National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1972

Volume III

CONSTRUCTION OF FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

This appropriation provides for contractual services for the design, major rehabilitation, and modification of facilities; the construction of new facilities; the purchase of related equipment and advanced design related to facilities planned for future authorization. The principal projects in the 1972 program are described below:

MANNED SPACE FLIGHT: This activity includes funds for the modification and provision of facilities for space shuttle technology and engine development.

SCIENTIFIC INVESTIGATIONS IN SPACE: This activity will provide funds for Centaur modifications to Titan III launch area, and alterations to launch complex 17 at the John F. Kennedy Space Center, NASA, Kennedy Space Center, Fla.

SPACE APPLICATIONS: No projects for 1972.

SPACE RESEARCH AND TECHNOLOGY: No projects for 1972.

AERONAUTICAL RESEARCH AND TECHNOLOGY: This activity includes funding for the modernization of the 40 x 80-foot wind tunnel at the Ames Research Center, Moffett Field, Calif.

SUPPORTING ACTIVITIES: The estimates for this activity provide for facility planning and design; a transportable ground tracking station site in western Europe, power plant replacements at the Goldstone Complex, Fort Irwin, Calif. and Santiago, Chile; and for essential rehabilitation of and modifications to facilities (including projects for the prevention, control and abatement of air and water pollution), at NASA installations and Government-owned plants operated by contractors for NASA.

The appropriation for FY 1971 was $24,950,000 and the authorization was $34,478,000. The request for 1972 is $56,300,000 an increase of $31,350,000 from the 1971 appropriation. Total expenditures are estimated to be $43,000,000 in FY 1972, a decrease of $7,000,000 from the $50,000,000 estimated for FY 1971.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1972 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN AS RECONCILED TO FINANCING SCHEDULE

	Fiscal Year 1970	Fiscal Year 1971	Fiscal Year 1972
Budget Activity			
1. Manned Space Flight.....	$14,250,000	$570,000	$20,000,000
2. Scientific Investigations in Space.....	1,170,000	700,000	15,200,000
3. Space Applications.....	---	1,880,000	---
4. Space Research and Technology.	---	1,250,000	---
5. Aeronautical Research and Technology.....	4,767,000	---	6,500,000
6. Supporting Activities.....	29,925,000	20,550,000	14,600,000
Total Budget Plan.....	$50,112,000	$24,950,000	$56,300,000
Financing:			
Appropriation.....	$53,233,000	$24,950,000	$56,300,000
Reprogramming to prior year budget plans.....	-3,121,000	---	---
Total financing of budget plan.....	$50,112,000	$24,950,000	$56,300,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1972 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN
BY BUDGET ACTIVITY SHOWING LOCATION TOTALS INCLUDED IN EACH ACTIVITY

	Fiscal Year 1970	Fiscal Year 1971	Fiscal Year 1972
1. MANNED SPACE FLIGHT.....	$14,250,000	$570,000	$20,000,000
John F. Kennedy Space Center, NASA.....	12,500,000	570,000	---
Manned Spacecraft Center.....	1,750,000	---	---
Various Locations.....	---	---	20,000,000
2. SCIENTIFIC INVESTIGATIONS IN SPACE.....	$1,170,000	$700,000	$15,200,000
Goddard Space Flight Center...	670,000	---	---
John F. Kennedy Space Center, NASA.....	---	---	15,200,000
Jet Propulsion Laboratory.....	---	700,000	---
Wallops Station.....	500,000	---	---
3. SPACE APPLICATIONS.....	---	$1,880,000	---
Goddard Space Flight Center...	---	1,880,000	---
4. SPACE RESEARCH AND TECHNOLOGY...	---	$1,250,000	---
Jet Propulsion Laboratory.....	---	1,250,000	---
5. AERONAUTICAL RESEARCH AND TECHNOLOGY.....	$4,767,000	---	$6,500,000
Ames Research Center.....	---	---	6,500,000
Langley Research Center.....	4,767,000	---	---
6. SUPPORTING ACTIVITIES.....	$29,925,000	$20,550,000	$14,600,000
Various Locations.....	26,425,000	16,050,000	11,100,000
Facility Planning and Design..	3,500,000	4,500,000	3,500,000
TOTAL PLAN.....	$50,112,000	$24,950,000	$56,300,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

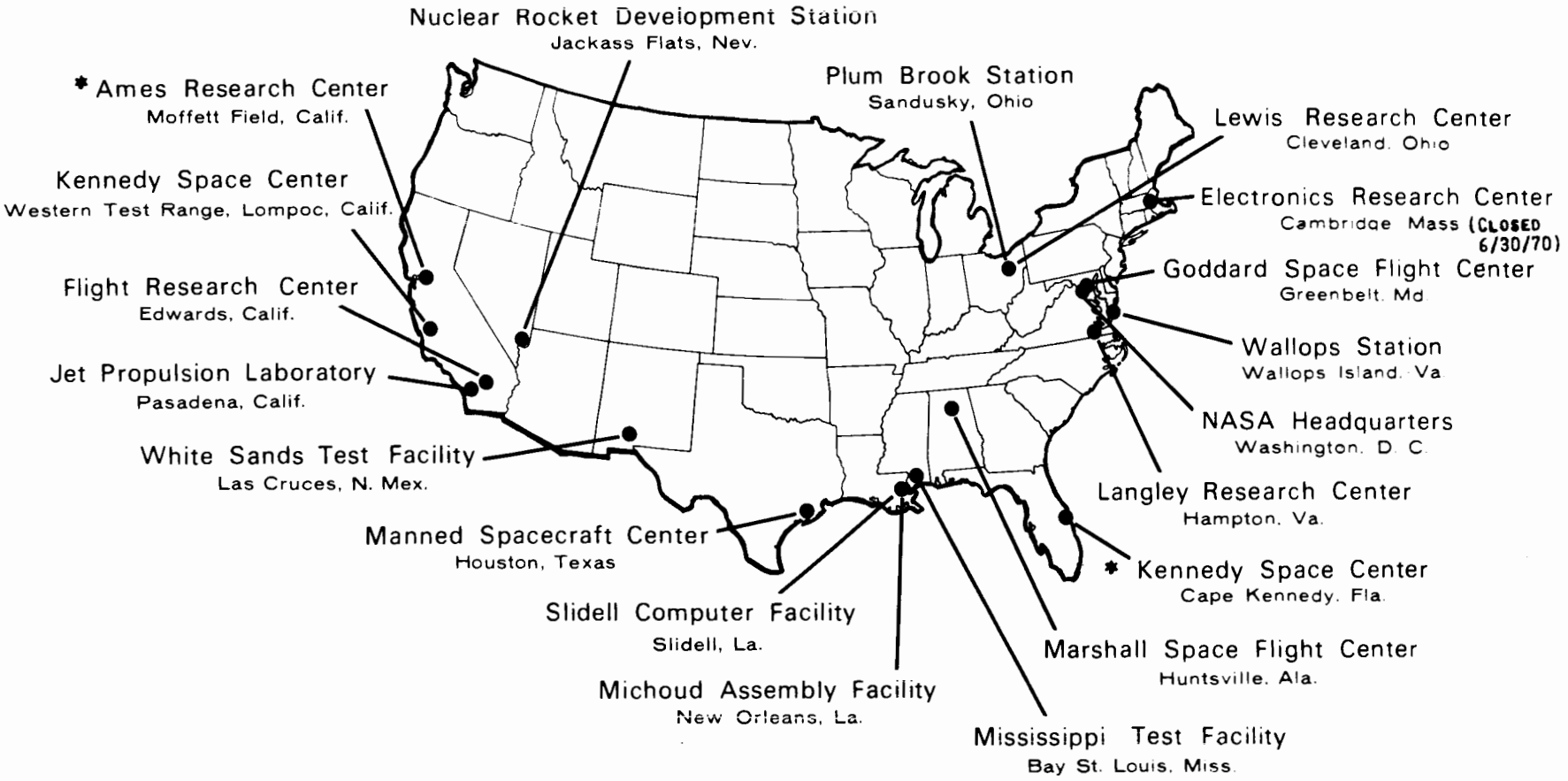
FISCAL YEAR 1972 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

Location	Fiscal Year 1970	Fiscal Year 1971	Fiscal Year 1972
Ames Research Center.....	---	---	$6,500,000
Goddard Space Flight Center.....	$670,000	$1,880,000	---
Jet Propulsion Laboratory.....	---	1,950,000	---
John F. Kennedy Space Center, NASA..	12,500,000	570,000	15,200,000
Langley Research Center.....	4,767,000	---	---
Manned Spacecraft Center.....	1,750,000	---	---
Wallops Station.....	500,000	---	---
Various Locations.....	26,425,000	16,050,000	31,100,000
Facility Planning and Design.....	3,500,000	4,500,000	3,500,000
Total Plan.....	$50,112,000	$24,950,000	$56,300,000

The geographic location of NASA installations is shown on the following page. Installations for which construction projects are requested in the fiscal year 1972 budget are identified.

NASA INSTALLATIONS



* Installations for which construction projects are requested in the FY 1972 budget estimates.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RECORDED VALUE OF CAPITAL TYPE PROPERTY
(In-House and Contractor-Held)
As of June 30, 1970
(In Thousands of Dollars)

Reporting Installation	Real Property: Land	Real Property: Buildings	Real Property: Other Structures and Facilities	Real Property: Leasehold Improvements	Real Property: Total	Equipment 3/	Fixed Assets in Progress	Grand Total
OFFICE OF MANNED SPACE FLIGHT	112,012	731,073	750,593	---	1,593,678	1,191,479	24,429	2,809,586
Kennedy Space Center	72,173	285,847	415,583	---	773,603	222,097	9,448	1,005,148
KSC - Florida	72,173	285,847	415,583	---	773,603	74,515	9,448	857,566
Western Test Range Operations Division Lompoc, California	---	---	---	---	---	3,832	---	3,832
Various Locations 1/	---	---	---	---	---	143,750	---	143,750
Manned Spacecraft Center	9,029	172,787	53,158	---	234,974	500,607	12,998	748,579
MSC - Houston, Texas	5,459	138,756	29,749	---	173,964	207,624	12,998	394,586
White Sands Test Facility WSTF - Las Cruces, New Mexico	---	8,712	17,797	---	26,509	28,346	---	54,855
Various Locations 1/	3,570	25,319	5,612	---	34,501	264,637	---	299,138
Marshall Space Flight Center	30,810	272,439	281,852	---	585,101	468,775	1,983	1,055,859
MSFC - Huntsville, Alabama	95	111,324	48,501	---	159,920	221,967	1,832	383,719
Michoud Assembly Facility MAF - New Orleans, Louisiana	7,504	63,908	25,361	---	96,773	40,694	151	137,618
Mississippi Test Facility MTF - Bay St. Louis, Mississippi	19,648	65,673	168,249	---	253,570	23,201	---	276,771
Slidell Computer Facility SCF - Slidell, Louisiana	63	4,450	823	---	5,336	16,920	---	22,256
Various Locations 1/	3,500	27,084	38,918	---	69,502	165,993	---	235,495
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY	7,454	529,965	219,616	140	757,175	426,706	40,334	1,224,215
Ames Research Center	2,374	170,901	3,302	1	176,578	73,617	6,022	256,217
ARC - Moffett Field, California	2,374	170,763	3,288	-	176,425	69,526	6,022	251,973
Various Locations 1/	---	138	14	1	153	4,091	---	4,244
Electronics Research Center 2/	1,573	18,468	1,716	---	21,757	28,255	567	50,579
ERC - Cambridge, Massachusetts	1,573	18,468	1,716	---	21,757	28,255	567	50,579
Various Locations 1/	---	---	---	---	---	---	---	---
Flight Research Center	---	7,726	2,222	---	9,948	52,914	366	63,228
FRC - Edwards, California	---	7,726	2,222	---	9,948	50,347	---	60,661
Various Locations 1/	---	---	---	---	---	2,567	---	2,567
Langley Research Center	116	121,891	143,955	---	265,962	122,671	14,335	402,968
LaRC - Hampton, Virginia	110	106,521	143,930	---	250,561	112,909	14,335	377,805
Various Locations 1/	6	15,370	25	---	15,401	9,762	---	25,163
Lewis Research Center	3,391	191,979	61,493	139	257,002	122,032	19,017	398,051
LeRC - Cleveland, Ohio	322	112,400	39,947	139	152,808	56,993	11,399	221,200
Plum Brook Station PBS - Sandusky, Ohio	2,970	75,415	17,895	---	96,280	11,417	7,618	115,315
Various Locations 1/	99	4,164	3,651	---	7,914	53,622	---	61,536
Space Nuclear Propulsion Office	---	19,000	6,928	---	25,928	27,217	27	53,172
NRDS - Jackass Flats, Nevada	---	19,000	6,928	---	25,928	4,351	23	30,302
Various Locations 1/	---	---	---	---	---	22,866	4	22,870
OFFICE OF SPACE SCIENCE AND APPLICATIONS	3,779	163,372	134,407	723	302,281	648,250	20,095	970,626
Goddard Space Flight Center	1,640	87,283	62,798	303	152,024	474,147	2,623	628,794
GSFC - Greenbelt, Maryland	1,301	69,704	13,080	299	84,384	158,623	2,623	245,630
Tracking Stations (Excl DSNS) 4/	339	17,491	49,673	---	67,503	270,966	---	338,469
Various Locations 1/	---	88	45	4	137	44,558	---	44,695
Jet Propulsion Laboratory	1,067	53,864	28,401	420	83,752	131,587	16,129	231,468
JPL - Pasadena, California	1,067	44,667	6,813	420	52,967	99,460	16,129	168,556
Tracking Stations (DSNS) 4/	---	9,197	21,588	---	30,785	32,127	---	62,912
Wallops Station	1,072	22,225	43,208	---	66,505	42,516	1,343	110,364
WS - Wallops Island, Virginia	1,072	22,225	43,208	---	66,505	42,073	1,343	109,921
Various Locations 1/	---	---	---	---	---	443	---	443
NASA Pasadena Office	---	---	---	---	---	---	---	---
NPO - Pasadena, California	---	---	---	---	---	---	---	---
OTHER								
NASA Headquarters	---	---	---	---	---	32,077	---	32,077
Washington, D.C.	---	---	---	---	---	5,561	---	5,561
Various Locations 1/	---	---	---	---	---	26,516	---	26,516
GRAND TOTAL	123,245	1,424,410	1,104,616	863	2,653,134	2,298,512	84,858	5,036,504

1/ Includes Capital Type Property in Possession of Contractors at Various Locations.
2/ Disestablished June 30, 1970.
3/ Includes Contractor-Held Special Test Equipment.
4/ DSNS - Deep Space Network Stations.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AMES RESEARCH CENTER

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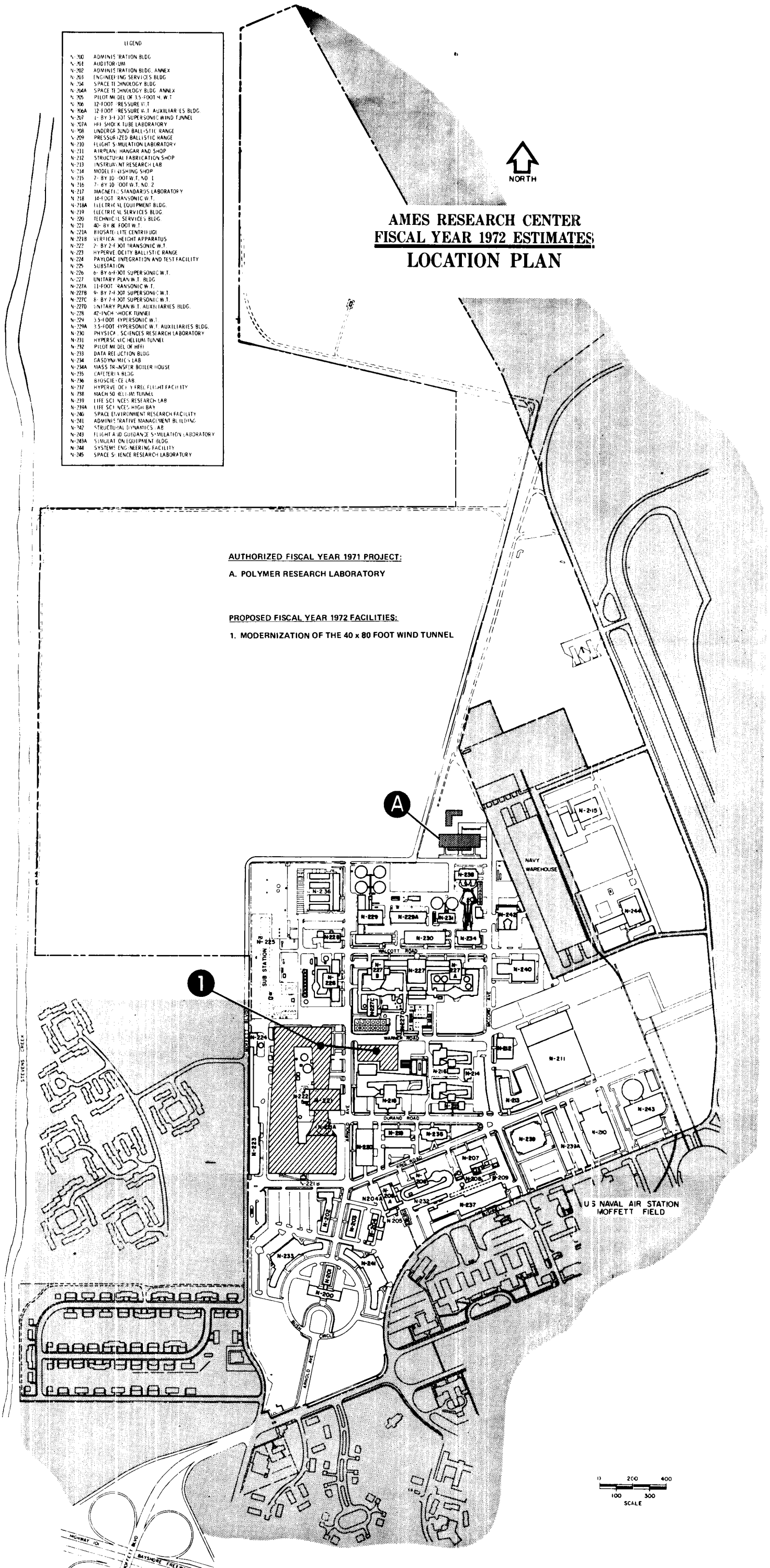
Summary	CF 1-2
Office of Advanced Research and Technology Project:	
Modernization of the 40X80-foot wind tunnel	CF 1-3


LEGEND
N-200 ADMINISTRATION BLDG.
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N-203 ENGINEERING SERVICES BLDG.
N-204 SPACE TECHNOLOGY BLDG.
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N-205 PILOT MODEL OF 3.5-FOOT H. W.T.
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N-206A 12-FOOT PRESSURE W.T. AUXILIARIES BLDG.
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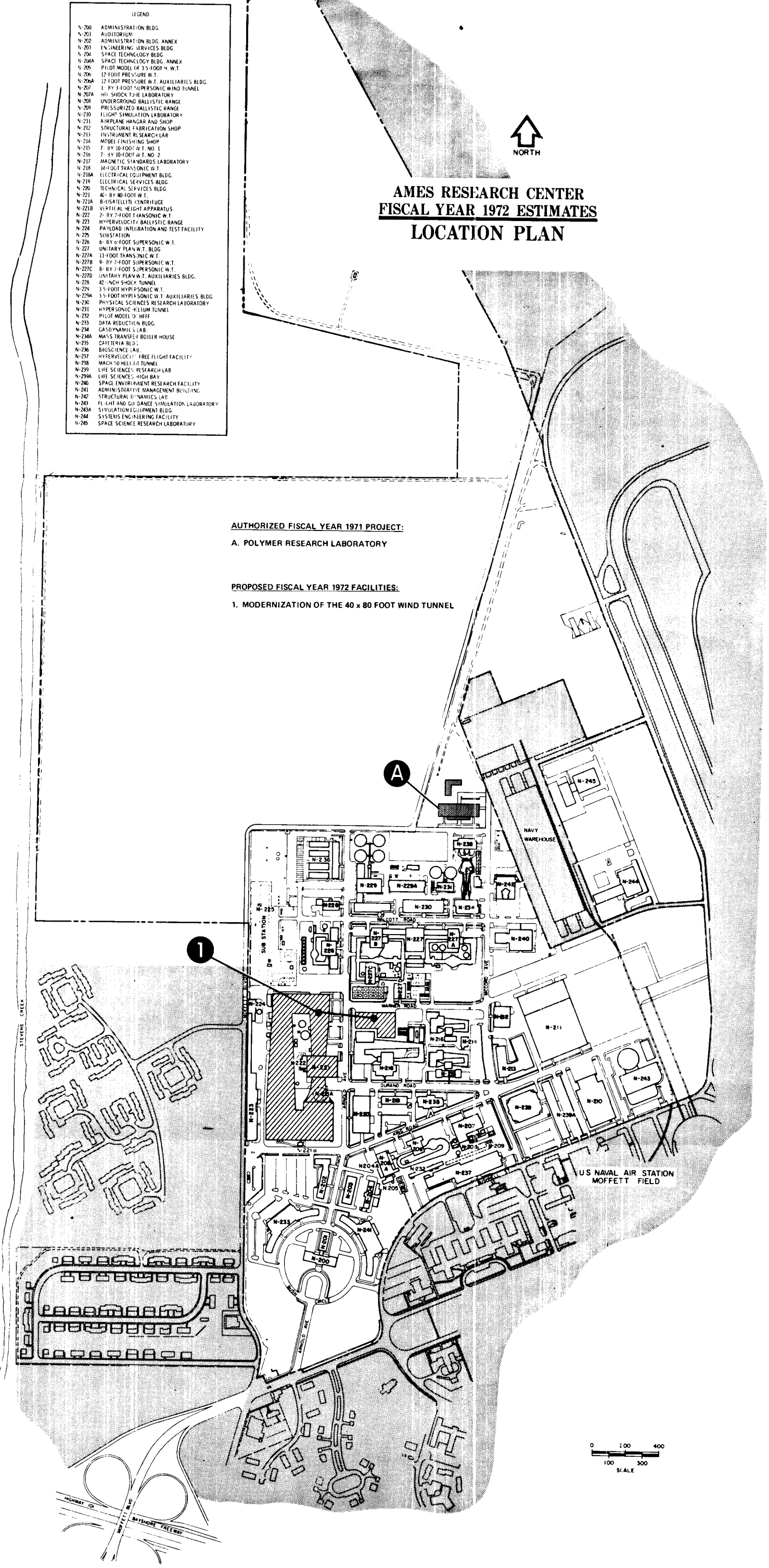
N-208 UNDERGROUND BALLISTIC RANGE
N-209 PRESSURIZED BALLISTIC RANGE
N-210 FLIGHT SIMULATION LABORATORY
N-211 AIRPLANE HANGAR AND SHOP
N-212 STRUCTURAL FABRICATION SHOP
N-213 INSTRUMENT RESEARCH LAB.
N-214 MODEL FINISHING SHOP
N-215 7- BY 10-FOOT W.T. NO. 1
N-216 7- BY 10-FOOT W.T. NO. 2
N-217 MAGNETIC STANDARDS LABORATORY
N-218 14-FOOT TRANSONIC W.T.
N-218A ELECTRICAL EQUIPMENT BLDG.
N-219 ELECTRICAL SERVICES BLDG.
N-220 TECHNICAL SERVICES BLDG.
N-221 40- BY 80-FOOT W.T.
N-221A BIOSATELLITE CENTRIFUGE
N-221B VERTICAL HEIGHT APPARATUS
N-222 2- BY 2-FOOT TRANSONIC W.T.
N-223 HYPERVELOCITY BALLISTIC RANGE
N-224 PAYLOAD INTEGRATION AND TEST FACILITY
N-225 SUBSTATION
N-226 6- BY 6-FOOT SUPERSONIC W.T.
N-227 UNITARY PLAN W.T. BLDG.
N-227A 11-FOOT TRANSONIC W.T.
N-227B 9- BY 7-FOOT SUPERSONIC W.T.
N-227C 8- BY 7-FOOT SUPERSONIC W.T.
N-227D UNITARY PLAN W.T. AUXILIARIES BLDG.
N-228 42-INCH SHOCK TUNNEL
N-229 3.5-FOOT HYPERSONIC W.T.
N-229A 3.5-FOOT HYPERSONIC W.T. AUXILIARIES BLDG.
N-230 PHYSICAL SCIENCES RESEARCH LABORATORY
N-231 HYPERSONIC HELIUM TUNNEL
N-232 PILOT MODEL OF HFFF
N-233 DATA REDUCTION BLDG.
N-234 GASDYNAMICS LAB.
N-234A MASS TRANSFER BOILER HOUSE
N-235 CAFETERIA BLDG.
N-236 BIOSCIENCE LAB.
N-237 HYPERVELOCITY FREE FLIGHT FACILITY
N-238 MACH 50 HELIUM TUNNEL
N-239 LIFE SCIENCES RESEARCH LAB.
N-239A LIFE SCIENCES HIGH BAY
N-240 SPACE ENVIRONMENT RESEARCH FACILITY
N-241 ADMINISTRATIVE MANAGEMENT BUILDING
N-242 STRUCTURAL DYNAMICS LAB.
N-243 FLIGHT AID GUIDANCE SIMULATION LABORATORY
N-243A SIMULATION EQUIPMENT BLDG.
N-244 SYSTEMS ENGINEERING FACILITY
N-245 SPACE SCIENCE RESEARCH LABORATORY
NORTH
AMES RESEARCH CENTER
FISCAL YEAR 1972 ESTIMATES
LOCATION PLAN
AUTHORIZED FISCAL YEAR 1971 PROJECT:
A. POLYMER RESEARCH LABORATORY
PROPOSED FISCAL YEAR 1972 FACILITIES:
1. MODERNIZATION OF THE 40 x 80 FOOT WIND TUNNEL
A
1
NAVY WAREHOUSE
U.S. NAVAL AIR STATION MOFFETT FIELD
SUB STATION
WILCOTT ROAD
WARNER ROAD
DURAND ROAD
ARNOLD AVE
STEVENS CREEK
HIGHWAY 101
BAYSHORE FREEWAY
0 100 200 300 400
SCALE

AMES RESEARCH CENTER
FISCAL YEAR 1972 ESTIMATES
LOCATION PLAN



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 72 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Ames Research Center		Office of Advanced Research and Technology
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Moffett Field, California	Santa Clara	Mountain View, California

INSTALLATION MISSION

Laboratory research in aerodynamics, thermodynamics, materials, structures, guidance and control, space sciences, environmental biology, life detection, life synthesis, human factors, and fundamental physics and chemistry, project management of unmanned spaceflight projects (scientific probes and satellites); development of scientific-experiment payloads for spaceflight projects managed at Ames and elsewhere.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1972 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Modernization of the 40x80-foot Wind Tunnel	OART	294	6,500	-0-	6,794
TOTAL			6,500		

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Ames Research Center	
PROJECT TITLE: Modernization of the 40 x 80-foot Wind Tunnel	
	FY 1972 CoF ESTIMATE: $6,500,000

COGNIZANT INSTALLATION: Ames Research Center

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

COGNIZANT PROGRAM OFFICE: Office of Advanced Research and Technology

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$294,000
Construction	---
Total FY 1971 and Prior Years	$294,000

SUMMARY PURPOSE AND SCOPE:

This project will provide for the repair and modification of the 40 x 80-foot wind tunnel. It also includes certain new construction. This project is necessary to improve safety of test operations, extend the useful life of the facility and increase its operational efficiency. The tunnel will be out of operation for about three months while the work is being completed. The major costs of the proposed project involve repair of the existing tunnel test section and structure. New construction will consist of two quick-change struts, a model support preparation building, and a building to house personnel involved in management and data reduction functions associated with this large wind tunnel activity.

PROJECT JUSTIFICATION:

The Ames 40 x 80-foot wind tunnel, which initially became operational in 1944 has been used during the long intervening period for research on the low speed characteristics of high-performance aircraft, the transition flight characteristics of high-disc-loading V/STOL aircraft, and the high-speed characteristics of high-performance rotary wing aircraft. This facility

has been instrumental in the research and development of many advanced aircraft (e.g., the BLC high-lift system on the F-4 fighter, the XV-1 compound helicopter, the XV-3 tilt-rotor VTOL airplane, the XV-5A lift-fan airplane, and the XH-51A rigid rotor helicopter).

The potential of V/STOL aircraft in both civil and military applications has been documented in a number of studies, as well as by the widespread and growing use of the helicopter. Moreover, the same basic factors which are creating the potential for V/STOL aircraft (i.e., the high cost and other adverse factors associated with large airports) are dictating that the landing and takeoff characteristics of conventional aircraft be improved. The 40 x 80-foot wind tunnel is unique in testing of V/STOL aircraft and propulsion systems up to flight speeds of 200 knots in the size ranges permitted. This valuable national resource which has a replacement value of approximately $28 million must be preserved and measures taken to insure that its capability can be fully utilized.

The requirement for the proposed repair and modification of the 40 x 80-foot wind tunnel is subdivided into the following three categories: to improve the safety of test operations, to extend the operating life of the facility, and to increase the efficiency of operations in the facility.

The need for improved protection for test personnel was illustrated during the failure of the AH-56A Cheyenne helicopter in the wind tunnel in September 1969. In this case a rotor tip weight penetrated the wind tunnel wall and entered the control room causing some personnel injuries. While some armor plate has since been installed to protect the test crew, there are additional areas needing protection such as the balance house where the wind tunnel operator is stationed. Of further concern in the 40 x 80-foot wind tunnel is the lack of adequate ventilation where painting of the large models is done. This work is presently being performed in the test chamber area of the wind tunnel where potential explosion hazards are generated from the flammable vapors. A new model preparation building is proposed to eliminate this danger and to permit more effective use of the test chamber area.

The existing overhead crane in the test chamber is now rated at 15 tons. Because of the steady growth in the weight of aircraft which are installed in the wind tunnel test section and the added weight of the proposed quick-change strut, it is necessary to have the capability to hoist loads up to 35 tons. Since a crane failure lifting heavy loads could result in injury to personnel, possible destruction of an expensive airplane or damage to the facility, the crane and its structure must be upgraded to 35 ton capacity.

The existing tunnel office areas are located underneath the diffuser of the wind tunnel, and are often subjected to high noise levels and exhaust fumes from gas turbine engines being tested in the wind tunnel. There is also the possibility of debris falling into these areas in the event of structural failure of test hardware. Because of the difficulty of structurally

reinforcing the wind tunnel floor and providing adequate protection from noise and fumes, the best solution to this problem is to provide an administrative building near the wind tunnel. The space vacated under the diffuser would then be used for minor modifications of test models and storage of tunnel related equipment.

The major deterioration in the wind tunnel structure is fatigue damage in the drive section. It is planned to repair the damaged sections and to minimize future fatigue problems by stiffening the structure in this area and by improving the flow into the fans to reduce the vibratory force input. In addition, the drive motors, motor-generator set, and associated equipment will be given a complete overhaul. There is evidence of fatigue damage in the fasteners which attach the corrugated skin of the wind tunnel to the frame. To minimize the possibility of a skin panel coming loose and going into the fans, refastening of the skin is required between the fans and the turning vanes upstream of the fans. It is also necessary to replace the fasteners immediately upstream of the test section to avoid the possibility of a skin panel coming loose and damaging a test aircraft. Another source of structural deterioration results from water collecting in pockets on the wind tunnel structure. This is particularly true for the drive system structure, which also has the heaviest vibration loads and is the most difficult to repair. A light metal roof over the drive section will be provided by this project to alleviate the general problem.

The main causes of lost operational time in the 40 x 80-foot wind tunnel are the setting up of the model support struts and strut fairing system in the test section, and the instrumentation problems associated with complex models such as rotors and V/STOL propulsion systems. The modifications proposed in this project will greatly reduce the lost time during set up and increase the productive operating hours of the facility. It is proposed to provide a new strut system which can be preassembled outside of the test section and then lifted in as a unit. This would reduce the tunnel down time required for a strut change from over thirty hours to less than four hours. The proposed quick-change strut system will require the 35 ton crane previously discussed, and will also require floor space in the test chamber area which is currently used for model assembly and checkout work. Thus, the implementation of the quick-change strut system will require that a new model assembly and checkout shop area be provided in the proximity of the wind tunnel. Also, the area currently used for test set up is in the main hoist operating area and must be cleared of personnel for safety reasons when large loads are hoisted into the test section. In addition, this area must be cleared of personnel whenever hazardous tests are taking place in the wind tunnel. In order to alleviate these problems and to preclude the loss of valuable manhours, the proposed model preparation and checkout building is necessary.

Major source of lost time in wind tunnel test operations is due to malfunctions in the instrumentation systems. This is particularly troublesome in tests of V/STOL aircraft propulsion systems and rotors, which may involve over 100 channels of dynamic measurements. Many of these measurements are absolutely essential to insure test safety and to avoid damage to expensive equipment. This frequently requires over 500 wires between the model and the read-out gear in the control room. Digitizing the signals in the model so that the number of wires can be reduced will minimize malfunctions. Another major source of trouble in the current instrumentation is associated with the slip rings used to transmit signals from a rotating system to the fixed system. These rings are subject to contamination and/or wear during test operations and cause considerable lost time in trouble shooting and maintenance. The plan is to replace the slip rings by miniaturized telemetry equipment mounted on the hub of the rotating gear.

PROJECT DESCRIPTION:

This project provides for the repair and modification of the existing 40 x 80-foot wind tunnel with some related new construction. The modification of the wind tunnel is necessary to reduce the safety hazards within the test operations area and to protect test personnel in the operator's room and model observation stations. The repairs and modifications to extend the useful life of the facility will help to avoid future unscheduled down time of equipment and at the same time, increase safety. These will include: (1) repair of motor section entrance and exit cover, (2) modification of motor support fairings to reduce vibrations, (3) increasing the capacity of test section crane and support structure to 35 tons, (4) increasing the freight elevator capacity to 6,000 pounds, (5) overhauling the drive motors and associated equipment, (6) refastening the wind tunnel skin in critical locations, (7) adding a roof over the drive section, and (8) applying protective coatings to all exterior surfaces of the wind tunnel.

The new construction is designed to increase the efficiency of operations and will include: (1) quick-change strut system; (2) motorized doors to purge the tunnel; (3) new access doors to the model storage and modification areas; (4) an improved data acquisition system, including telemetering, multiplexing transducer outputs, dynamic force measurement, and on-line monitoring; (5) a new data reduction and management building; and (6) a high-bay model preparation building. The road to the model preparation building will be widened for the movement of aircraft.

Sketches of the modifications and the new construction are shown on the last two pages of this project writeup.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$5,250,000
Site development	LS	---	---	231,000
Wind tunnel repairs and modifications	SF	400,185	$6.60	2,641,000
Quick-change struts	LS	---	---	804,000
Model preparation building	SF	36,000	25.00	900,000
Management and data reduction building	SF	10,000	30.10	301,000
Variable frequency power system (repair and extension)	LS	---	---	302,000
Utilities (outside 5-foot line)	LS	---	---	71,000
Equipment				1,250,000
Data acquisition system	LS	---	---	1,100,000
Shop equipment	LS	---	---	150,000
Fallout Shelter (Not Feasible)	---	---	---	---
		TOTAL		$6,500,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

AMES RESEARCH CENTER
FISCAL YEAR 1972 ESTIMATES

MODERNIZATION OF THE 40×80 WIND TUNNEL

PROPOSED CONSTRUCTION PROGRAM

A. New Test Chamber Crane 35T New Heavy Duty Elevator to Test Section (3rd Level) 5000# Capacity.

B. Extend Armor Plate in Test Section New Sound Proof-Vibration Free Tunnel Operators Room. Two Model Observation Stations. One Each Side Test Section.

C. Provide a Large, 50 Ft. Wide by 20 Ft. High Model Access Door to Model Modification Area.

D. Remove Wall Steel Siding, Etc., to Provide a 22 Ft. Wide by 20 Ft. High Roll Door.

E. Replace Tunnel Skin Fasteners - Remove Wall Steel and Siding.

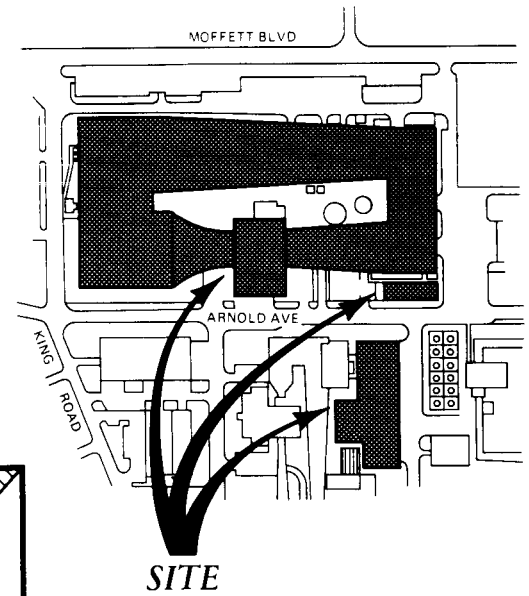
F. Provide 24 Ft. Wide by 20 Ft. High Roll Door.

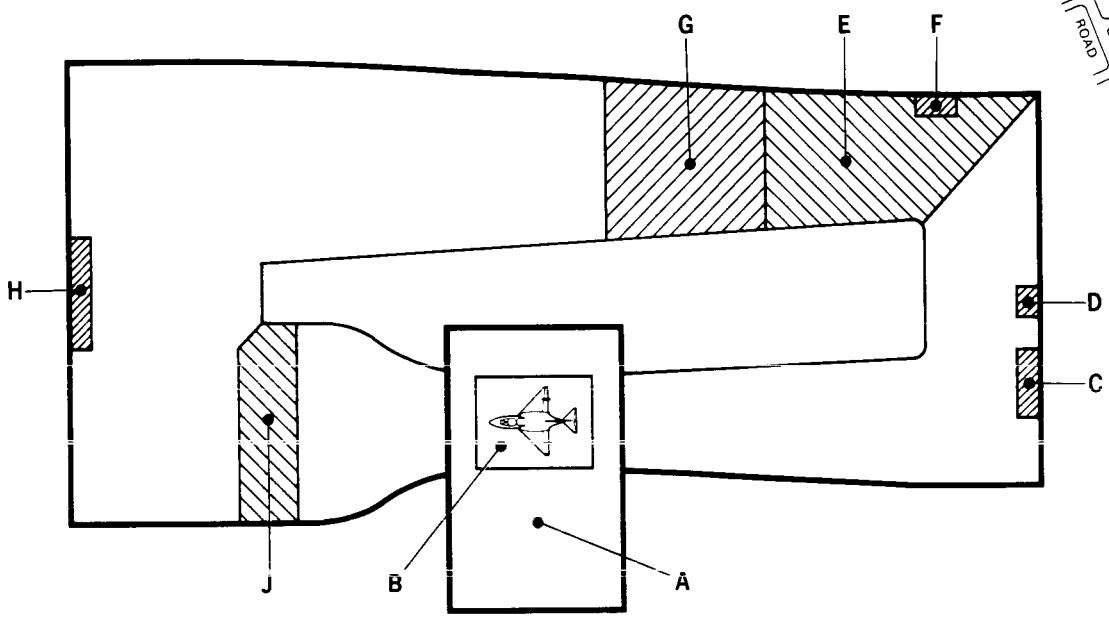
G. New Skin Stiffeners Motor Entrance & Exit Cones and Nacelles - New Motor Support Fairings - Canopy Over the Motor Section - Overhaul all Electrical Equipment.

H. Motorized purge doors.

J. Replace tunnel skin fasteners.

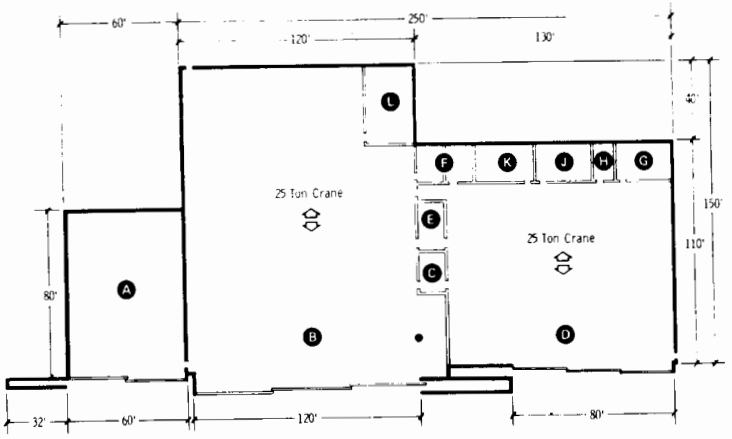
PLOT PLAN





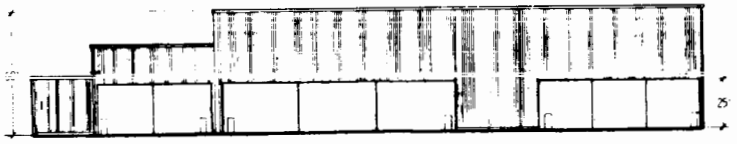
AMES RESEARCH CENTER
FISCAL YEAR 1972 ESTIMATES

MODERNIZATION OF THE 40×80 WIND TUNNEL



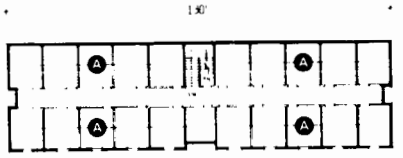
PLAN

A Model Finishing Shop
B Model Prep Area
C Toilet
D Instrumentation and Checkout Area
E Instrument Shop
F Office
G Control Room
H Engine Test Room
J Tool Room
K Mechanical Room
L Shop



ELEVATION

MODEL PREPARATION BUILDING



SECOND FLOOR PLAN

FIRST FLOOR PLAN

A Research Scientists Offices
B Mechanical Room
C Computer Room
D Conference Room
E Entry and Delivery

ELEVATION

OFFICE BUILDING

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

	Page No.
Location plan	CF 2-1
Summary	CF 2-2
Office of Space Science and Applications Project:	
Centaur modifications to Titan III launch area	CF 2-3
Alterations to launch complex 17	CF 2-13

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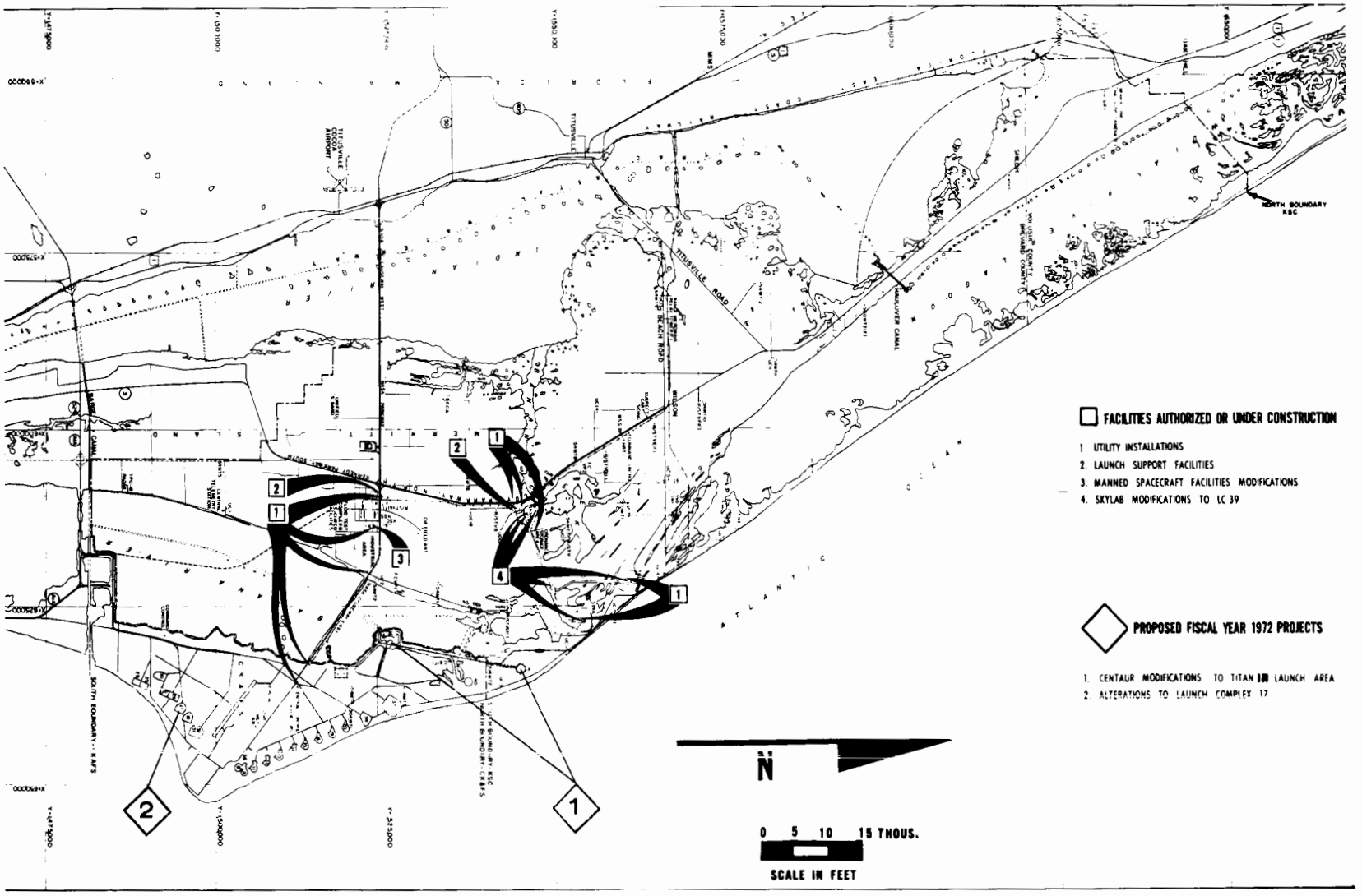
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES
LOCATION PLAN



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 72 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
John F. Kennedy Space Center, NASA		Manned Space Flight
LOCATION OF INSTALLATION Cape Kennedy and Merritt Island	COUNTY Brevard	NEAREST CITY Cocoa Beach, Florida

INSTALLATION MISSION

The Center conducts overall planning and supervision of the integration, test, checkout and launch of NASA space vehicle systems at the Air Force Eastern and Western Test Ranges, and Merritt Island, and provides support services for all NASA elements located in the area.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1972 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Centaur Modifications to Titan III Launch area	OSSA	255	10,700	*	10,955
Alteration to Launch Complex 17	OSSA	8,186	4,500	*	12,686
*Dependent upon future year requirements.					
TOTAL			15,200		

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center	
PROJECT TITLE: Centaur Modifications to Titan III Launch Area	
	FY 1972 CoF ESTIMATE: $10,700,000

COGNIZANT INSTALLATION: John F. Kennedy Space Center

LOCATION OF PROJECT: Cape Kennedy Air Force Station, Brevard County, Florida

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$255,000
Construction	---
Total FY 1971 and Prior Years	$255,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to provide, by alterations and additions, the necessary modifications to the Titan III launch facilities to permit the final assembly, prelaunch checkout and launching of the Titan Centaur vehicle combination and its associated spacecraft. These missions include the Titan Centaur Proof Flight, scheduled for early 1974, which is a vehicle test precursor to the Helios A mission in the second half of 1974 and the Viking A and B missions scheduled for the August-September 1975 Mars opportunity. The two Viking mission launches may require a pad turnaround capability of as little as ten days. The Air Force Titan III Integrate-Transfer-Launch (ITL) facility area at Cape Kennedy consists of: (1) a four-cell Vertical Integration Building with two launch control rooms; (2) three transporters and van sets for movement of the assembled vehicle; (3) a Solid Motor Assembly Building in which the solid propellant motors are attached to the core; and (4) two launch pads (#40 and #41) each with its mobile service tower and support facilities. The Air Force will make available to NASA the use of one cell of the Vertical Integration Building and launch control areas. It will also provide one set of transporter and van sets, (a second

transporter and van set configured to Titan Centaur specifications is required and will be procured) and make available to NASA the use of the Solid Motor Assembly Building and Launch Pad 41 for Titan Centaur.

PROJECT JUSTIFICATION:

The Titan Centaur addition to the National Launch Vehicle capability will provide the high energy (H_2-O_2) final stage and, consequently, the escape velocity needed for heavier planetary exploration missions now planned for the mid-1970's. Adoption of this combination of stages will enable NASA to use the existing Air Force Launch Complex 41 to service, check out and launch the Titan Centaur vehicle. Because the Centaur stage is new to Complex 41, additions and modifications will be necessary to service the Centaur stage and the spacecraft-related ground support equipment.

PROJECT DESCRIPTION:

The alterations and additions to the Titan Launch Complex include:

Mobile Service and Umbilical Towers

The Mobile Service Tower (MST) will be modified at the upper levels within the environmental enclosure by the installation of one additional folding service platform and alterations to the existing platforms to match the access levels of the Centaur for handling of incapsulation equipment and for the final prelaunch checkout of this stage and the spacecraft as well as its protective aerodynamic shroud. The Umbilical Tower will require similar modifications, including additional folding platforms to provide access to the Centaur stage electrical and fueling umbilicals.

Aerospace Ground Equipment Enclosure

Modification of the Aerospace Ground Equipment (AGE) Enclosure, at Launch Complex 41, will consist of the construction of an 1,100 square foot enclosure on the platform between the tracks on the upper level. This is needed to provide environmental protection for Centaur stage and spacecraft launch support equipment. In addition, lighting, power outlets, grounding of equipment and air conditioning for the AGE area will be provided.

Guidance Optical Alignment Shelter (GOAS)

A concrete block shelter will be provided to house the Centaur Azimuth Alignment Theodolite, its air conditioning and support equipment.

Facility Electric Power

A 2,500 KVA substation will be provided to supply power for the new loads which are added at Launch Complex 41 for Centaur stage and spacecraft related support equipment.

Vehicle/Spacecraft Air Conditioning System

The air conditioning system shelter will be extended to house additional air conditioning equipment necessary to accommodate the Centaur stage and spacecraft prelaunch environmental requirements.

Liquid Hydrogen System

A 28,000 gallon LH_2 storage tank including roads, barricades, supporting structures, piping and control equipment will be provided.

Liquid Oxygen System

A 13,000 gallon Liquid Oxygen (LOX) storage tank, also roads, lighting, barricades, supporting structures and systems, piping and control equipment will be provided.

Gaseous/Liquid Nitrogen System

High pressure storage vessels (2,400 psig and 5,500 psig Gaseous Nitrogen (GN_2) and 28,000 gallons Liquid Nitrogen (LN_2)) including liquid to gas converters and all supporting structures, access roads, piping and control equipment will be provided.

Gaseous/Liquid Helium

The area for gaseous helium storage vessels will be enlarged to provide for new 5,500 psig vessels, compressors, mobile gaseous and liquid trailer parking areas. Access roads, supporting structures, piping and control equipment will also be provided.

Vertical Integration Building

One of the four bays of the Vertical Integration Building (VIB) will be modified to accept the Titan Centaur vehicle. This will involve the installation of new platforms and modifications to existing platforms to allow access to the Centaur stage, the addition of new gas systems and electrical equipment to service and check out the Centaur stage in the VIB.

Solid Motor Assembly Building (SMAB)

Provide for van tie-down anchors, power and grounding.

Transporters and Vans

The Titan Centaur program will require two complete transporters and van sets. The transporter consists of a rail-mounted launch platform and permanently attached umbilical mast, and is used with two vans, one for checkout equipment and one for instrumentation. One existing transporter and van set is available from the Air Force for NASA use but will require modification. The umbilical mast requires strengthening and the addition of Centaur stage umbilical retraction system. The existing vans require installation of new and modified equipment to permit checkout and control of the Titan Centaur vehicle.

The second transporter and van set configured to Titan Centaur specifications will be procured.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Site Preparation	LS	---	---	$154,000
Construction				1,433,000
Mobile service tower and umbilical tower	LS	---	---	460,000
Aerospace equipment enclosure modification	SF	1,100	$60.00	66,000
Guidance optical alignment shelter	LS	---	---	165,000
Facility electrical power	LS	---	---	95,000
Vehicle/spacecraft air conditioning shelter	LS	---	---	90,000
Liquid hydrogen system	LS	---	---	88,000
Liquid oxygen system	LS	---	---	80,000
Gaseous/liquid nitrogen system	LS	---	---	65,000
Gaseous/liquid helium	LS	---	---	66,000
Vertical integration building modifications	LS	---	---	238,000
Solid motor assembly building modifications	LS	---	---	20,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment				$9,113,000
Gaseous/liquid nitrogen system	LS	---	---	178,000
Gaseous helium system	LS	---	---	36,000
Air conditioning	LS	---	---	121,000
Modify launch control and instrumentation van	LS	---	---	1,825,000
Modify existing transporter	LS	---	---	668,000
New vans	LS	---	---	3,600,000
New transporter	LS	---	---	2,685,000
Fallout Shelter (Not Feasible)	---	---	---	---
		TOTAL		$10,700,000

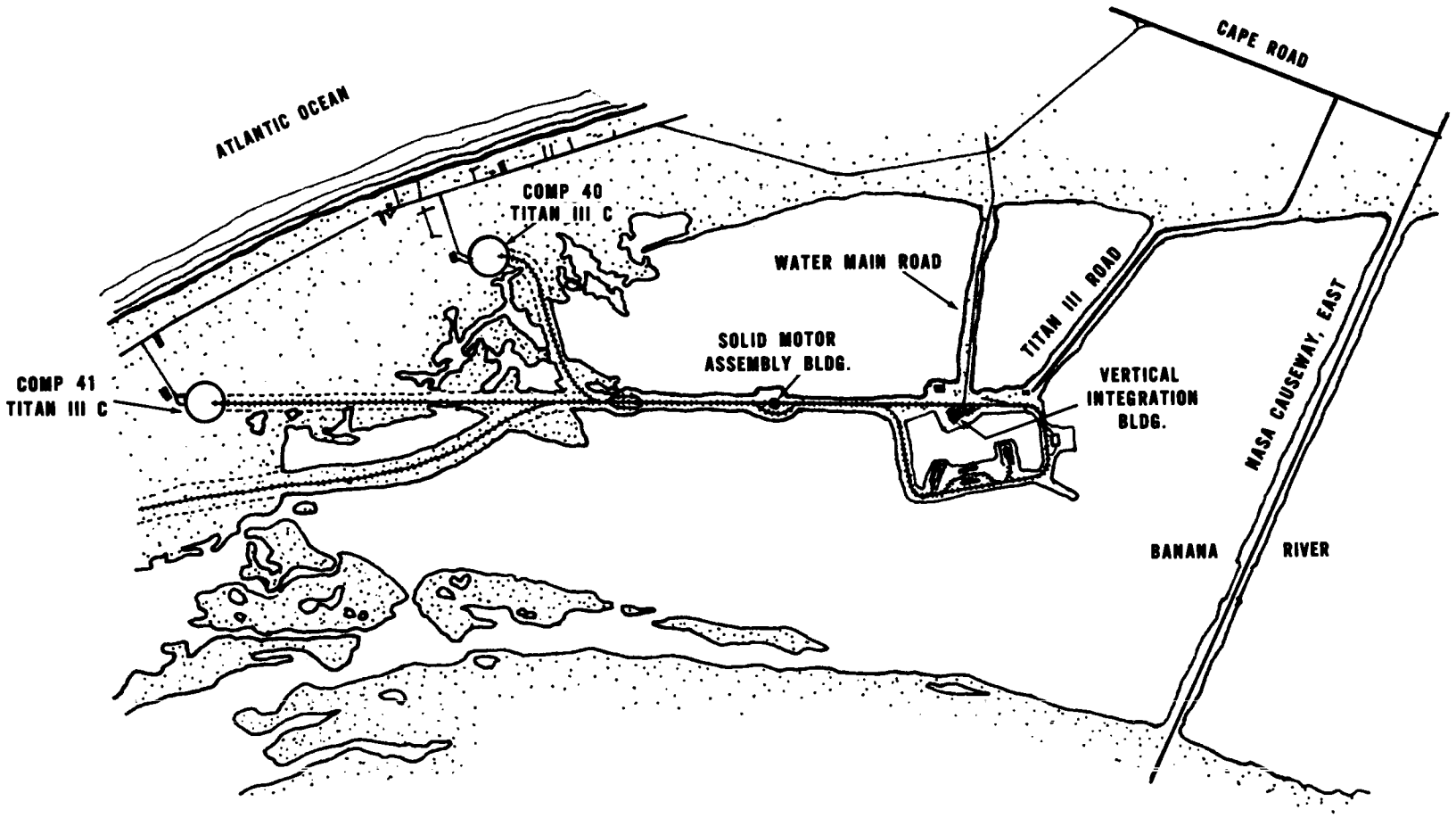
Associated equipment is being developed with the R&D Titan Centaur program because of the integral relationship of launch complex ground support equipment with the flight vehicle. Approximately $26.5 million in R&D funds are budgeted for in FY 1969 through FY 1974 for major Titan Centaur related equipment necessary to make this complex operational. In addition, slightly over $6 million surplus Government property will be installed under this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

This project will complete the modification for the presently planned Titan Centaur program; future requirements will be dependent upon future launch vehicle configurations and spacecraft unique prelaunch checkout requirements.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES

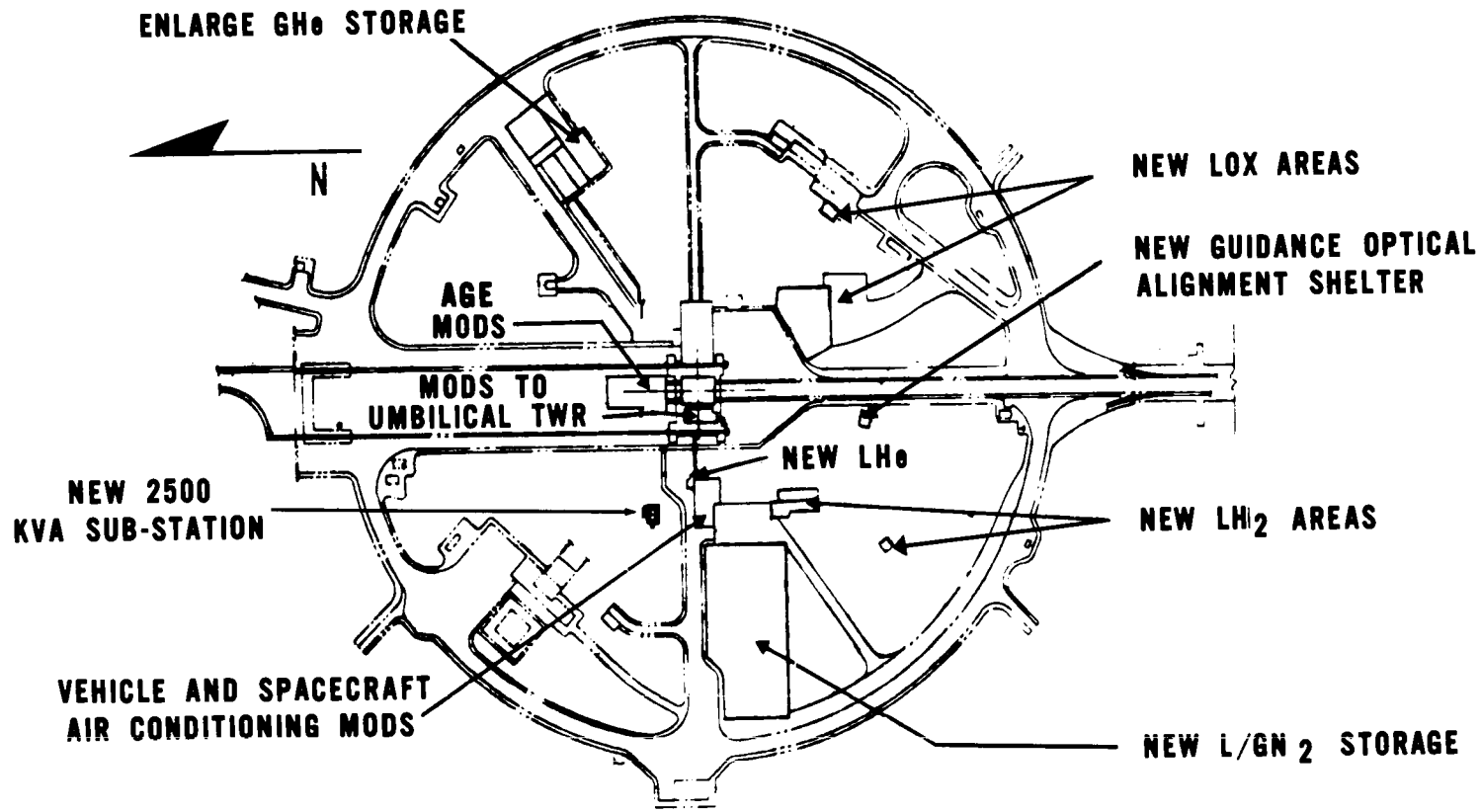
CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



SITE PLAN FOR TITAN III LAUNCH AREA

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES

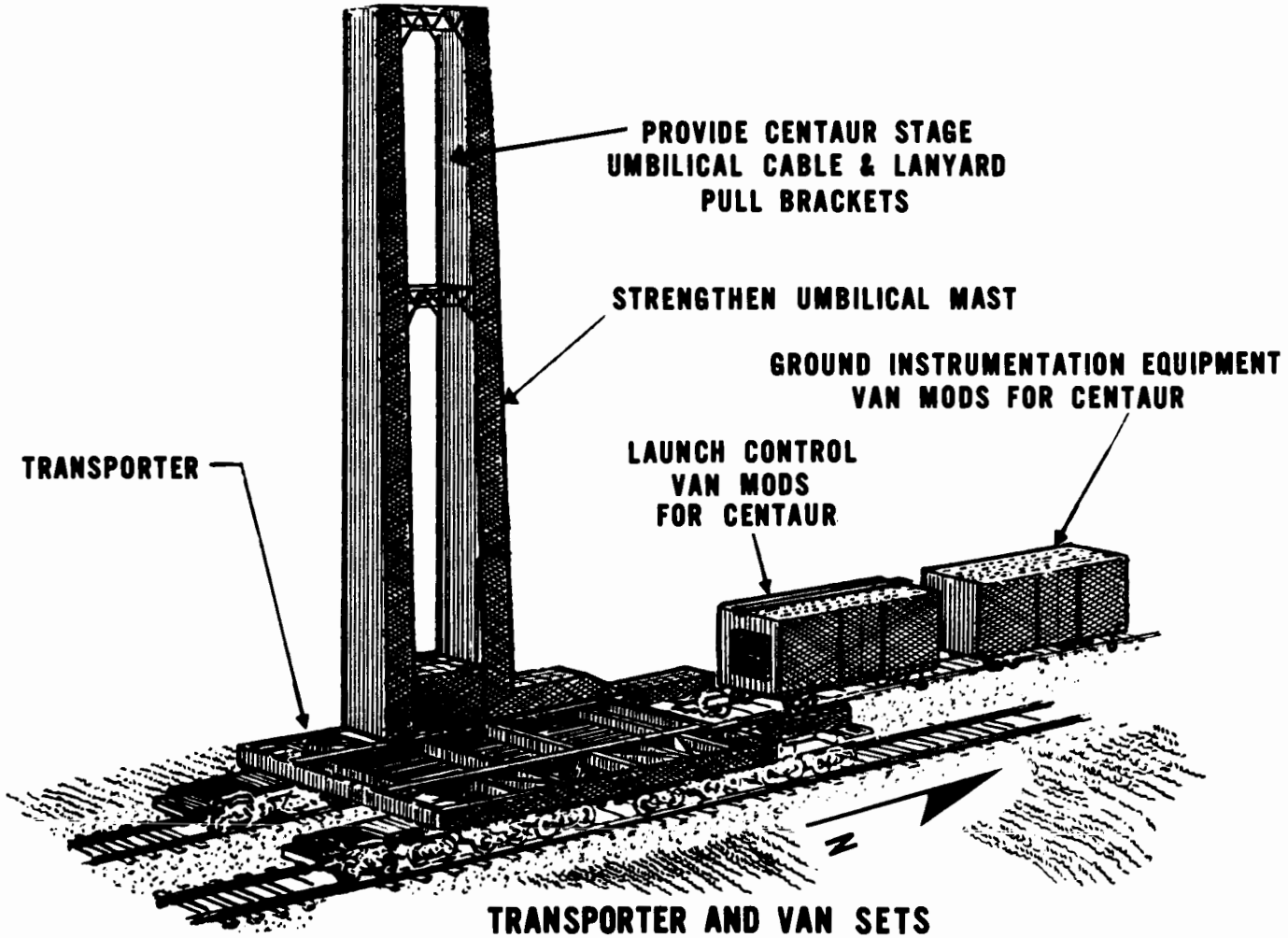
CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



SITE PLAN FOR COMPLEX 41

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES

CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA

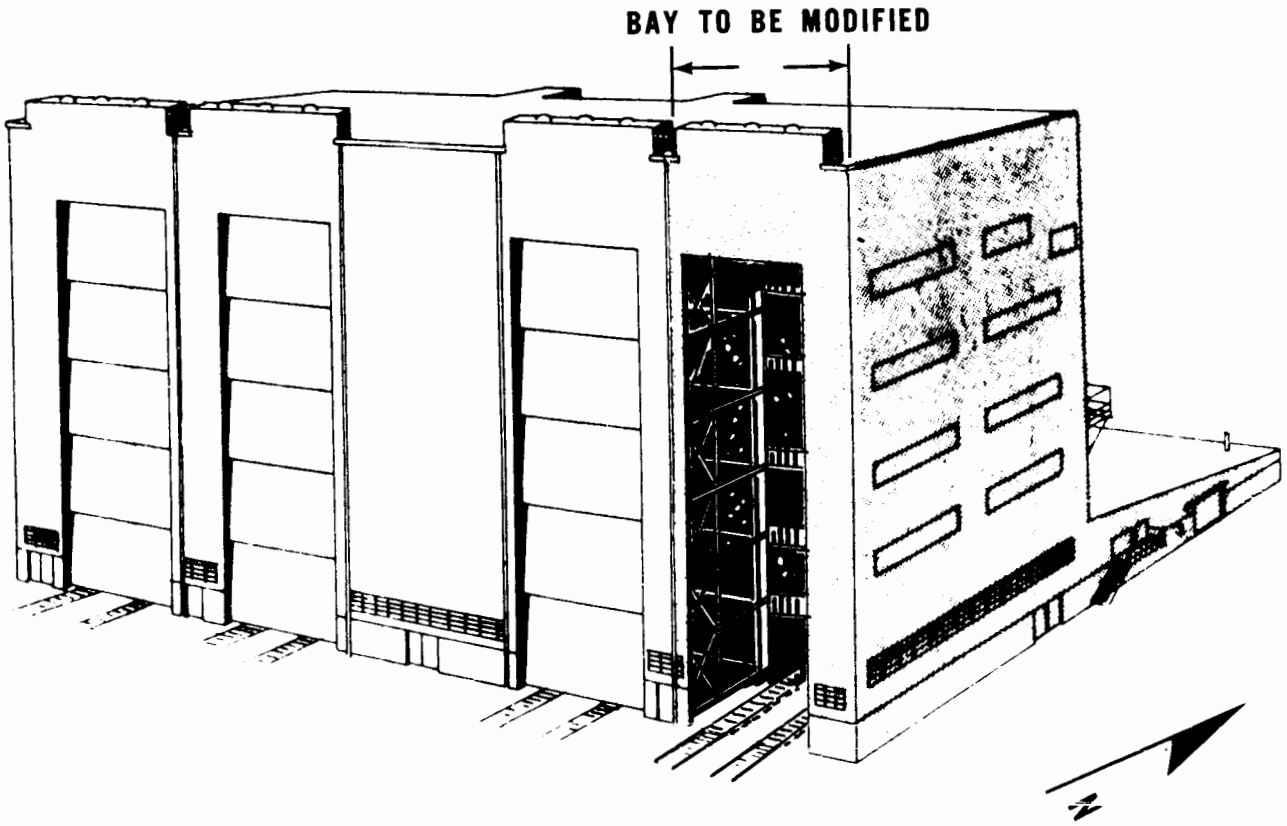


TRANSPORTER AND VAN SETS

MODIFICATION OF AIR FORCE SET (Shown) AND PROVISION OF NEW SET

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES

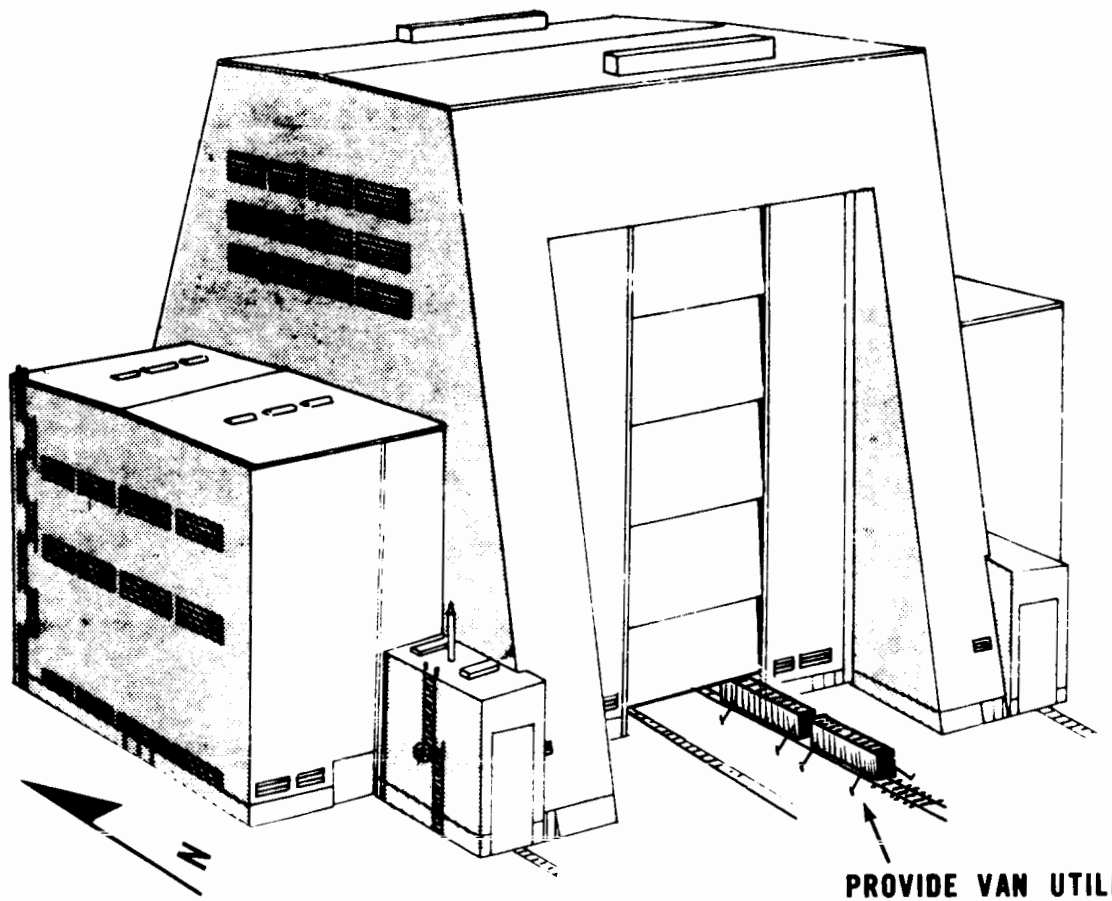
CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



VERTICAL INTEGRATION BUILDING

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES

CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



PROVIDE VAN UTILITIES AND ANCHORS

SOLID MOTOR ASSEMBLY BUILDING

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center	
PROJECT TITLE: Alterations to Launch Complex 17	
FY 1972 CoF ESTIMATE:	$4,500,000

COGNIZANT INSTALLATION: John F. Kennedy Space Center

LOCATION OF PROJECT: Cape Kennedy Air Force Station, Brevard County, Florida

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$808,919
Construction	7,377,063
Total FY 1971 and Prior Years	$8,185,982

SUMMARY PURPOSE AND SCOPE:

Launch Complex 17 consists of two launch pads (A and B), a blockhouse, a ready room and other associated facilities. It is the east coast facility used to check out, service and launch the Delta Space vehicle (There is one west coast complex located at the Western Test Range, Vandenberg Air Force Base, California, used for polar orbit missions which cannot be launched from the east coast due to range safety constraints). Each pad consists of three major interrelated structures: a mobile service structure, a fixed umbilical tower, and a launch stand.

This project provides alterations to the mobile service structure umbilical tower and launch stand on Launch Pad 17A to support the Delta Universal Boat-Tail, the Delta Inertial Guidance System, and the improved Delta vehicle. In addition, the project proposes to enlarge and upgrade the clean room capability of the Pad 17A service structure to permit launching of

future spacecraft utilizing larger fairings, and provide for potential booster growth. The inadequate fifteen-year old launch vehicle air conditioning units on each pad will be replaced with modern equipment.

PROJECT JUSTIFICATION:

A continuation of the two pad capability, maintained during the past decade, is necessary to support the Delta vehicle ETR launch schedule. The launches include NASA missions as well as several international cooperative missions for scientific investigation and communication including communication satellites for NATO, Italy and Canada and scientific satellites for the European Space Research Organization.

The alterations will provide the capability to launch improved Delta vehicles in the Multiple Solid Vehicle configuration, a 10-foot diameter 27-foot long spacecraft fairing and the Delta Inertial Guidance System (DIGS). The adjoining LC 17B pad has been modified to accept the multiple solids, the modified Delta vehicle, and DIGS configuration to meet mission requirements starting in early CY 1972.

Implementation of the alterations to Launch Pad 17A will result in improved on-pad spacecraft checkout capability, reliability, growth potential, lightning protection, spacecraft environmental control, and personnel safety. It will reduce recurring launch vehicle cost since the DIGS will replace the more complex existing system. In addition, increased pad flexibility will be afforded the many Delta users.

The enlarged and upgraded service structure clean room capability will specifically support the cleanliness requirement of future scientific spacecraft such as the OSO (Orbiting Solar Observatory), to match the manufacturing and assembly environment.

PROJECT DESCRIPTION:

This project provides the following alterations and additions:

Mobile Service Structure

Revise work platform openings and reposition platforms in lower areas. Install solid rocket motor cradles and actuator. Install new solid motor handling hoist system. Modify platform lifting system. Modify weather curtains, stairs, handrails, and utilities. Reinforce the structure to take the added weight of the larger clean room, and rework the main vertical cross truss to provide for the increased size of the clean room work area. Install lightning protection and an aircraft warning system.

Umbilical Tower

Provide a protective wall to shield the umbilical structure and support equipment from vehicle exhaust. To accomplish this will require reworking of certain utilities, swing arms and catwalks on two sides of the umbilical tower. Reinforce the total structure as required, to support the added dead load and increased sail area generated by the protective wall.

Launch Deck

Install new reinforced deck plates and auxiliary deflectors, rework the deck support girders to frame the larger openings and revised launch mount, install new fire protective coatings on deflectors, and provide for protection of utilities from exhaust flame.

Service Structure Clean Room

Construct a larger and upgraded air conditioned service structure clean room approximately 20' x 40' and 40' high. Provide sliding roof hatch and swinging door arrangement for passing spacecraft fairings during launch preparations. Alter jib crane as required and install a new three ton bridge crane for equipment and fairing manipulation.

Theodolite and Prism Station

Construct a concrete structure to house a theodolite station and two concrete shelters at specified points on the complex to house reflecting prisms.

Air-Conditioning Systems for LC 17A and B

To meet increased environmental requirements, replace at each pad the existing vehicle 44 ton air conditioning system with 75 ton units and existing clean room air-conditioning system with 100 ton units. Modify duct work to accommodate increased air quantity flow. House new equipment for protection from the elements.

Equipment Additions and Modifications

Reroute and provide new valving and controls for the first stage propellant lines, provide purge and pneumatics systems, modify the existing control systems and propellant loading consoles located in the blockhouse and provide two new blockhouse guidance and telemetry consoles, provide connecting cable between the blockhouse and pad; provide pad terminal boxes and racks; provide the DIGS and the solid motor alignment equipment.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$2,500,000
Mobile service structure	LS	---	---	880,000
Umbilical tower	LS	---	---	220,000
Launch deck	LS	---	---	330,000
Service structure clean room	LS	---	---	800,000
Theodolite and prism stations	LS	---	---	60,000
Air conditioning modifications	LS	---	---	210,000
Equipment				2,000,000
First stage fuel and LOX transfer piping and pneumatic system modifications	LS	---	---	450,000
First stage propellant and launch control console modifications	LS	---	---	520,000
Second stage control console modifications	LS	---	---	130,000
Guidance system control and monitoring console	LS	---	---	500,000
Azimuth measuring and collimation equipment	LS	---	---	250,000
Solid motor alignment system	LS	---	---	150,000
Fallout Shelter (Not Feasible)	---	---	---	---
		TOTAL		$4,500,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

Future year funding estimates are dependent on future vehicle and spacecraft configurations and requirements.

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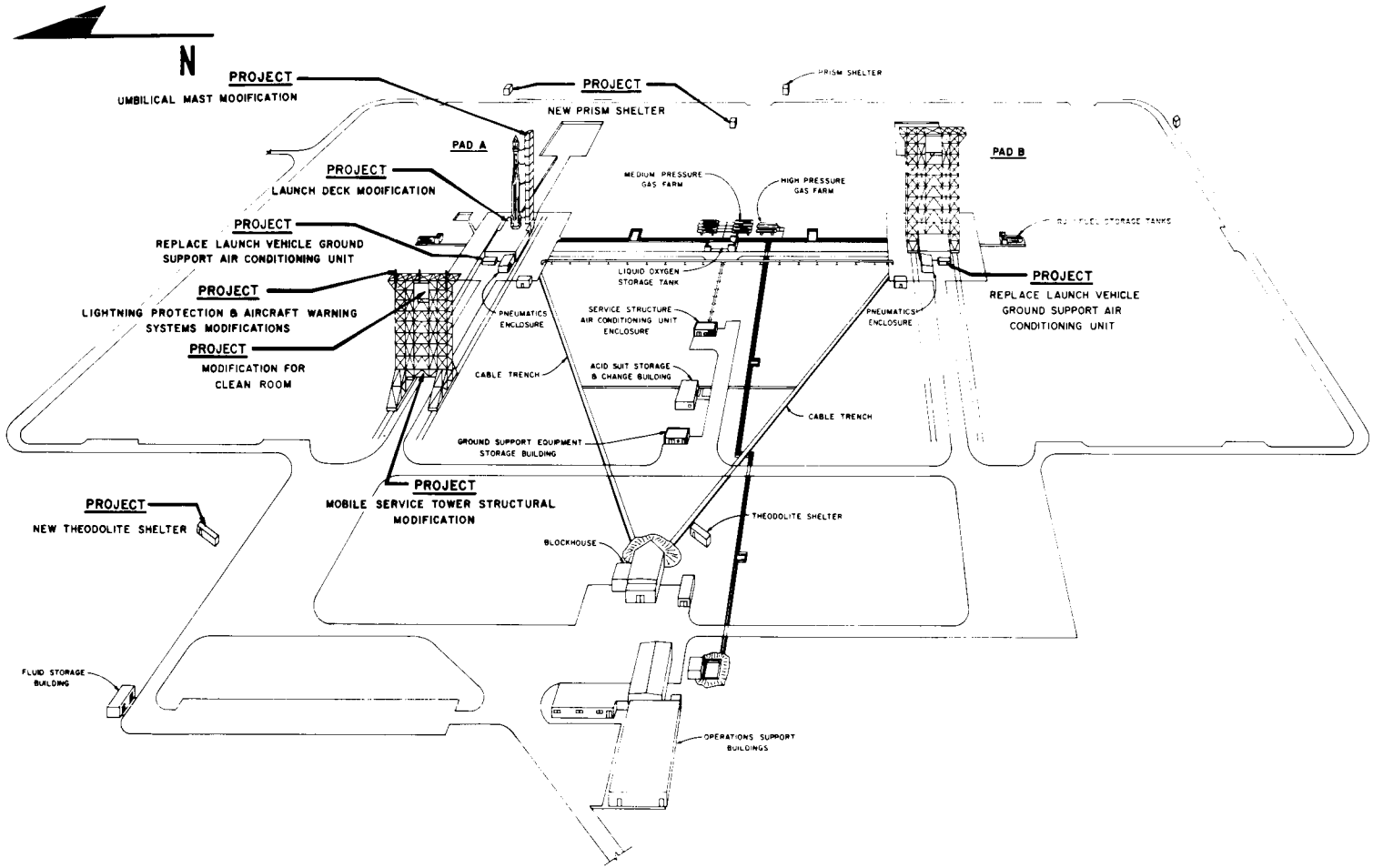
JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1972 ESTIMATES
ALTERATIONS TO LAUNCH COMPLEX 17



PERSPECTIVE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

VARIOUS LOCATIONS

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Office of Organization and Management Project:	
Rehabilitation and modification of facilities	CF 3-2
Office of Manned Space Flight Project:	
Space Shuttle Facilities	CF 3-8
Office of Tracking and Data Acquisition Projects:	
Power plant replacements	CF 3-16
Relocation of ATS transportable ground station	CF 3-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 72 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Various Locations		Various
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Not Applicable	Not Applicable	Not Applicable

INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1972 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Rehabilitation and Modification of Facilities	O&M	23,017	10,000		33,017
Space Shuttle Facilities	(OMSF (OART	630	20,000	10,000	30,630
Power Plant Replacements	OTDA	54	600	-0-	654
Relocation of ATS Transportable Ground Station	OTDA	60	500	-0-	560
TOTAL			31,100		

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Various Locations	
PROJECT TITLE: Rehabilitation and Modification of Facilities	
	FY 1972 CoF ESTIMATE: $ 10,000,000

COGNIZANT INSTALLATION: Various Locations

LOCATION OF PROJECT: Various Locations

COGNIZANT PROGRAM OFFICE: Office of Organization and Management

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$2,092,320
Construction	20,925,000
Total FY 1971 and Prior Years	$23,017,320

SUMMARY PURPOSE AND SCOPE:

To provide for major rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants engaged in NASA activities. The purpose of this program is to protect, preserve, and improve the general capability and usefulness of these facilities, and to insure the continued safe, economical, and efficient use of NASA's physical plant. Also included are items necessary to provide for the correction of conditions contributing to the pollution of air and water at NASA field installations and Government-owned industrial plants engaged in NASA activities, and to comply with Federal, State, and local requirements for the prevention, control, and abatement of pollution.

PROJECT JUSTIFICATION:

The NASA physical plant at initial cost totals about $5.0 billion--current replacement value is estimated at about $7.5 billion. It is composed of two major segments. The first and oldest consists of the research centers and industrial plants which are now, in many cases, over 25 years old. The second segment is composed of facilities acquired more recently to support the Manned Space Flight program. Both segments of the plant have been exposed to hard and continued usage and particularly the older segment has

experienced a long history of changing utilization and adaptation. Rehabilitation and modification of these facilities is required as a continuing program. This is necessary to: (1) protect the capital investment represented by these facilities; (2) insure their continued and reliable operation; (3) improve their capability and usefulness to NASA mission accomplishment; (4) provide a safer environment for personnel; and (5) to overcome the cumulative effects of wear, deterioration, and obsolescence.

Only major rehabilitation and modification of facilities type work is included. They are of the magnitude that they cannot be accomplished by day-to-day maintenance or by minor repair efforts. Routine maintenance, major additions, new construction, and projects which qualify as special or specific program requirements are excluded.

A portion of this project will implement the required action to comply with the Executive Order No. 11507 signed by the President on February 4, 1970, entitled "Prevention, Control, and Abatement of Air and Water Pollution at Federal Facilities." Section 5(a) of this order requires that air and water pollution projects at existing federal facilities are to be completed or under way no later than December 31, 1972. The NASA plan to provide for the necessary corrective and preventive measures, as identified in this project, has been presented to the Office of Management and Budget as required by E.O. 11507 under Section 5(b).

PROJECT DESCRIPTION:

Items of work proposed to be accomplished within this program are outlined under "Project Cost Estimate" and total $7.0 million. These represent items considered to be of the highest priority at this time. They have been carefully selected from a list totalling about $35 million, on the basis of relative urgency and expected return on the investment involved. It is recognized, however, that during the course of the year some rearrangement of priorities may be necessary and possibly a change in some of the items to be accomplished within allocated funds may be required.

Included items for the prevention, control and abatement of pollution, proposed to be accomplished within this program are outlined in the Project Cost Estimate and total $3.0 million. This is the residual of an initially evolved program of $4.0 million. These represent items considered to be of the highest priority and have been carefully surveyed and screened at each installation as work required for full compliance with existing or proposed standards established by the regulatory agencies. The proposed items are directly related to air and water treatment and controls.

PROJECT COST ESTIMATE:

Rehabilitation and Modification - General

I. OFFICE OF MANNED SPACE FLIGHT	$1,085,000
A. Kennedy Space Center	300,000
(1) Modification of fire protection systems	300,000
B. Manned Spacecraft Center	535,000
(1) Modification of water distribution system	255,000
(2) Modification of fire protection systems	280,000
C. Various Locations	250,000
(1) Rehabilitation and modification of industrial plants	250,000
II. OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY	1,907,000
A. Ames Research Center	250,000
(1) Rehabilitation of unitary wind tunnel	250,000
B. Flight Research Center	300,000
(1) Rehabilitation of utilities systems	300,000
C. Langley Research Center	575,000
(1) Rehabilitation of air conditioning systems (west area)	325,000
(2) Rehabilitation of Roofs	250,000
D. Lewis Research Center	432,000
(1) Rehabilitation of administration building, space power chambers, and solar power laboratory	432,000
E. Plumbrook Station	350,000
(1) Rehabilitation of electrical distribution and fire alarm/detection systems	350,000

III.	OFFICE OF SPACE SCIENCE AND APPLICATIONS	$1,435,000
	A. Goddard Space Flight Center	395,000
	(1) Modification of fire protection systems	395,000
	B. Wallops Station	790,000
	(1) Building fire protection systems	350,000
	(2) Rehabilitation of runway and taxiway	440,000
	C. Jet Propulsion Laboratory	250,000
	(1) Rehabilitation of procurement offices and the development laboratory	250,000
IV.	OFFICE OF TRACKING AND DATA ACQUISITION	2,573,000
	A. Various Locations	2,573,000
	(1) Modification of electrical utilities systems (8 locations)	690,000
	(2) Rehabilitation of communications duct system, Hawaii	360,000
	(3) Rehabilitation of air conditioning systems (5 locations)	280,000
	(4) Modification of fire protection/safety systems	1,243,000
	(a) Space Tracking and Data Acquisition Network	(438,000)
	(b) Manned Space Flight Network	(585,000)
	(c) Deep Space Network	(220,000)
	Subtotal (rehabilitation and modification - general)	$7,000,000

Rehabilitation and Modification - Pollution

1.	OFFICE OF MANNED SPACE FLIGHT	$1,418,000
	A. Kennedy Space Center	290,000
	(1) Modification of water pollution control facilities (water)	200,000
	(2) Replacement of treatment facilities (water)	28,000
	(3) Modification of waste disposal system at the GSA motor pool (water)	9,000
	(4) Modification of propellant treatment facilities services components laboratory (water)	20,000

(5) Modification of treatment facilities - LC 39 converter compressor facility (water)	$19,000
(6) Modification of treatment facilities for "S" band facility (water)	14,000
B. Marshall Space Flight Center	494,000
(1) Modification of waste sewer system (water)	292,000
(2) Modification of pollution control facilities (air)	202,000
C. Manned Spacecraft Center	634,000
(1) Tertiary treatment facilities (water)	200,000
(2) Pollution controls for boilers and cooling tower blowdowns (water)	284,000
(3) Exhaust gas treatment, atmospheric reentry and structural evaluation facility (air)	150,000
II. OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY	1,374,000
A. Lewis Research Center	987,000
(1) Fuel oil storage tank for converting to fuel oil (air)	150,000
(2) Improvements to storage and disposal control areas (air)	147,000
(3) Exhaust stacks emission controls (air)	400,000
(4) Instrumentation and equipment for existing laboratory pollution controls (air)	60,000
(5) Modification of research laboratories exhaust system (air)	150,000
(6) Modification of industrial waste retention basins (water)	80,000
B. Plumbrook Station	120,000
(1) Installation of incinerator (air)	120,000
C. Ames Research Center	267,000
(1) Collection and control of nitrogen oxide and carbon monoxide (air)	250,000
(2) Carpenter shop-collection system (air)	17,000

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III.	OFFICE OF SPACE SCIENCE AND APPLICATIONS	$105,000
	A. Jet Propulsion Laboratory	105,000
	(1) Installation of air pollution control facilities at Edwards (air)	100,000
	(2) Perimeter air sampling for high temperature storage magazine (air)	5,000
IV.	OFFICE OF TRACKING AND DATA ACQUISITION	103,000
	A. Mojave Tracking Station	103,000
	(1) Modification of existing treatment plant (water)	103,000
	Subtotal (rehabilitation and modification - pollution)	$3,000,000
	TOTAL	$10,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is estimated that between $10,000,000 and $15,000,000 per year will be required for the continuation of this rehabilitation and modification program.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Various Locations	
PROJECT TITLE: Space Shuttle Facilities	
	FY 1972 CoF ESTIMATE: $20,000,000

COGNIZANT INSTALLATION: Various Locations

LOCATION OF PROJECT: Various Locations

COGNIZANT PROGRAM OFFICES: Office of Manned Space Flight
Office of Advanced Research and Technology

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$630,000
Construction	-0-
Total FY 1971 and Prior Years	$630,000

SUMMARY PURPOSE AND SCOPE:

The purpose of this project is to modify and upgrade existing Government-owned facilities that are required for engine development and for early technology development in support of the space shuttle program. The included test facilities are required for research, development, evaluation and qualification of key elements of the total program as follows: engines, auxiliary propulsion systems and thermal protection systems.

PROJECT JUSTIFICATION:

General - A primary objective of the space shuttle program is a significant reduction in the cost of future space transportation. The program includes space shuttle vehicles that will employ a vertical take-off and horizontal landing. The space shuttle will consist of a rocket-powered, two-element vehicle consisting of an orbiter and booster. The operational mode will be a vertical launch system with the booster accelerating the orbital stage to the outer fringe of the earth's atmosphere where separation will occur. The

orbiter element will proceed to orbit, powered by its own rocket engines, to deliver its payload and perform its assigned mission. After reentry, the orbiter will return to earth for a horizontal landing. The space shuttle is to provide a highly flexible payload capability to support a variety of space applications, including an airline type environment for passenger transport. The success of the space shuttle type vehicle system is to a large extent dependent on achieving very high efficiencies in the associated propulsion and the thermal protection systems.

Engines - The development of a reusable high pressure throttleable liquid oxygen/liquid hydrogen rocket engine to be used in both the booster and the orbiter is a "pacing item" in the program. This engine will not be a modification of any previously developed liquid oxygen/liquid hydrogen engine. It will represent a new design and will be based on newly developed technology concepts. The thrust of each main engine will be in the range of about 550,000 pounds. The total number of engine firings, the average duration per firing, the number of firings estimated per month, and the number of engines to be used in the development program requires that a minimum of two sea level and one altitude test positions be available for testing the space shuttle main engines. These test positions will be provided by modifying existing government-owned test facilities.

In addition to these space shuttle main engine test facilities, there is a requirement to modify existing test facilities to support the development of auxiliary propulsion and the orbital maneuvering systems which are essential to the space shuttle orbiter operations. These engines will be in the 1,000 to 10,000 pound thrust range.

The locations of the engine test facilities must currently be identified as "Various Locations". The selected sites will be dependent, among other factors, upon their adequacy, economy of facility alterations and overall operations.

Thermal Protection System - The most demanding problem in the evolution of a space shuttle system is expected to be the development of an airframe structure in conjunction with the necessary thermal protective systems which will involve materials which must be light weight and extensively reusable. The space shuttle vehicle will incorporate a number of different thermal protection elements, including ablators, metallic reradiative panels, surface insulation and hot structure.

To support the development of the thermal protection systems program, modification to existing research and testing facilities totalling $5.5 million is required. The modification of these existing ground facilities will provide the capability to test large test samples of prototype thermal protection systems.

PROJECT DESCRIPTION:

This project provides for necessary alterations to existing test and research facilities required for the engine and technology development in support of the space shuttle program. The purpose, description and cost estimate for each subproject follows:

MAIN ENGINE TEST FACILITIES

SUMMARY PURPOSE AND SCOPE:

To modify and upgrade existing test facilities for shuttle engine system testing. Two sea level test stands and procurement of long-lead items for one altitude simulation test facility will be provided.

JUSTIFICATION:

The space shuttle planning is based upon achieving operational capability in the late 1970's. The intervening period will require the development of a suitable vehicle which will require a minimum of refurbishment, have a short ground turn-around capability, and be designed to operate at low levels of acceleration during launch and reentry. A key element in the development is a new high pressure, throttleable LOX-LH_2 rocket engine which will be used in both the booster and the orbiter. The orbiter engine will have a translatable skirt to provide a higher expansion ratio in the space environment.

Preliminary evaluations of the total number of engine firings, the average duration per firing, the number of firings estimated per month, and the number of engines to be used in the development program, requires a minimum of two sea level and one altitude test positions.

Planning is based upon utilizing facilities at existing government-owned sites which have the capability of being modified for testing the shuttle engines. Preliminary engineering and evaluation studies are being made at sites throughout the United States. The cost estimates reflect a requirement of $11 million for two sea level test positions. The cost estimate for the altitude test position is approximately $9.0 million; however, only $2 million is required in this fiscal year for the procurement of long-lead items, such as on-line data processing and control equipment, and liquid oxygen and a hydrogen run tank.

The activation of these test facilities will take place over a two-to-three year period. The sea level positions should be operational by January 1973 and the altitude position by July 1974. Current engine development planning requires activation of the sea level position as indicated in order to obtain adequate development testing prior to committing booster engines to fabrication for delivery beginning in March 1974. The altitude test facility is

required by July 1974 to assure adequate altitude testing prior to the start of fabrication of the first orbiter flight engines. Start of this fabrication is scheduled to start about 12 months prior to scheduled delivery in October 1975. This testing is needed so that any change in design may be known prior to the start of fabrication. The FY 1972 budget provides for construction of the two sea level stands and initiation of long-lead procurement for the altitude test facility. The remaining modification required for the altitude facility will be programmed in the FY 1973 budget.

DESCRIPTION:

This project provides for the procurement, modification, and activation of test facilities for testing the **space shuttle engine.** The engine test requirements will be met by two sea level (ambient) test stands and one altitude simulation test facility. The modifications will consist of structural changes, addition of LOX and LH_2 run tanks and storage tanks, new thrust measuring systems, and changes to the mechanical, electrical, control, instrumentation, propellants and pressurant systems. Modifications of the firex and deflector cooling water systems will be required. The altitude system will include an altitude simulation chamber, diffuser, steam ejectors and a steam supply system. The facilities will provide for vehicle suction duct dynamics and launch acceleration simulator.

PROJECT COST ESTIMATE:

Engine Test Facilities

1.	Sea Level Testing Capability (two test positions)	$11,000,000
	a. Structure and material handling systems	2,150,000
	b. Mechanical systems	7,150,000
	c. Electrical systems	600,000
	d. Instrumentation systems	1,100,000
2.	Altitude Testing Capability (one test position - long-lead procurement)	2,000,000
	a. Liquid oxygen/hydrogen run tanks	500,000
	b. Processing and control equipment	1,500,000

AUXILIARY PROPULSION SYSTEM TEST FACILITIES

SUMMARY PURPOSE AND SCOPE:

To modify and upgrade existing test facilities to support the development of the auxiliary propulsion system (APS) and the orbital maneuvering system (OMS) for the space shuttle.

JUSTIFICATION:

The auxiliary propulsion system and orbital maneuvering system must be developed concurrently with the development of the main space shuttle engine as it is envisioned that a common fuel supply will be utilized in the shuttle vehicle. The development and final design of flight hardware and other subsystems cannot begin until the final propulsion systems have been selected.

To support the development of the auxiliary propulsion system, it is necessary to provide a capability for testing up to 2,000 pound thrust gaseous hydrogen/oxygen engines and components under both altitude and sea level conditions. Test facilities to support testing of up to 10,000 pound thrust liquid hydrogen/oxygen engines and related flight systems under altitude conditions are additionally required for the development of the orbital maneuvering system.

Testing will be required at the component level to ascertain characteristics of propellant conditioning, flow control, ignition, pulse operation, thermal balance, and thruster performance. Breadboard systems composed of thrusters, gas generators, heat exchangers, accumulators, turbopumps, valves, regulators, and controls will be tested in this facility to determine system dynamics. Following the component and breadboard development testing, integrated APS and OMS testing will include systems performance definition as well as duty and life cycle demonstration tests.

The location of the propulsion test facilities are currently identified as Various Locations. Engineering studies are currently underway to determine the most desirable location. It is estimated that $1.5 million will be required, which will involve the maximum use of existing capability.

DESCRIPTION:

This project provides for the procurement, modification, and activation of test facilities for testing of auxiliary propulsion systems and orbital maneuvering system for the space shuttle. The modification will consist of structural changes, addition of LOX and LH_2 run tanks and storage tanks, gaseous oxygen and hydrogen storage, high pressure plumbing, and other changes to the mechanical, electrical, control, instrumentation, propellants and pressurant systems.

COST ESTIMATE:

1.	Structure and Material Handling Systems	$300,000
2.	Liquid and Gaseous Oxygen/Hydrogen Distribution Systems	900,000
3.	Instrumentation and Control Systems	300,000
	TOTAL	$1,500,000

THERMAL PROTECTION SYSTEMS

SUMMARY PURPOSE AND SCOPE:

To modify and upgrade existing government research facilities required for the research, development, evaluation and qualification of various thermal protection systems for the space shuttle vehicle.

JUSTIFICATION:

The development of an **airframe** structure in conjunction with thermal protective systems will be a most difficult problem. Aerodynamic heating as high as 2800°F is one of the primary technical challenges facing the development of the space shuttle. The technology research, development, evaluation and qualification of the thermal protection system are of such magnitude that the research capabilities of various centers must be utilized to concentrate on specialized problem areas and on alternate solutions.

Thermal protection system (TPS) technology efforts are currently in progress. Full-scale evaluation of the TPS, however, must begin in Fiscal Year 1972 to provide reasonable assurance of program success. To support the development of the thermal protection systems program, modification of existing research and test facilities totalling $5.5 million is required. The modification of these existing ground facilities must be started in FY 1972 to provide the capability to evaluate and screen large test samples of prototype thermal protection systems, which is scheduled to be started in FY 1973.

DESCRIPTION:

To support the development of a lightweight reliable TPS, it is necessary to modify existing research and development facilities to provide the necessary capability to evaluate specific problem areas under various unique space simulation conditions. This project provides for:

1. Ames Research Center, California - Interaction-Heating Shuttle Panel Test Facility will increase the existing 20 megawatt arc facility to 60 megawatts. A low subsonic arc heater and a hypersonic arc heater will also be provided. This upgrading will allow the generation of large scale hot flows for long durations as required to evaluate the effect of interaction heating over joints and discontinuities.

2. Ames Research Center, California - Combustion Facility Modification for Shuttle Thermal Protection Testing provides for modification to the combustion chamber and nozzle system of the existing gas-dynamic laser facility. A water-cooled test section with the capability of mounting 2 foot by 2 foot test panels will also be installed to permit the evaluation of various panel design concepts.

3. Langley Research Center, Virginia - Modification to the 9 by 6 foot Thermal Tunnel includes installing an air ejector pump and panel holder to conduct aeroelastic studies on full-scale TPS at realistic high speed environment.

4. Manned Spacecraft Center, Texas - Upgrading Atmospheric Reentry Materials and Structures Evaluation Facility includes installing a high pressure arc heater and variable pressure test position. The existing vacuum system will also be upgraded. This facility will be used for assessment of candidate thermal protection systems.

COST ESTIMATE:

1. Ames Research Center, California - Interaction-Heating Shuttle Panel Test Facility Modification	$3,000,000
a. Add 40 MW Power - Substation and Transformer	2,500,000
b. Arc Heaters - Low Subsonic and Hypersonic Flows	500,000
2. Ames Research Center, California - Combustion Facility Modification for Shuttle Thermal Protection Testing	800,000
a. Modify Combustion Chamber and Nozzle System	400,000
b. Test Section (Panel Holder)	300,000
c. Utilities - Pumps, Valves and Piping	100,000
3. Langley Research Center, Virginia - Modification to the 9 by 6 foot Thermal Tunnel	500,000
a. Air Ejector	200,000
b. Panel Holder	160,000
c. Utilities - Piping, Valves and Controls	140,000
4. Manned Spacecraft Center, Texas - Upgrade Atmospheric Reentry Materials and Structures Evaluation Facility	$1,200,000
a. High Pressure Arc Heater	155,000
b. Variable Pressure Test Position	305,000
c. Upgrade Vacuum System	740,000
TOTAL	$5,500,000

SUMMARY PROJECT COST ESTIMATE:

Main Engine Test Facilities	$13,000,000
Various - Main Engine Sea Level Test Stands (2 each)	11,000,000
Various - Altitude Test Stand (Long-lead procurement only)	2,000,000

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Auxiliary Propulsion System Test Facility Modification	1,500,000
Various - Auxiliary Propulsion System Test Facility	1,500,000
Thermal Protection Systems	5,500,000
1. Ames Research Center - Interaction-Heating Shuttle Panel Test Facility Modification	3,000,000
2. Ames Research Center - Combustion Facility Modification for Shuttle Thermal Protection Testing	800,000
3. Langley Research Center - Modification to the 9x6 foot Thermal Tunnel	500,000
4. Manned Spacecraft Center - Upgrade Atmospheric Reentry Materials and Structures Evaluation Facility	1,200,000
TOTAL	$20,000,000

FUTURE COF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

It is anticipated that between $7.0 to $10.0 million will be required for these projects in subsequent years. This includes about $7.0 million for the altitude test stand and some $3.0 million anticipated as possible needs for further modification to the other included facilities.

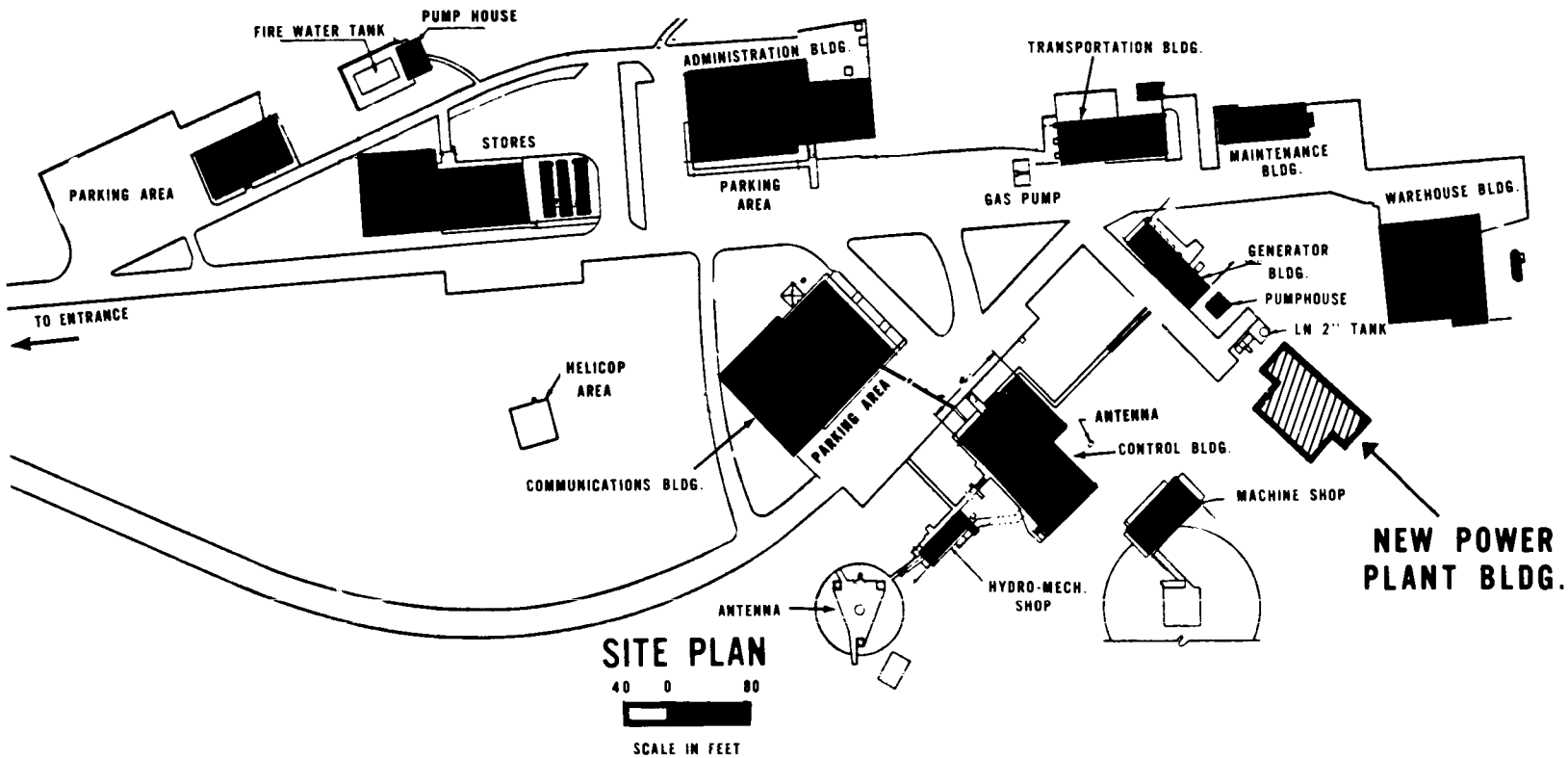
	Unit of Measure	Quantity	Unit Cost	Total Cost
B. Santiago, Chile				
Land Acquisition	---	---	---	---
Construction				$230,000
Power plant building	SF	5,000	$21.00	105,000
Mechanical distribution	LS	---	---	20,000
Electrical distribution*	LS	---	---	79,000
Utilities	LS	---	---	21,000
Site development	LS	---	---	5,000
*Includes relocation/installation of existing generators				
Equipment	---	---	---	---
Fallout Shelter (Not Feasible)	---	---	---	---
		Subtotal		$230,000
		TOTAL		$600,000

Existing government-owned engine generator sets (4-350 KW) (1-500 KW) and switch gear will be used at no cost to this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

VARIOUS LOCATIONS
FISCAL YEAR 1972 ESTIMATES
POWER PLANT REPLACEMENTS
GOLDSTONE (ECHO SITE), CALIFORNIA

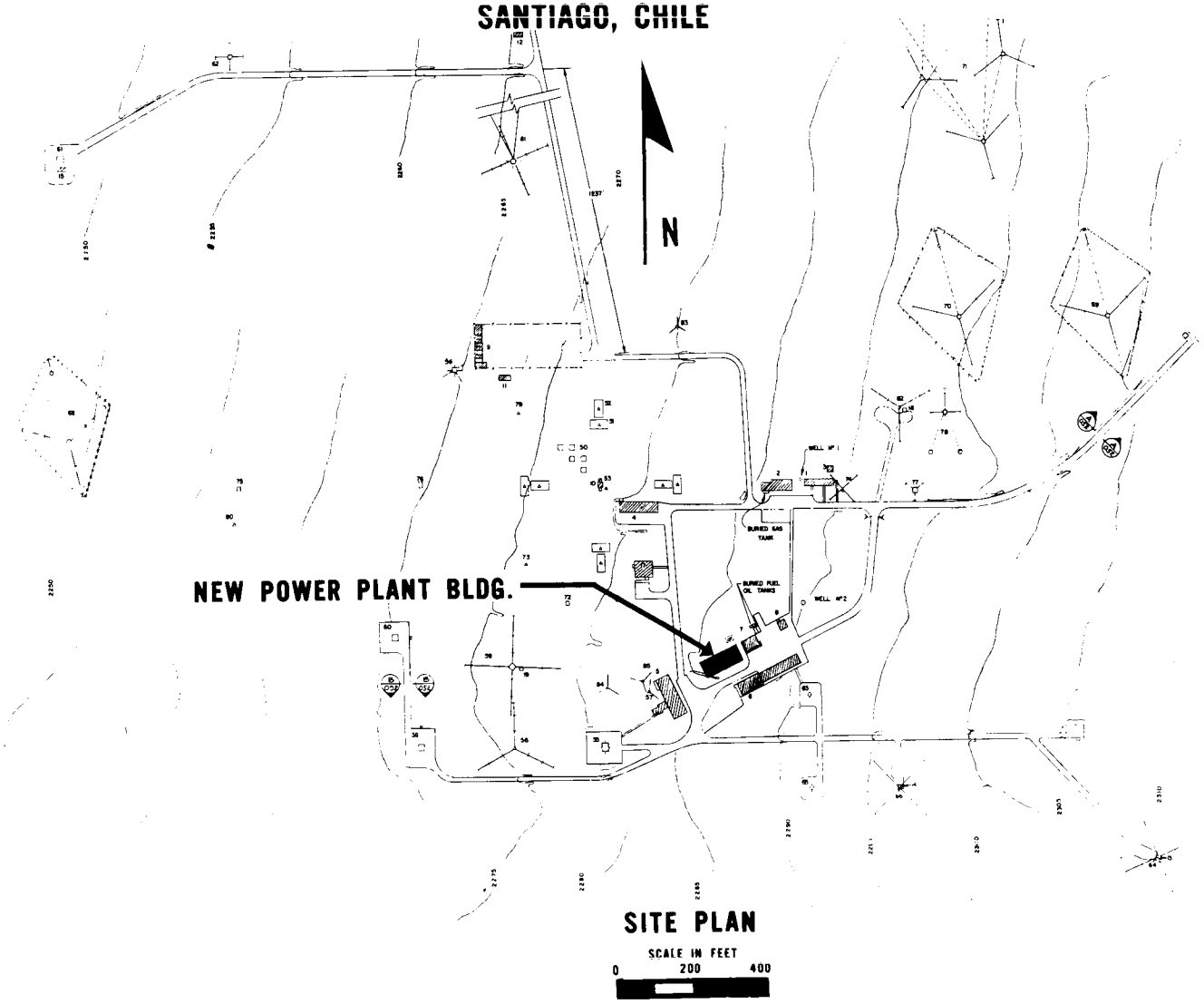


VARIOUS LOCATIONS

FISCAL YEAR 1972 ESTIMATES

POWER PLANT REPLACEMENTS

SANTIAGO, CHILE



AUTHORIZATION LINE ITEM: Various Locations

PROJECT TITLE: Relocation of ATS Transportable Ground Station

FY 1972 CoF ESTIMATE: $500,000

COGNIZANT INSTALLATION: Goddard Space Flight Center

LOCATION OF PROJECT: Europe

COGNIZANT PROGRAM OFFICE: Office of Tracking and Data Acquisition

FY 1971 AND PRIOR YEARS CoF FUNDING:

Planning and Design	$60,000
Construction	---
Total FY 1971 and Prior Years	$60,000

SUMMARY PURPOSE AND SCOPE:

This project will provide for the construction of concrete pads, foundations, and other supporting facilities to accommodate an existing transportable ground station for tracking and ground support of the Applications Technology Satellite (ATS F). Monitoring of the instructional television experiments, require that a site in Western Europe be established.

PROJECT JUSTIFICATION:

One of the missions of the ATS F satellite scheduled for launch in 1973 is the transmission of instructional television to India and Brazil. In order to implement this plan, a ground station is required within range of the satellite C-Band horn and with a favorable viewing angle to the spacecraft. These requirements can be met by relocating the ATS transportable station to Western Europe.

PROJECT DESCRIPTION:

The project provides for construction of supporting features to accommodate the ATS Transportable Ground Station. The existing transportable station (formerly located in Australia) is being modified at Goldstone, California

and will be relocated to the Western European area, affording a satisfactory viewing angle to the spacecraft.

Supporting features will include foundations for a 40 foot antenna, telemetry and command antennas, concrete pads for equipment and support vans, a utility building of 3,000 square foot gross area, site development, and access roads.

The utility building will primarily house government furnished diesel generators, switchgear, and auxiliaries for the site power generating system.

The site area will be paved with bituminous concrete while antenna foundations and van pads will be of reinforced concrete.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$500,000
Utility building	SF	3,000	$28.67	86,000
Mechanical distribution	LS	---	---	57,000
Electrical distribution*	LS	---	---	148,000
Antenna and van foundation pads	SY	1,050	9.52	10,000
Utilities	LS	---	---	17,000
Roads, walks, parking area	SY	15,000	5.53	83,000
Security fence	LF	3,166	7.90	25,000
Site development	LS	---	---	74,000
Equipment	---	---	---	---
Fallout Shelter (Not Feasible)	---	---	---	---
		TOTAL		$500,000

Existing government owned engine generator sets (2-250 KW) (2-200KW) and switch gear will be used at no cost to this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

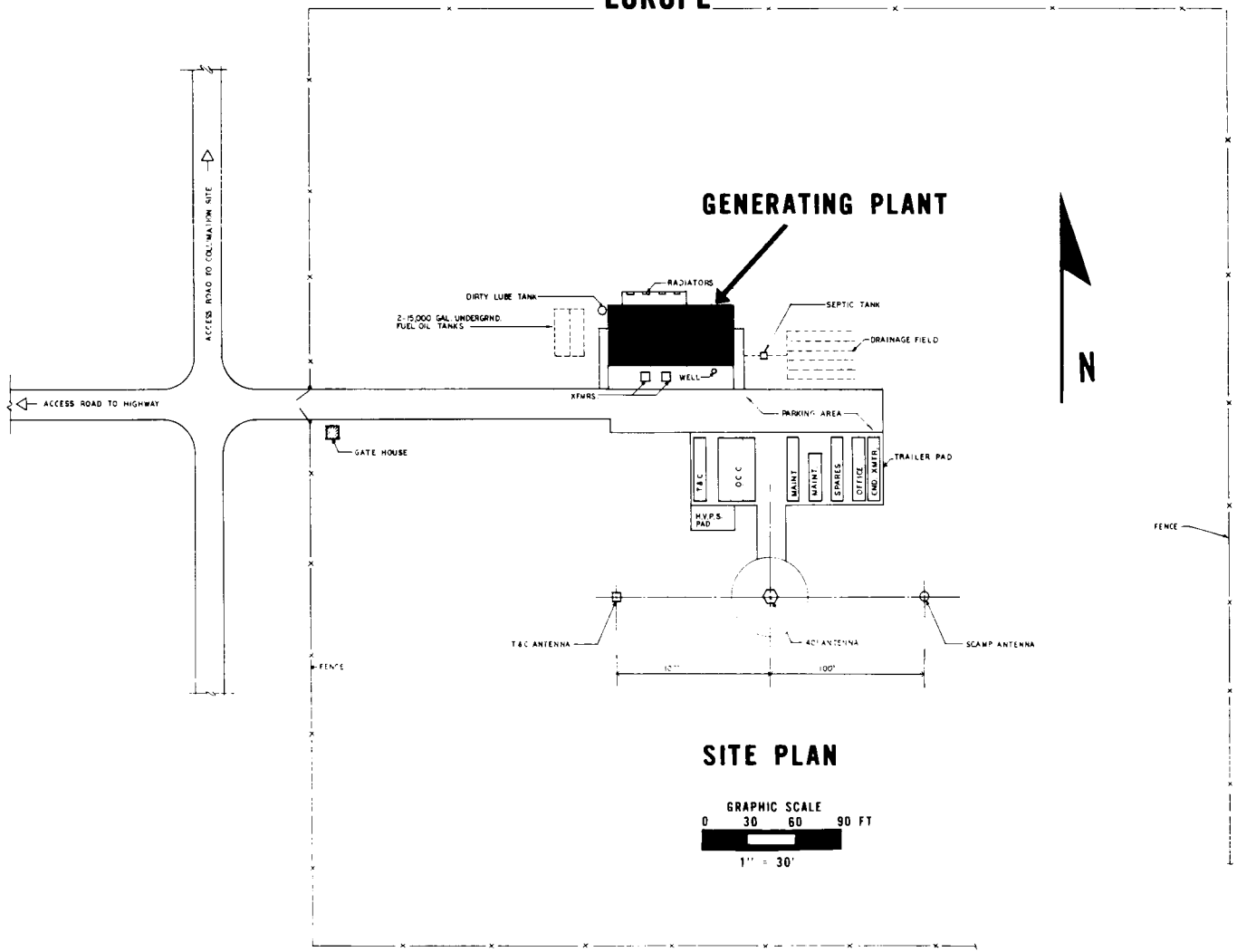
*Includes engine-generator installation

VARIOUS LOCATIONS

FISCAL YEAR 1972 ESTIMATES

RELOCATION OF TRANSPORTABLE GROUND STATION

EUROPE



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

FACILITY PLANNING AND DESIGN

	Page No.
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Office of Organization and Management	
Facility planning and design	CF 4-2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 72 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
All		Office of Organization and Management
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
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INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 19 72 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Facility Planning and Design	O&M	64,375	3,500		Not Applicable
TOTAL			3,500		

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

Facility Planning And Design

These funds are required to accomplish the following advance planning and design activities related to facilities projects:

a. Preliminary engineering reports, cost estimates, and design and construction schedules.

b. Preliminary plans and specifications as well as final construction contract plans, specifications and associated cost estimates and schedules.

c. Necessary development and master planning for field installations.

d. Special facilities siting and other investigations, facilities methodology and other studies, and facilities reports.

This $3.5 million request for facility planning and design for FY 1972 is made up of three major segments:

a. Necessary updating of development and master plans for field installations and required facilities studies, investigations and reports which will define facility parameters within which subsequent preliminary engineering efforts will be based. Master plans are revised on an average of once every three years for each installation, with about one-third of the installations being involved in any one fiscal year.	$700,000
b. Preparation of preliminary engineering reports, investigations and studies related to proposed facilities projects to be considered for inclusion in the subsequent FY 1974 Construction of Facilities program are provided for by this amount. These reports are required to permit the early and timely development of the best project required to meet the functional need and to provide the related basic data, cost estimates and schedules related to any such future budgetary proposals.	$1,100,000

c.	The amount requested will provide for the preparation of final design, plans, drawings and specifications necessary for the accomplishment of the subsequent FY 1973 Construction of Facilities program.	$1,700,000
	TOTAL	$3,500,000