systems that provide conditioned air underfloor directly to the computers and overhead distributed air for personnel comfort. Additional savings can be achieved by separating the control of the two types of air. By operating the personnel air only when needed, and still supplying continuous cooling to the computers, a reduction in total energy is achieved. The systems will also be modified to limit reheat for the control of humidity from a separate energy source, instead the heat from the computers will be used for humidity control. These modifications to the computer facilities will result in a payback of less than 1/2 year.

6. Modifications for Utilities Metering, Various Buildings 165,000

This project is Phase II of a two year program to provide the individual building utilities metering necessary to obtain needed energy management information. This project provides for the replacement of the primary chilled water flow devices at 33 buildings which are linked to the Utility Control System (UCS). The work includes replacement of flow devices and piping modifications to increase the accuracy of metering from the present 66 percent of the total flow range to approximately 90 percent of the total flow range. Flow

devices and piping in the present configuration do not provide the capability to fully meter flows. Accurate, dependable, energy consumption data monitoring requires upgrading of the existing equipment. This project is necessary for analysis of energy consumption to improve energy usage at JSC.

7. Rehabilitation of Air Compressors, Central Heating and Cooling Plant, Building 24 380,000

This project is Phase I of a two-year program to rehabilitate the air compressors in Building 24. This phase provides for the rehabilitation of the utility air supply system by replacing two reciprocating compressors with one centrifugal compressor. The project includes removal of the two 1,024 cfm (483 liters/second) reciprocating compressors and installing one new 2,600 cfm (1,300 liters/second) Centrifugal compressor, and its associated piping, air intake filters, electrical modifications, and required controls. The existing compressors are reciprocating type with teflon piston rings. These units require excessive maintenance resulting in large manhour expenditures and high replacement parts costs. By comparison, the proposed centrifugal air compressors require little maintenance. Additionally, the centrifugal compressors will produce a lower noise level, partially alleviating the existing noise problem in the plant.

F. Kennedy Space Center (KSC) 820,000

1. Rehabilitation of the Fender System, Haulover Canal Bridge 405,000

This project is to replace the Haulover Canal Bridge timber pile fender systems including the wooden wales, walkways and handrails. The bridge, which provides access to KSC from the north, is a two-lane structure approximately 30 feet (9.1 meters) wide and 225 feet (69 meters) long. It has three spans consisting of a double leaf trunnion bascule main span with two steel girder flanking spans. The clear channel distance between the fender systems is 90 feet (27 meters). The two fender systems along the channel consist of 132 treated timber piles, (66 piles each system) 40 feet (12 meters) long, rough cut treated timber wales, walkways and handrails. Each fender system is approximately 160 feet (49 meters) long. The fender systems are to be completely replaced using concrete prestressed piling and roughcut treated timber wales, walkways and handrails. A recent underwater inspection of the Haulover Canal Bridge fender systems revealed that the timber piles have been severely damaged by shipworms. Piling had an average section loss of 30 to 60 percent with approximately 20 percent of the piling having a section loss of between 60 and 90 percent. The fender system protects the bridge piers from boat and barge traffic. Damage to this bridge would not only affect access to KSC but would also interrupt Intracoastal Waterway traffic.

2. Modify Fire Suppression System, Goddard Unified S-Band Operations Building 415,000

This project modifies the fire suppression system in the electronics areas in the Goddard Unified S-Band Operations Building, M5-1494. Presently this area has Halon 1301 fire protection. Halon 1301 systems were installed at the Unified "S" Band Facility in the early part of 1973. Due to the consolidation of the worldwide tracking capabilities to this facility, and preparations for the Shuttle program requirements, the interior configuration and space utilitization has changed considerably. Additionally, NASA safety standards have been recently revised to establish automatic sprinkler systems as the accepted fire suppression system for electronic equipment operations. These standards also prohibit the use of Halon 1301 in facilities which are substantially renovated, remodeled, or expanded. All areas, other than the Halon 1301 areas, of the Operations Building have automatic wet pipe sprinklers installed. These resources will provide a wet pipe sprinkler system in the electronics operations areas. Also, new ionization detectors will be installed so all electronic operations areas will have an early warning system. The existing Halon control panel, which contains control/monitor capabilities for seven out-of-building Halon zones, will be relocated to the new control station in the Operations Building.

G. Langley Research Center (LaRC) 2,115,000

1. Modification to .3 Meter Transonic Cryogenic Tunnel, Building 1242..... 475,000

This project provides an active boundary layer control system for the .3 Meter Transonic Cryogenic Tunnel in Building 1242. Included in this work is installation of a compressor, reinjector piping, and controls necessary for improved test section boundary layer treatment. These new components will augment the vented test section by using flow control valves and other associated controls to reinsert the nitrogen gas back into the tunnel circuit. This boundary layer removal system will support the advanced airfoil research program, which requires the high quality, high Reynolds number aerodynamic performance data to be provided by this modification. Data derived from this test program will support development of the new generation aircraft such as the energy efficient transports and high capacity cargo aircraft.

2. Rehabilitation of Electric Power Distribution..... 475,000

This project increases the capacity of the Taylor Road Substation (Building 1147) from 12,000 kilovolt-amps (KVA) to 19,500 KVA by adding a 7,500 KVA transformer. In addition, a tie cable and switchgear will be installed between the Taylor Road Substation and Drive Control Building 1241 which will interconnect the Taylor Road Substation, Moffett Road Substation and Ames Road Substation. The additional capacity provided for the

Taylor Road Substation is necessary because the present connected load of existing facilities exceeds 33,000 KVA. The tie cable is necessary to insure the reliability of the system in case of an equipment failure at the Taylor Road Substation by providing an emergency backfeed from the other two substations.

3. Rehabilitation of Instrument Research Lab, West Wing, Building 1230..... 465,000

These resources provide for rehabilitation of approximately 43,000 square feet (4,000 square meters) of office, shop and laboratory space in the west wing of Building 1230. The work includes the replacement of dampers, coils and controls in the heating, ventilating and air-conditioning (HVAC) system. Anodized bronze aluminum frame windows, new ceilings, lights, wall and floor finishes are also included in this project. This rehabilitation project is necessary to replace the deteriorated components of this 35-year old facility. The HVAC system, as an example, is outdated and requires new components of current design to reduce maintenance and conserve energy.

4. Modifications to the Transonic Dynamics Tunnel, Building 648..... 400,000

This project modifies the freon handling system in Building 648 of the Transonic Dynamics Tunnel to reduce the loss of freon to the atmosphere. These modifications include disassembling the two compressors and replacing components that are worn out. In addition, the efficiency of the freon recovery system will be improved by installing a heat exchanger and condenser. Mixing of freon and air which now occurs in the test section during removal and replacement of freon will be minimized by reducing structural pockets in this region. These modifications are needed because: (1) the breakdown of one of the freon recovery system compressors could cause a lengthy shutdown of the facility; and (2) the loss of freon to the atmosphere is presently 88 tons (80,000 kilograms) per year. This project will reduce the loss to 38 tons (35,000 kilograms) per year.

5. Modification for Fire Protection, Buildings 1268 and 1268A..... 300,000

This project provides a fire protection sprinkler system for 50,000 square feet (5,600 square meters) of the electronic operations areas in Buildings 1268 and 1268A. These buildings house computational equipment valued at more than 45 million dollars which provides critical and essential support to on-going research at LaRC. The fire protection system provided by the project will protect the Government's investment in this equipment and these buildings.

H. Lewis Research Center (LeRC) 1.740.000

1. Modification of Extrusion Press, Materials Processing Laboratory (105) 350,000

These resources provide modifications to the 1,000-ton (8,900 Newton) extrusion press in the Materials Processing Laboratory, Building 105, to enable creep forming of high temperature materials. The work includes installation of a new electro-hydraulic control system which slows the low end speed of the hydraulic ram. In addition to this control system work, an electronic data acquisition system will be installed to record various extrusion event characteristics as a function of the press' ram travel and/or time. The press' existing water hydraulic system and pneumatic control system will also be rehabilitated for increased reliability.

This press is basic metal working equipment for most of the alloy research conducted at the Lewis Research Center. It is also used extensively to support other government agencies and contract programs. Since its installation in 1959, this press has been used principally for powder metallurgy research and extrusion of refractory metal shapes such as tungsten tubing. Current programs employing this press include the development of new composite materials, ceramics, and high temperature alloys needed for turbine blades and vanes in gas turbine engines. Production creep forming in industry has resulted in extruded shapes for turbine rotors and blading which require very little machining. Use of this technology has led to production costs which are substantially lower than those for producing parts by more conventional machining methods. The new low speed capability provided by this project will enable the development of creep forming techniques for some of the new high temperature materials being developed.

2. Modification of Drive Speed Control for 8-Foot x 6-Foot Supersonic Wind Tunnel, Building 53 460,000

This project provides for modifications to the drive motor system speed controls for the 8-Foot by 6-Foot (2.4 meter by 1.8 meter) Supersonic Wind Tunnel. The obsolete controls on this 87,000 horsepower (65,000 kilowatt) drive motor system were originally designed for adequate control over a speed range of 770 revolutions per minute to 880 revolutions per minute. These controls will be replaced with a new control system that will enable precise control of the drive system over a speed range of 480 revolutions per minute to 880 revolutions per minute. The new controls will include an electronic tachometer for sensing rotational speed, speed set-point controls, power rate-of-change controls, and associated wiring.

Use of this 30-year old wind tunnel has changed over the years. Although originally designed for operation from Mach 1.4 to Mach 2, modifications have expanded the range to include speeds between Mach 0.4 and Mach 2. Current research programs in this tunnel require many operations near Mach 0.4. The existing controls however, are not designed to attain and precisely hold the 480 revolutions per minute drive motor system speed required for Mach 0.4 operation.

Because of the age of the existing control system, its reliability is decreasing and repair parts are not available. Many components are badly worn and the wiring insulation has deteriorated. The modifications provided by this project will greatly improve the operation and reliability of this tunnel. Test conditions will be attained more rapidly, resulting in manpower and energy savings.

3. Modification of Propulsion Systems Laboratory, Building 125..... 260,000

This project modifies both the thrust measurement system in the Propulsion Systems Laboratory Test Chamber 4 for 2-dimensional measurements and the medium voltage switchgear for the spray cooling water supply and return pumps. This work in Building 125 is necessary to accommodate changed research requirements.

The two gas turbine engine test chambers in this facility, Test Chambers 3 and 4, are used for a variety of full scale operating engine tests. Such tests are in support of NASA programs and joint NASA-Department of Defense programs. In addition to testing the performance and efficiency of engines used in conventional take-off and landing (CTOL) type aircraft, these test chambers are used to support work on engines for short take-off and landing (STOL) type aircraft. This STOL work requires the testing of engines with exhaust-deflecting nozzles which have thrust components in two directions. The modifications to the Test Chamber 4 thrust measuring system included in this project will provide the necessary multi-axis thrust measuring capability.

This facility contains an engine exhaust gas spray cooling system. It has two 600 horsepower (450 kilowatt) cooling water supply pumps and two 450 horsepower (340 kilowatt) pumps for returning the heated water to a cooling tower. Normal operation of these pumps requires that they be cycled on and off frequently during test runs to provide the necessary cooling water flow. The existing electrical switchgear being used for this purpose consists of four 2,400 volt feeder circuit breakers. These units are not designed for the heavy cyclic duty they perform and frequent maintenance is required to keep them operational. A failure of any one of these four breakers to interrupt power during a fault situation would cause the facility main breaker to interrupt power to the entire facility. Such a disruption of power is not only undesirable, but is also potentially hazardous. To assure increased reliability, the existing switchgear will be replaced with 2,400 volt, fused, air-break type motor starters with power supplied to them by one of the existing motor circuit breakers.

4. Modification of Lighting Systems, Various Buildings 220,000

This project will replace incandescent lighting in selected areas of eleven buildings at the Lewis Research Center. Energy efficient high pressure sodium or flourescent lighting will be installed in Buildings 5, 16, 49, 85, 86, 88, 90, 92, 114, 500, and 501. Deteriorated rubber insulated wiring will be replaced to eliminate the potential fire hazard it presents. This cost-effective work will assure adequate illumination levels in these areas, and save approximately 625,000 kilowatt hours of energy annually. In addition, the new lamps have a much longer life expectancy than the incandescent lamps which results in reduced maintenance manpower requirements and enhanced safety. The estimated payback period for this work is less than 5 years.

5. Modifications of Electrical Substation B, Building 13 450,000

This project provides modifications to medium voltage electrical switchgear known as the Emergency Bus Switchgear and to the B2 2,400 volt electrical distribution system at Lewis Research Center's (LeRC) Electrical Substation B (13). The 35-year old 2,400 volt Emergency Bus Switchgear consists of six sets of three individually operated no-load break type fused disconnect switches. This manually operated switchgear provides a portion of the 2,400 volt power supplied to every facility at LeRC built before 1952. Operation is hazardous because a switchman must open the switchgear cabinet doors and manually open or close the three disconnect switches one at a time. This obsolete switchgear will be replaced with gang operate fused switchgear that can be operated with the cabinet doors closed. The 35-year old B2 2,400 volt electrical distribution system supplies power to approximately 27 buildings throughout the Center and is the original 2,400 volt source of power at the Center. Additional substations have been added and modest capacity tie circuits were installed between the 2,400 volt systems. Increases in loads connected to these systems have made the backup systems provided by these tie circuits inadequate. This project provides an alternate power source for the B2 system by the installation of appropriate switchgear and tie circuitry between the B2 transformer and the nearby lightly loaded B4 transformer. This tie circuit will provide a full capacity backup for the B2 system. In addition, the capacity of the existing tie circuit between Substations B and G will be increased and reconnected to the B4 system. This modification will allow all B2 system loads to be transferred to the B4 system without load shedding. Overall reliability of these electrical power sources will be substantially increased.

I. Marshall Space Flight Center (MSFC) 1,575,000

1. Modifications to Provide Automation of Building Systems Management 400,000

This project will increase the usefulness and efficiency of the computer-based Utility Control System (UCS) through the addition of energy conservation options. These options, such as outside air temperature cutout and reset, true economizer cycle, supply air reset, high temperature hot water reset, optimized chiller

control, and damper closure, will be implemented through the existing software programs and addition of new hardware to the UCS. The existing computer-based system was designed to accept additional energy-saving options and more buildings. These additions will not only provide a more efficient use of the Utility Control System but also they will generate fossil fuel savings. Total annual savings achieved by this phase of work are estimated to be 1.09 x 10^6 KWH of electricity and 10.8 x 10^6 pounds (4.9 x 10^6 kilograms) of steam. Simple payback period for this project is estimated to be 3.3 years.

2. Rehabilitation of Building 4487, "C" Wing East..... 450,000

These resources provide for the interior and exterior rehabilitation of approximately 68,000 square feet (6,300 square meters) of "C" Wing East, adjacent corridors, and a portion of "B" Wing East, Building 4487. The work involves renovation or replacement of heating, ventilating and air-conditioning (HVAC) systems, lighting and power systems, water and gas distribution systems, and repair of walls, floors, windows, and ceilings. This is the last increment of modification and rehabilitation projects for this building. Building 4487 was originally constructed in the 1950's, and normal deterioration over more than 20 years has increased energy consumption, maintenance costs, and building systems downtime. This building is one of the primary laboratory facilities at MSFC. The area to be upgraded houses elements of the Electronics Development Division of the Electronics and Control Laboratory. These specialized laboratories are used to accomplish R&D technology objectives. Completion of this project will result in a reduction of maintenance costs and energy consumption, and will provide improved laboratory support for NASA programs.

3. Rehabilitation and Modification of Cable Distribution System, Communications Facility, Building 4207. 475,000

These resources provide for the rehabilitation and modification of the Central Communications Cable System. Specifically, the modification provides for construction of three manholes, a cross connect and distribution equipment building, and installation of approximately 14,000 feet (4,300 meters) of large diameter cable. The manholes will be eight feet (2.4 meters) deep and six feet (1.8 meters) square. The building will be 320 square feet (30 square meters) and be provided with environmental control, 15 KW motor generator set backup power, and racks for mounting electronic equipment. The cable tunnels will extend from beneath room 107 of the present communications building to a point a few feet west of the building and from the cross connect building to an existing manhole. The rehabilitation consists of replacing rusted structural supports in 14 manholes. Technical integrity of the MSFC communication cable plant must be maintained and the system must be modified to meet increasing requirements. The modifications will provide a cross connect capability that will increase the cable service to the 4700 area. Reliability will be increased by the use of new cable between Building 4207 and the manhole near the new cross connect building. The present system has deteriorated and has been extensively repaired twice in the past five years. MSFC is responsible for the NASA Voice

Teleconferencing Network which is operated from this facility. It connects all major NASA installations and contractor locations, and helps NASA effectively manage its widespread programs.

4. Modifications to Various Buildings for Energy Conservation..... 250,000

These resources provide for the installation of storm windows in selected areas of five buildings, and the installation of sodium vapor lamps in the high bay areas of three buildings at MSFC. The work includes the installation of approximately 18,200 square feet (1,690 square meters) of storm windows in building areas which require heating, ventilating and air-conditioning 24 hours per day, 365 days per year. These facilities are Building 4207 (Communications Facility), Building 4487 (Laboratory and Office Building), Buildings 4491 (Office and Laboratory Building), Building 4619 (Structures and Mechanics Laboratory) and Building 4663 (Computer Facility). Also included in this project is the replacement of approximately 400 mercury vapor lamps and ballasts with energy efficient high pressure sodium vapor lamps and ballasts in the high bay areas of Buildings 4619, 4705 (Fabrication and Machine Shop) and 4708 (Engineering and Development Laboratory). The number of lamps will be reduced by approximately 50 percent but will provide the same lighting intensity. This project is necessary to reduce energy consumption at MSFC. Utility rates have increased approximately 200 percent in the last 5 years and trends indicate similar increases in the future. Delay in accomplishing the work included in this project will adversely impact the energy reduction program. The buildings involved will continue to support many NASA program such as Space Shuttle, Spacelab, Space Telescope, Space Processing, Large Space Structures, Solar Heating and Cooling, and Space Research and Technology. The project payback period is estimated to be 4.1 years.

J. Michoud Assembly Facility (MAF)..... 540,000

1. Rehabilitation of Steam Boiler, Building 207..... 335,000

These resources provide for the replacement of Boiler No. 2, a 60,000-pound per hour (27,200 kilograms per hour) steam boiler in the MAF Boiler House, Building 207. The project includes removing a portion of the Boiler House wall, removal of the boiler, installation of a new 100,000-pound per hour (45,400 kilograms per hour) boiler, and modifications to the steam piping, feedwater piping, blowdown piping, and forced draft ductwork. The boiler house provides steam to the Main Manufacturing Building as well as other supporting buildings for both environmental control and External Tank (ET) production. Increases in ET production rates will cause an increase in steam demand which may exceed the capability of the primary boiler. Thus, Boiler No. 2 will provide backup capability. The present boiler was installed in 1970, has been out of service since 1976, and was recently declared uneconomical to repair. Delay of this project could result in interruption of External Tank production.

2. Modifications for Automation of Building Systems Management 205,000

This is Phase III of an incrementally funded project to provide for the installation of a utility control system (UCS). These resources provide for incorporation of additional hardware, such as temperature and pressure sensors, status and alarm points, and start-stop relays into the UCS. This hardware will permit expanded use of the UCS computer software by providing more data-collection and automatic control of pumps, motors, and other equipment. Also included will be the automated control and monitoring of high bay lighting, chillers, parking lot lighting, and security systems. The additions will result in the conservation of energy through expanded use of the UCS computer software capability. It will also enable more effective use of maintenance personnel and increase the efficiency of the plant.

K. National Space Technology Laboratories (NSTL) 1,395,000

1. Modification of Fire Alarm System 300,000

These resources provide for modification of the Utilities Control System (UCS) to incorporate a fire alarm system for 38 buildings and facilities. The existing fire alarm system annunciator and relay panels will be removed. New relay panels will be installed and tied into the UCS using new field interface devices to interconnect to the UCS Central Processor Unit. Additional memory capability will be provided in the Central Processor Unit to accommodate programming of the fire alarm system. Existing smoke detectors will be replaced by new detectors. The Fire and Security Dispatch Office will be modified to accommodate the new fire alarm system.

The present fire alarm system was installed between 1963 and 1966. During the past year a large number of the relays in this system have failed. As a result of these failures, the spare relays available for this system have been depleted. Some of these relays, critical to system operation, are no longer manufactured and replacements are unobtainable. If the failure rate of these cables and components continues at the current rate, portions of the sitewide service will become inoperative in the next five years. The sitewide Utilities Control System interconnects all buildings and facilities at NSTL. This modification of the UCS system to include fire alarms is economical in that it utilizes existing distribution lines and equipment and eliminates the costly replacement and maintenance of a parallel distribution system.

2. Modification of 13.8 KV Electrical Distribution System 210,000

This project provides for modification of the 13.8 KV primary distribution system in the base and Space Shuttle Test Areas. The modifications will include installation of automatic reclosers, additional fused and sectionalizing switches, and fault relays/indicators; provision for automatic load transfer switching equipment

in critical areas; and construction of three new manholes to permit the continued use of the existing canal submarine cables. In the past several years numerous faults have occurred in the electrical distribution system. These faults have been caused by natural phemomenon (winds, lightning, etc.) and equipment failure due to aging and fatigue. Improvements to the distribution system will: (1) improve reliability by decreasing the number of faults and associated electrical disruptions to critical facilities; and (2) decrease the operational impact of interruptions by greatly reducing the number of facilities/areas affected and thereby reducing the time required to restore service to critical facilities. This project will assure the required reliability of the electrical system and prevent costly schedule delays and possible equipment damage.

3. Modifications to Cooling Towers..... 250,000

These resources provide for the installation of fire protection sprinklers on 11 wood cooling towers and automatic chemical feed and monitoring systems for 20 cooling towers. The sprinkler systems will include automatic sprinklers, pressure regulators and manual control valves and will be in conformance with the national fire protection codes. The automatic chemical feed systems will include installation of an electronic dissolved solids meter, chemical injection pump, interconnecting piping, a drain solenoid valve and corrosion coupon within the piping system, and electrical service for each of the cooling towers. A recent safety survey found that the 11 wood cooling towers serving NSTL facilities should be provided with an automatic sprinkler system. The survey conclusions were that, in the event of a fire, the fire service trucks cannot reach the facility location in time to preclude substantial damage to the towers and possibly adjoining facilities. The potential property damage and the resulting work interruptions make completion of this work essential. The present cooling tower chemical feed systems provide chemicals in amounts not balanced to the requirements for water quality control. The excess chemicals cause premature deterioration of cooling towers and an increased cost for unneeded chemicals. The proposed automatic system will continuously monitor the chemicals and inject only the amounts required, resulting in savings, better protection, and full compliance with EPA requirements.

4. Rehabilitation of Warning and Paging Systems..... 160,000

This project will replace the oral warning system cable by installation of new cables suitable for underground installation. Above ground cable termination pedestals will be installed. This is the first year of a multiyear program for oral warning and paging system cable replacement. The first year program will install new cables and pedestals from Building 7001 to Building 1200 including the connection of Building 8100. Cables from Building 4995 to Buildings 4400, 4210, 4220, 4110, 4120, and 4122 will also be included in the first year effort. The oral warning system was installed in 1965 in underground ducts with interconnecting cable splices made in underground manholes. Following heavy rains, the water table is raised and the cables are exposed to water. Over the years such exposure to water has caused deterioration, especially at the junction where the splices were made. The above ground pedestal type terminations will prevent water from

entering at other splice connections. Failure to correct the problem will result in continued interruption to the oral warning and paging systems with eventual failure of the system. The loss of this system would reduce the effectiveness of the communication system which is required for sitewide notification of hazardous test conditions. The paging system also contributes to crowd control during periods of natural disaster when disaster victims are sheltered at NSTL.

5. Modifications of Various Facilities 475,000

This project provides for the modifications of interior and exterior lighting systems in 21 buildings and replacement of inefficent electrical motors in 17 buildings. Interior lighting modifications include reducing the number of light fixtures consistent with lower illumination standards, replacing inefficient lamps with higher efficient lamps that are now available commercially, replacing discolored diffusers, and improving control of lighting. Exterior lighting modifications for associated external work areas, parking lots, and roads will consist of reducing the number of lighting fixtures and installing high efficiency lamps sufficient to maintain the minimum effective area lighting. The project also provides for replacement of low efficiency electrical motors with high efficiency motors in 17 buildings.

These motors are used to drive pump and air-handlings in the 17 buildings and are presently oversized or otherwise inefficient for the required loads. Replacement of these motors with sizes that match the equipment load and are more efficient will reduce energy. The lighting system modifications provide for reducing electrical energy for lighting by 25% - 30%. This reduction will result in a payback of less than 4 years. Replacement of inefficient electrical motors is necessary to reduce not only the kilowatt hours consumed but also the penalties based on power factor disparity and peak electrical demand loading. The energy saved by this element of the project will result in a payback of 2.4 years.

L. Wallops Flight Center (WFC) 2,065,000

1. Rehabilitation of Building F-4 435,000

These resources provide for the rehabilitation of 10,200 square feet (950 square meters) of space in Building F-4 which is used by visiting launch range users, experimenters and foreign nationals participating in research operations. The exterior work includes replacing the doors and windows. Interior rehabilitation includes insulation of exterior walls, new wall and floor coverings, new bathroom facilities, and some new plumbing, lighting, and wiring. In addition, a new energy efficient central heating, ventilating and air-conditioning system will be installed. Building F-4 was constructed in 1945 and is in substandard condition.

Rehabilitation of this facility is required to correct excessive and widespread deterioration, and reduce the consumption of energy.

2. Modification of HVAC Systems, Various Buildings..... 390,000

This project modifies the heating, ventilating and air-conditioning (HVAC) systems of Buildings E-104 through E-108 and N-159 for more effective utilization of chilled water capacity. This work will include the installation of 2,000 linear feet (600 meters) of insulated chilled water pipe from the existing large capacity oversized chiller in Building N-159 to Buildings E-104 through E-108. The chillers from Buildings E-106 and E-108 will be relocated to Building N-159. The relocation of these chillers to more effectively utilize available chiller equipment and conserve energy was defined by an energy conservation study accomplished at the Center.

3. Rehabilitation of Buildings F-1 and F-2 485,000

This project provides for the exterior and interior rehabilitation of Buildings F-1 and F-2. Exterior work includes replacement of doors and windows; reductions in window areas; cleaning, tuckpointing, and sealing of the brick exteriors; and replacement of roofs. Interior work includes the installation of energy efficient variable volume forced-air central heating and cooling systems having economizer cycles, insulation of exterior walls complete with new interior surfaces, installation of new plumbing systems, upgrading of lavatories, and application of new interior wall and floor finishes. In addition, ventilation will be installed in the reproduction area of Building F-1 to conform with current safety standards. These 34-year old buildings, which house offices and reproduction areas, have deteriorated to substandard condition throughout and now require extensive rehabilitation. The steam heating systems are in poor condition and require frequent repairs to control leaks. Temperature controls are no longer adequate. The present window-type air conditioners waste energy. This project will restore these buildings to standard condition, protect them against the weather and substantially improve their energy efficiently.

4. Modification of Water and Fire Protection Systems, Mainland and Island Areas..... 300,000

This project modifies the Mainland and Tsland water supplies and fire protection systems to correct serious fire protection deficiencies. Mainland area work includes the provision of a 50,000-gallon storage tank, and installation of a 6-inch (15 centimeter) diameter water main along Radar Road from Building U-75 to Building U-30. This main, complete with the necessary pumping capability, will supply water to three existing hydrants and to one new hydrant also included in this project. In addition, a sprinkler system and a fire detection system will be installed in Building U-70. Radar systems in this building provide essential research support of both Wallops Flight Center and Kennedy Space Center missions. Island work includes restoring

operation of the existing elevated water tank, Facility V-90; installing an 8-inch (20 centimeter) main in the vicinity of Building 2-65 between the Island Road 6-inch (15 centimeter) main and the Launch Area By-Pass Road 10-inch (25 centimeter) main; and installing a sprinkler system in Building W-20, Blockhouse 3, which is the control room for the Scout rocket launch site. The water supply systems in both the Mainland and the Island areas have inadequate water flow and pressure capabilities for meeting fire protection requirements in these areas.

5. Modification of Water and Fire Protection Systems in the M and A-41 Areas 455,000

This project provides modifications to water supply mains and fire protection systems for the M and A-41 areas on the Main Base. Included is the installation of a 10-inch (25 centimeter) diameter water main routed from the vicinity of aircraft hangar Building D-1, under runway 10-28 and the associated taxiway, to the M area. Water will be supplied to the A-41 area by an 8-inch (20 centimeter) diameter branch line extending from the 10-inch (25 centimeter) diameter main at the north end of runway 17-35. This system will furnish water to four existing hydrants as well as to the three new hydrants and the new sprinkler systems in Buildings M-15, M-16, M-20 and A-41 also included in this project. This work is urgently needed to correct serious fire protection deficiencies in these areas. The M-area buildings are used for storage, inspection, and handling of solid rocket motors. Building A-41 houses the air field radar facilities. Because of the high risks associated with a potential fire in the M-area and the serious impact on air field operations of a fire at A-41, this work must be accomplished now.

M. Various Locations 725.000

1. Rehabilitation of Gear Box Support on Three 64-Meter Antennas..... 335,000

These resources provide for the rehabilitation of the gear box supports for three 64-Meter Antennas located in Madrid, Spain; Canberra, Australia; and Goldstone, California. The work will include the fabrication at all three 64-Meter sites of an active elevation gear box support assembly to continuously maintain the alignment of the pinion - bullgear mesh. This assembly will enable the continuous readjustment of the gear mesh for even gear wear under changing loads. The existing gear box assembly is a passive system providing rigid support only. Major adjustments to compensate for changing conditions require extensive effort with large expenditures of station time and manpower. The lack of active compensation for changing conditions is causing excessive wear on both the bullgear and back-up roller assembly. Replacement of the assembly is required to insure reliability of the 64-Meter Antennas.

2. Modifications to Deep Space Network Power Plants, Goldstone, California..... 390,000

This project will provide for the remote operation of three manually operated Deep Space Network (DSN) power plants at Goldstone, California, to provide for safety, increased reliability and more effective utilization of electrical power.

The power plants will be modified by adding automatic controls and protective devices required for remote operation of the power generating equipment. The work will include the installation of automatic synchronizers and motor operated controls to adjust generator or bus frequency and voltage for paralleling. Relays, current transformers and potential transformers are required to provide sensing and logic switching for automatic controls. Additional protective devices will be installed to report operating conditions of each engine-generator set, fuel level, fluid leakage, and fault conditions. Signals from each of the new and existing protective devices will be available to monitor evaluate and analyze equipment operations to effectively support critical mission operations. The addition of automatic controls will reduce the risk of human error.

With the present system, the operator must perform several manual operations to switch power from commercial to generators, or to replace one generator with another. These operations must be performed in a specific order and coordinated with data displayed by various instruments. During emergency conditions, when reaction time is important, operator errors may be difficult to avoid. The automated controls will accomplish these functions in the proper sequence without the need for operator assistance.

Safety of the equipment will be enhanced by the additional protective devices. Remote alarms will indicate pending failure conditions and logic will be provided to determine the proper action required based on the current situation and equipment availability. Immediate decisions will be made to replace operating equipment before a major problem develops. The automatic controls will allow fast implementation of the actions required.

This project will significantly reduce the potential for loss of power which could result in lost tracking data and could jeopardize the mission or even cause loss of a spacecraft.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH 1,140,000

TOTAL 20,000,000

FUTURE COF ESTIMATED FUNDING TO COMPLETE THIS PROJECT:

An estimated $18 to $22 million per year will be required for the continuation of the facility rehabilitation and modification program.

MINOR
CONSTRUCTION
OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

MINOR CONSTRUCTION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	400,000	CF 12-2
Dryden Flight Research Center	245,000	CF 12-3
Goddard Space Flight Center	850,000	CF 12-3
Jet Propulsion Laboratory	950,000	CF 12-4
Johnson Space Center	80,000	CF 12-6
Langley Research Center	640,000	CF 12-7
National Space Technology Laboratories	435,000	CF 12-8
Wallops Flight Center	205,000	CF 12-9
Various Locations	195,000	CF 12-9
Total	4,000,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE:	Minor Construction of New Facilities and Additions to Existing Facilities, Not in Excess of $250,000 Per Project
INSTALLATION:	Various Locations
	FY 1981 CoF ESTIMATE: $4,000,000
FY 1979: $4,200,000	FY 1980: $3,500,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of the Comptroller

SUMMARY PURPOSE AND SCOPE:

These resources will provide for minor facility construction at NASA field installations and Government-owned industrial plants supporting NASA activities. Each project included in this program is estimated not to exceed a cost of $250,000 and involves either the construction of new facilities or additions to facilities. The FY 1981 request of $4,000,000 will improve the usefulness of NASA's physical plant by changing the utilization of or augmenting the capabilities of various facilities. Included in this request are those programmatic and institutional projects considered essential to the accomplishment of mission objectives.

PROJECT JUSTIFICATION:

The configuration of NASA's physical plant necessarily responds to changes in utilization and adaptations required by changes in technology or in mission needs. Additionally, demands are generated by research, development, test, and similar activities. Specific justification for each minor construction project is provided by center under "PROJECT COST ESTIMATE."

PROJECT DESCRIPTION:

Included in the FY 1981 minor construction program are those facility projects supporting institutional or technical facility needs which could be adequately identified at the time of submission of this budget estimate. Items of work totalling $4,000,000 are included in this resource request and have been distilled from a list totaling about $6,000,000. The selection was based on the relative urgency of each item and the expected return on the investment. During the course of the year, some rearrangement of priorities may ensue, requiring changes in some of the items to be accomplished. Such changes will be accommodated within the resources allocated.

These projects represent requirements that must be met in this time frame to support institutional goals and programmatic objectives.

a.	Utility Distribution Systems	240,000
b.	Technical Buildings/Structures	1,325,000
c.	General Purpose Buildings	2,195,000
d.	Pavements and Drainage	240,000

PROJECT COST ESTIMATE:

A.	Ames Research Center (ARC)	400.000
1.	Construction of Wind Tunnel Blade Sanding Shop	240,000

These resources provide for construction of a 5,000-square foot (460 square meter) building to house the Wind Tunnel Blade Sanding Shop. This steel frame building will be located north of Building N-229B with access from 7th Street. The Wind Tunnel Blade Sanding Shop is a metal finishing shop where all of the Center's wind tunnel blades, models, and other surface critical research equipment are finished by craftsmen using a variety of abrasives and polishes, The existing shop is totally inadequate for this function because it is too small and provides no covered space for storing blades during the finishing process. Blades now must be stored outside. Also the existing shop is in a high noise area requiring the use of ear protection during wind tunnel operations.

2. Construction of Shop and 2nd Floor Offices in Building N-211 160,000

These resources provide for construction of a 1,550-square foot (144 square meter) two-story addition within Building N-211. Room 157, a high bay area, will be converted into a two-floor structure. The first floor will remain as shop space and will be refitted with electrical and pneumatic utilities and an overhead crane. The second floor will house personnel from the Aircraft Maintenance Branch. There is a critical need to provide adequate shop space for aircraft component bench-checks and aircraft equipment support. Space in Building N-211 is presently inadequate and there is no suitable shop available where aircraft components can be bench-checked or serviced.

B. Drvden Flight Research Center (DFRC) 245.000

1. Construction of Support Shop 245,000

These resources provide for construction of a 3,200-square foot (300 square meter) pre-engineered metal building for support shop operations. The facility will be a single story structure on a concrete floor slab with a 12-foot (3.6 meter) eave height. Heating, lighting, air-conditioning, toilet facilities and a wet pipe sprinkler system are included in this project. The Space Power Battery Shop and the Experimental Projects Facility presently located in a portion of Shop Building 4806 are in dire need of additional space to effectively support program requirements associated with Remotely Piloted Research Vehicle (RPRV) missions. The support shop, presently located in Building 4806, will be relocated to this new building and the vacated space will be used for space power battery shop and experimental projects facility expansion.

C. Goddard Space Flight Center (GSFC) 850.000

1. Construction of Addition to Spacecraft Operations Facility, Building 14. 130,000

This project adds approximately 1,600 square feet (150 square meters) to the west portion of the Spacecraft Operations Facility, Building 14. This addition will be one story in height, on a concrete slab, and with energy efficient walls finished to match the existing building. The work also includes electrical power, lighting, and a HVAC system. The addition is needed to provide an all weather passage for operating and maintenance personnel, and improved security from Building 14 to the Network Control Center (NCC). Space is provided for vending food service for essential personnel who operate these two facilities three shifts a day, seven days a week, remote from other food service facilities. This facility is necessary at this time due to the operations in the NCC and the increased number of personnel in the area.

2. Construction of Addition to Visitor Center, Building 88 240,000

These resources provide for construction of a 7,000-square foot (650 square meter) addition to the Visitor Center (Building 88). This addition will be of steel frame construction, insulated, and will match the existing building. Also included will be the necessary electrical power, lighting, and HVAC systems. This project is required at this time to provide additional indoor space to protect delicate display items and an assembly area for briefing large groups on NASA's programs. The present exhibit area is too small for the available displays and for the assembly of large tour groups.

3. Construction of Access Roads 240,000

These resources will provide for construction of approximately 11,000 linear feet (3,350 meters) of access roads for emergency vehicles in the Optical Tracking Ground Plane Facilities (200), Magnetic Test Facility (300), and Propagation Test Facility (500) areas. Work will include clearing, grading, drainage, and construction of a 6-inch (15 centimeter) thick, 12-foot (3.7 meter) wide roadway of crushed run gravel. The project was recommended by a fire protection survey which identified the need for additional access for emergency vehicles to these remote facilities in wooded areas. As an example, a major fire at the Magnetic Test area could result in a loss of valuable research equipment valued at over a million dollars.

4. Construction of Ductbank 240,000

These resources provide for construction of approximately 4,000 linear feet (1,219 meters) of underground 12-way ductbank for signal and communication cables. The ductbank will connect Buildings 3/14 with Buildings 6, 11, and 21 and will be routed along Roads 2, 1A, and 4. This work also includes the construction of masonry manholes. Communication ducts connecting these buildings were constructed in 1968 and are now being fully utilized. An additional ductbank is required to connect the Space Telescope Science Operations Center (STSOC) and other research facilities in Building 21 to Buildings 3/14. The increased use of computers and data processing equipment in these buildings requires the installation of additional communications ducts for effective use of research equipment. This project is required at this time to relieve the overburdened communications network and to provide for the planned growth of equipment in these facilities.

D. Jet Propulsion Laboratory (JPL) 950,000

1. Construction of Addition to Space Science Facility 186 230,000

These resources provide for the construction of a 2,400-square foot (220 square meter) addition to Building 186. The addition will be constructed over a basement which presently houses closed circuit television

(CCTV) distribution and video terminal rooms. The architecture/structure will be similar to the adjacent Space Sciences Division Building and will incorporate the basement as its foundation and mechanical room. Not included in this project are special sound control treatment or equipment and special lighting. At present nearly all JPL CCTV programming is accomplished in the Von Karman Auditorium, Building 186, where the CCTV control room with a minimum capability light studio is located. Inadequate for color television production and too limited in space, this facility cannot meet growing technical requirements.

Virtually all major JPL locations can receive color television programming for project operations, informational programs, training and educational programs, major announcements, and emergency instructions. The proposed new building addition will be the center for all such programming at JPL. Major future programs which may be supported by the use of the CCTV addition include Mariner Jupiter/Saturn/Uranus, Shuttle mission operations, and Voyager.

2. Construction of Addition to Technical Services Facility E-83, ETS..... 240,000

These resources provide for construction of a 1,530-square foot (142 square meter) addition to the Technical Services Facility (TSF) at Edwards Test Station (ETS). The addition provides space for consolidation of the chemical laboratory function, instrumentation calibration and repair, and transducer calibration work common to the entire ETS site. Construction includes a concrete slab on grade, concrete block walls, truss joist steel roof framing with insulation, built-up roofing, air-conditioning and electrical power. Chemical and instrumentation functions are now in trailers and World War II stucco sheds scattered about the ETS site. Completion of this addition will result in improved control of these functions and is key to demolition of old maintenance intensive buildings at Edwards Test Station.

3. Construction of Warehouse, ETS..... 240,000

These resources provide for construction of a 4,675-square foot (434 square meter) light steel frame structure. The structure will be used as a warehouse to provide general and bonded storage for intermittently used test and launch gear, spaceflight components, and backup assemblies for space testing programs. The building will have a concrete floor, warehouse lighting, heating, ventilating, and fire protection. The walls and roofs will be insulated. A 15-foot (4.6 meter) clear height under the roof framing will allow for stacking of storage racks and the use of material handling equipment. The building is so sited that should additional space be required, two more bays at 1,150 square feet (107 square meters) per bay could be added. Consolidation of this equipment in an indoor facility for protection from the weather will improve efficiency of flight tests. This equipment is now stored in operational buildings and on the ground in outside uncovered areas where it is subject to damage and deterioration. There is no other building at ETS that can effectively provide these necessary warehousing needs.

4. Construction of Addition to General Office Facility 111..... 240,000

These resources provide for an increase in the office space capacity of the first floor, east wing, of Building 111. A new north wall for this building will be constructed about 25 feet (7.6 meters) north of the existing front wall, enclosing an additional 2,100 square feet (195 square meters) for needed office space. In conjunction with this, 1,344 square feet (125 square meters) of existing office space will be remodeled to form a total open space of 3,444 square feet (320 square meters) suitable for use of the flexible "landscape" office system. The new roof, exterior walls and windows are designed to be architecturally compatible with the present building. A separate air-conditioning system will be provided as well as new ceilings, floorings and finishes to match the existing building. The majority of the available "office type" space on the first floor of the east wing of Building 111 is occupied by the Documentation Section. This section is composed of writers, editors, artists, publication and reproduction specialists who are responsible for the preparation and production of all the laboratory's internal and external scientific and technical information products, including proposals, displays, reports, brochures, etc. Coordination and layout space are critical factors in meeting schedules. Lack of adequate space has necessitated housing ten essential personnel in a remote trailer installation and some 15 other writers and editors in Building 200 at the extreme southern limits of the lab. This facility addition will permit the consolidation of the various documentation functions and promote a more efficent operation.

E. Johnson Space Center (JSC)..... 80.000

1. Construction of Addition to Life Systems Laboratory, Building 7..... 80,000

These resources provide a 1,250-square foot (116 square meter) addition to the east side of Building 7. The existing wall of the liquid oxygen storage area will be increased in height by approximately 5 feet (1.5 meters). A new south wall, approximately 14 feet (4.3 meters) high and 38 feet (12 meters) long, with a 10-foot by 14-foot (3.0 meter by 4.3 meter) roll-up door for gas trailer access, will be added. The new area will then be covered by extending the roof of the existing storage area. Existing wall openings and gates will be blocked to provide for protection from the weather. Also, ventilation and electrical service will be provided. This additional space is necessary for a test buildup working area. Building 7 currently contains three altitude chambers and one ambient pressure enclosure. With the addition of the Shuttle Environmental Control Life Support System (ECLSS) Test Article and the Orbiter Airlock Simulator, there is insufficient covered area to provide for both storage of test support hardware and a place for uninterrupted access to large test equipment.

F. Lannley Research Center (LaRC) 640.000

1. Construction of an Addition to Building 1209. 235,000

These resources provide for construction of a one-story addition on the northeast side of Building 1209. The addition will provide approximately 3,600 square feet (330 square meters) of space and will include the necessary heating, ventilating and air conditioning (HVAC) and electrical requirements. Exterior finish materials will match the existing face brick and window design. This project is necessary to provide space for a word processing system, the Research Facilities Engineering Division (RFED) Microprocessor Laboratory, central engineering files, and engineering project offices. The word processing system is presently located in trailers. The RFED Microprocessor Laboratory and central files have expanded beyond the space available. In addition, small project offices are needed for personnel who are temporarily housed in this building for various short-term projects.

2. Construction of Addition to Building 1205 170,000

These resources provide for construction of a new 800-square foot (75 square meter) addition on the east side of Building 1205. The enclosed brick structure will house a new 115,000-pound (52,200 kilogram) fatigue testing machine. Three hydraulic pumps presently located in Building 1205 and a new 35-gallon per minute (2.2 liters/per second) hydraulic pump will also be installed in this addition. The small size of the existing pump room makes it difficult to service the pumps. Further, space does not exist for the new pump unit and fatigue testing machine. This facility will be used by the Structural Integrity Branch to test the fatigue life and strength of composite materials.

3. Construction of Pointing Control Lab, Building 1232 235,000

These resources provide for construction of approximately 2,700 square feet (250 square meters) of space in the high bay area of Building 1232. Construction will include the addition of a test chamber for safely testing high speed rotational equipment and the installation of an enclosed vibration free test bed. The vibration free test bed will be for verification testing of the Annular Suspension and Pointing System (ASPS) and preflight ground testing of the system with its attached payload. Mission models for the 1980-1990 time frame indicate that a significant number of shuttle-borne experiments will require payload auxiliary pointing systems to satisfy mission requirements. These pointing systems are used to accurately align experiments using objects in space as a reference. A pointing control laboratory is required to develop the advanced technology associated with these devices. In addition, it will permit functional verification of system operation prior to commitment for flight operations.

G. National Space Technology Laboratories (NSTL) 435.000

1. Construction of Addition to Central Heating Plant, Building 3204 200,000

These resources will provide for a 3,600-square foot (330 square meter) addition to Building 3204 and 1,790 square yards (1,500 square meters) of paving for parking space, access road, and driveway to consolidate operation and maintenance personnel and equipment for the utility control system, high temperature hot water system, and heating, ventilating, and air-conditioning (HVAC) system. This addition consists of a concrete slab-on-grade extension of the existing building walls and roof, and installation of partitions and utilities to provide office areas and shop/storage space. The parking area will be asphalt over compacted shell base. This addition is necessary to provide for a more effective and efficient HVAC operation. Over the past few years, the NSTL population and utilization of facilities have increased, resulting in an increase in the number of service calls received daily. In order to accomplish the maintenance operations within reduced institutional funding, a more effective management control of maintenance resources is required. The operations personnel, tools, work/shop and storage areas are currently separated into two buildings, one mile apart. This centralization will allow maximum cross utilization of personnel and equipment as well as better operational response to trouble calls.

2. Construction of Addition to Data Engineering Building 1110 235,000

These resources will provide for an addition of 4,300 square feet (400 square meters) to Building 1110. The construction will include a slab on grade; reinforced concrete exterior panels, demountable interior walls of metal studs, and vinyl covered plaster board; vinyl tile floor; heating, ventilation, and air-conditioning; and electrical utilities. The NSTL Technical Support Contractor's computer operation, photographic services, and reproduction services are currently operating in crowded areas. The computer operation programmer offices are in two trailers with a total of 2,000 square feet (190 square meters). These trailers are over 15 years old and thus increasingly difficult to maintain. The roof leaks on to equipment during frequent rains, and the environmental conditions are not satisfactory. The reproduction services presently occupy 1,720 square feet (160 square meters) of space in Building 1105. A recent safety survey determined that the area is not adequate to accommodate the existing equipment because of dangerously narrow aisles. The photographic services currently utilize 540 square feet (50 square meters) of a hallway for work area. This addition will provide for the relocation of the computer programmers from trailers and the relocation of reproduction services from the crowded, unsafe, and scattered areas. The space vacated in Building 1105 will be used by the photography section to clear the hallway of equipment and resolve the overcrowded conditions. This project will correct existing safety concerns, allow the disposal of two temporary trailer units, and provide improved operational support, especially of the Earth Resources and Space Shuttle Programs which are the primary users of the photographic and reproduction services.

H. Wallops Fliaht Center (WFC) 205.000

1. Construction of Aircraft Support Building 125,000

This project provides a 3,200-square foot (297-square meter) insulated pre-engineered steel building. Construction work will include the installation of a heating system, electrical power, and lights. Also included is the demolition of Building D-49, a 28-year old masonry block building which has deteriorated, shows evidence of structural failure of the foundation and walls and would require extensive rehabilitation. The new building will be located near aircraft hangar D-1. It will be used for the storage of aircraft parts used in support of research aircraft operations and will provide space for the aircraft hangar booster fire water pump.

2. Construction of Addition to Equipment Storage Building (N-222) 80,000

This project provides an addition of approximately 1,200 square feet (110 square meters) on the west side of the Equipment Storage Building (N-222). The work will include four roll-up doors, electrical power, lights, and a heating system. An open storage addition of 1,200 square feet (110 square meters) on the east side of the building will also be provided. The existing building will be reroofed and will have a roll-up door installed. These additions are required to provide suitable storage for large research equipment. The roll-up door is necessary to improve mechanical equipment operations in the existing building. Reroofing is required due to the deterioration of this 21 year old building.

I. Various Locations 195,000

1. Construction of Addition to Operations Building DSS-43 195,000

These resources provide for the construction at Deep Space Station-43 (DSS-43) in Canberra, Australia, of a 400-square foot (37 square meter) addition to the Operations Building 42/43 to house station frequency and timing equipment in a controlled, highly reliable environment. The building additions will include a computer room, HVAC equipment with electronic controls, a fire protection system, and an air lock to isolate the timing room from the main operations building. The deep space network master frequency standard at each station consists of various cesium or hydrogen masers which require extremely precise control of temperature, air currents, air cleanliness, magnetic environment, and vibration. The present hydrogen maser is housed in a basement reproduction room at DSS-43. This room was designed with standard HVAC equipment and electrical power which is unstable and unreliable for proper performance of the station's master frequency standard.

TOTAL. 4,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that between $3 million and $5 million per year will be required for the continuation of this essential minor construction work.

FACILITY PLANNING
AND DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

	Amount	Page No.
Regular Requirements:	8.400.000	
Master Planning	300,000	CF 13-2
Sustaining Engineering Support	1,500,000	CF 13-2
Preliminary Engineering Reports and Related Special Engineering Support	2,450,000	CF 13-5
Final Design	4,150,000	CF 13-6
Other Requirements:	1.600.000	
Spacelab/Payloads Facility Planning and Design	650,000	CF 13-7
Energy Reduction Analysis and Support...	950.000	CF 13-7
Total	10.000.000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1981 ESTIMATES

PROJECT TITLE: acility Planning and Design			
		FY 1981 CoF ESTIMATE:	$10.000 ,000
FY 1979:	$10,650,000	FY 1980:	$14,000,000

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

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

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

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

d. The accomplishment of facilities siting and other investigations, studies and reports.

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

1. REGULAR REQUIREMENTS 8.400.000

A. Master Planning 300.000

Provides for the updating and further development of 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. Provides for the documentation of 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 modest and 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 1981 are:

(1) Goddard Space Flight Center

A major update to incorporate land use interfaces with latest Agricultural Research Center planning, proposed consolidation of test sites, and future construction plans.

(2) Wallops Flight Center

A major update of inventory base and land/facility utilization plans and rehabilitation program planning.

(3) Dryden Flight Research Center

An update to involve facility utilization planning for the Dryden facilities during the early operational period of the Shuttle, as well as updating the inventory data base.

B. Sustaining Engineering Support 1.500.000

Provisions for facility studies and specific engineering support continue in importance as evidenced in recent years, and must be given high priority throughout FY 1981. These efforts are important due to the unpredictable cost situation which currently exists and may continue; cost trends in construction materials

and fuels; the continuing importance of energy conservation and efficiency; and the operation and maintenance cost for the physical plant. This 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 1981 requirements:

(1) Building Research Advisory Board Support

Covers annual support to the Federal Construction Council's (FCC) operations and provides for special studies that the Council will perform throughout FY 1981 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

Provides for continuous services in support of utilities procurement and utility systems. This includes technical counseling, surveillance, and recommendations with regard to utility rates, contract negotiations, and systems operations and control. These services are an annual requirement and continue to be important, with continuing increases in energy costs.

During the last fiscal year, these resources have enabled the Agencyto achieve fair and reasonable rates in several major utility contract negotiations. Valuable technical assistance from the expertise that these resources provided, at Ames Research Center (ARC) and Langley Research Center (LaRC), resulted in minimizing the impact of sharply higher utility rates.

It is anticipated that one or two major utility contracts per year will require such expert technical input as utility contract renewals move through a normal cycle throughout the Agency. During FY 1981, we expect contract negotiations to occur at Lewis Research Center (LeRC) and Michoud Assembly Facility (MAF). The potential increase in natural gas costs may result in the requirement for additional contract negotiations.

These resources will provide for an updating of our system for forecasting utility costs and rates, so that better and more reliable utility budget requirements can be established. The accuracy and credibility of these forecasts impact the Agency's planning of other resources.

Significant use of these services is the technical maintenance of NASA's utility control and management system which requires close coordination and technical input in order to insure proper use and function of the Agency's investment in utility control and management systems.

These and other similar utility system services are provided for by these resources in order to properly manage this function.

(3) Design Specifications Update and Support

Provides for the continuation of engineering services to update and refine the Agency-wide construction specification system. This system combines a catalog of preapproved standard construction specifications, and a cost effective program for selective retrieval and printout of bid specifications. These standard specifications are used by architect-engineer firms to produce bid documentation which is uniform throughout the Agency and easily updated.

(4) Facility Operation and Maintenance Analysis

Provides for continued engineering support for implementing improvements at NASA field installations relative to manpower utilization, work control systems, preventive maintenance, facilities management and reporting systems. Improvements will also involve techniques to identify where and how increases in productivity are possible by using earlier, reliable measurement methods. Included in this activity are field surveys to be conducted on a priority basis at selected NASA field installations to evaluate the effectiveness of the operations and maintenance management systems.

(5) Value Engineering Cost Validations and Analyses

Provides for engineering services to improve cost-effectiveness of facility projects by subjecting project design criteria, specifications and working drawings for specific material components and systems to a detailed independent review by engineering specialists in the particular area of involvement. Also provides services necessary to accurately predict and validate facility costs which will aid in resources planning for the various field installations.

(6) Facilities Utilization Analyses

Provides for the analyses of Agency-wide facilities utilization data covering: (1) office and other types of building space; (2) designated major technical facilities; and (3) special studies comparing the utilization of technical facilities which are similar in type or capability, such as wind tunnels. Such

analyses provide for the review of data assembled in various formats, thereby permitting: (1) insights into and development of better methods of identifying underutilized facilities; (2) improved techniques of quantifying level of facilities use; and, (3) actions for improved facilities utilization. Work provides for review of each installation's inventory data base in support of the facilities utilization program. Surveys are necessary to validate the reported data in relation to a specific problem or need, and to assist in providing a credible foundation for plans to improve the utilization of facilities.

(7) Engineering Handbook Update

Provides guidance to field installations on a standardized approach to facilities engineering. The handbook is used as a source of basic policy and criteria for in-house engineering and work performed by architect-engineer firms. New criteria is continually being developed and/or revised. The Handbook must be modified on a progressive basis.

(8) Environmental Studies

Provides for the identification of potential environmental problems or the quick resolution of any related controversies at the NASA field installations. These conditions may be brought about by:

- New Federal, state and local environmental regulations, emission standards and environmental management planning programs that must be considered at various installations;
- Changes resulting from new or expanded program activities, new facilities, or major site expansions at NASA installations; and,
- Changes that take place in the external environmental conditions at NASA installations.

Early identification of potential environmental problems and quick resolution of these and related controversies at the installations are important. Project managers and facility planners require up-to-date, accurate information to comply with legal and regulatory requirements.

C. Preliminary Engineering Reports and Related Special Engineering Support 2,450,000

(1) Preliminary Engineering Reports (PER's) ..... (1,700,000)

Preparation of PER's, investigations, and project studies related to proposed facility projects in the FY 1983 and FY 1984 Construction of Facilities programs are provided for by this estimate. These reports

are required to permit the early and timely development of the most suitable project to meet the stated functional need. Reports provide basic data, cost estimates and schedules relating to future budgetary proposals. This request provides for PER work associated with proposed construction except as provided for in "Other Requirements" (Paragraph 2) for Spacelab/Payload. In the FY 1983 program, updated PER's are required for an estimated $20-25 million of construction. PER's are required for new projects estimated at approximately $34-40 million. The estimated cost for the FY 1983 PER effort is $1,700,000.

An additional $750,000 has been included in this line for the completion of new PER's for approximately $35-40 million of construction projects which will be high priority candidates for inclusion in the FY 1984 Construction of Facilities program. The activity associated with FY 1984 will be confined to the most urgent and clear-cut priority candidates, and will be undertaken on a limited basis in an attempt to obtain earlier and better definition of programs. It is felt that this will permit better budget estimates, earlier design completion and, thereby, result in better and less costly projects. Subject to validation of the success of this endeavor, we plan to increase the level of early detailed review of such candidate projects in future years. This activity is made essential by the extensive lead time now associated with PER work and the more limited Center capabilities to manage such work on the compressed schedule we have adhered to in the past. This early initiation of PER effort was first provided for in the FY 1980 Budget. It is expected that three to four years experience will be needed to fully assess its effectiveness.

(2) Related Special Engineering Support ..... (750,000)

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 documentation and validation of "as built" conditions, survey/study of present condition of such items as roofing and cooling towers, utility plant condition and operational modes, analysis and support of environmental impact assessments and statements and other 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 4,150,000

The amount requested will provide for the preparation of designs, plans, drawings, and specifications necessary for the accomplishment of projects other than Spaceiab and Payloads. Amounts required for those efforts are included under "Other Requirements" (Paragraph 2). Projects involved are planned for inclusion in the FY 1982 and FY 1983 programs. This is in accordance with the overall plan discussed earlier in the "Preliminary Engineering Reports" section to obtain better facilities on line earlier at a lower cost.

The request will provide for final design work associated with construction proposed for the FY 1982 Program, estimated to cost $45 to $55 million, and for $15 to $20 million of high potential projects proposed for the FY 1983 program. The amount included for FY 1982 candidates and for residual requirements of this nature which have accumulated from prior years' final design activities is $4,200,000. For FY 1983, $1,150,000 is included and the supporting rationale is much the same as that set out in the PER estimate.

2. OTHER REQUIREMENTS 1.600.000

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 ultimately ensure the best design, cost estimate and schedule. These projects then require planning effort and associated design lead time well beyond that normally associated with general type facility projects. These requirements must be provided for beyond the regular and most recurrent facility planning and design needs.

A. Spacelab/Payload Facility Planning and Design 650.000

The requirement is for the preparation of Preliminary Engineering Reports (PER's), facility site investigations, design of facility projects, and studies to determine facility capabilities required to support the operational phase of the Space Shuttle Transportation System pertaining to Spacelab/payloads. Included are facility requirements for the integration and checkout of Spacelab/payloads, upper stage vehicles, and housing and maintenance of associated flight and support equipment. Projects forecast for FY 1982 include a facility to house and maintain the payload canister and transporter, replacement of payload ground communications cabling, possibly a hydrazine propellant loading capability, and additional payload user support capabilities.

B. Energy Reduction Analysis and Support 950.000

Provides resources for the third phase of requirements for energy management and reduction analysis in response to a continuing effort to reduce energy consumption. Many recent national energy developments and considerations continue to introduce a need to improve the management of the Agency's energy resources, such as (1) the increased need and urgency to conserve energy as an essential element of good business and economic viability; (2) the continuing focus and emphasis accorded to energy reduction in building and facilities as an outgrowth of the requirements of Executive Order No. 12003 and the National Energy Conservation Policy Act (NEPCA); and, (3) the continuing emphasis on these requirements as mandated by Executive Orders and by the national energy situation. This FP&D requirement covers those special needs which are related to complex facility studies, analyses, and other preliminary activities leading to the better identification of cost and

energy effective facility projects and improved energy management. These preliminary activities are essential and vital to the total effort of effective future energy reduction, and must be undertaken on a priority basis if near-term and long-term energy reduction goals and improved energy management are to be attained.

NASA has continuously intensified its efforts to identify, study and develop new energy reduction initiatives and improved energy management techniques which have resulted in sound and effective facility projects, improved facility operations and better energy awareness. It is anticipated that the resultant projects and operation changes will reduce and/or limit future energy consumption through improved efficiency and, at the same time, minimize the impact of rapidly rising energy costs. Experience to date, continues to demonstrate that these planning resources can lead to appreciable energy reductions and can direct limited investment resources toward the most prudent and cost, effective modifications to facilities on a priority basis. An anticipated additional. 7 percent to 10 percent reduction in NASA's total energy consumption can be achieved witn in an estimated additional utility cost savings of between $7-$10 million per year in terms of average FY 1979 energy costs. These resources are essential and continue to be the key to timely identification of future facility investments. If not accomplished in a timely manner, additional utilities costs and other costs will be required in future years.

(1) Provides for engineering support, studies and analyses to update energy criteria and design methodologies, operation and maintenance procedures, research testing procedures, facility energy impacts of new programs, ana the evaluation of the energy effectiveness of prior investments. This is essential in maintaining the Agency's energy reduction mode arid insuring the validity of energy reduction efforts. These resources will also provide for residual efforts and completion of' studies already underway.

(2) Provides for technical services, studies, analyses, and planning for the use of alternate energy sources to substitute for. the scarcer fossil fuels. As availability of some forms of fossil fuel becomes difficult and more costly to acquire, the substitution of these fuels with waste products, solar, wind, biomass, etc., becomes: more essential and cost effective. The increased utilization of coal in an energy efficient and pollution acceptable manner is also included in the effort. These alternate sources of energy require deliberate ana careful planning and analysis if prudent and reasonable future investments are to be made.

TOTAL..... 10,000,000

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FISCAL YEAR 1981 BUDGET ESTIMATES