National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1963

CONSTRUCTION OF FACILITIES

PART 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

APPROPRIATION SUMMARY

	1961	1962	1962 Supplemental	1963
SALARIES AND EXPENSES	$(170,760,000)	$(206,750,000)	$ -	$ -
RESEARCH AND DEVELOPMENT	(670,453,000)	(1,220,000,000)	(85,000,000)	-
RESEARCH, DEVELOPMENT AND OPERATION	841,213,000	1,426,750,000	85,000,000	2,968,278,000
CONSTRUCTION OF FACILITIES	122,787,000	245,000,000	71,000,000	818,998,000
TOTAL	$ 964,000,000	$1,671,750,000	$156,000,000	$3,787,276,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

SUMMARY OF CONSTRUCTION PROGRAMS

	Fiscal Year 1961	Fiscal Year 1962 Appropriated	Fiscal Year 1962 Requested Supplemental	Fiscal Year 1963
Ames Research Center.	$545,000	$6,115,000	---	$14,439,000
Atlantic Missile Range.....	27,321,000	72,225,000 1/	$55,000,000	359,963,000
Facility Planning and Design.....	---	5,154,000	---	10,000,000
Flight Research Center.....	---	---	---	1,807,000
Goddard Space Flight Center.....	9,500,000	9,180,000	---	23,780,000
Jet Propulsion Laboratory.....	8,531,000	3,580,000	---	10,360,000
Langley Research Center.....	11,957,000	6,530,000	---	8,092,000
Lewis Research Center	9,590,000	1,040,000	---	43,833,000
Manned Spacecraft Center.....	---	60,000,000 2/	---	30,755,000
Marshall Space Flight Center.....	26,208,000	25,716,000	---	33,437,000
Michoud Plant.....	---	980,000 2/	---	18,400,000
Mississippi Test Facility.....	---	10,090,000 2/	16,000,000	92,500,000
Nuclear Rocket Development Station	---	15,000,000 2/	---	40,000,000
Pacific Missile Range	492,000	995,000	---	---
Various Locations....	28,235,000	44,786,000	---	127,332,000
Wallops Station.....	2,090,000	7,965,000	---	4,300,000
Total.....	124,469,000	269,356,000	71,000,000	818,998,000
Transferred from "Salaries & Expenses"	-590,000	---	---	---
Transferred from "Research & Development".....	-360,000	-24,356,000	---	---
Transferred from Department of Defense.....	-1,070,005	---	---	---
Reserve.....	338,005	---	---	---
Total appropriation	$122,787,000	$245,000,000	$71,000,000	$818,998,000

1/Includes $4,700,000 authorized under "Various Locations"
2/Included in authorization act under "Various Locations"

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONGRESSIONAL BUDGET SUBMISSION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES-1963 PROGRAMS

Page No.	Location and Project	Project Estimate	Location Total
CF 1	Ames Research Center:		$14,439,000
CF 1-A1	Location Summary		
CF 1-A2	Location plan		
CF 1-A3	Bioscience laboratory.....	$924,000	
CF 1-B1	Mach number 50 helium tunnel.....	1,500,000	
CF 1-C1	Radiative heat system for mass transfer facility.....	2,225,000	
CF 1-D1	Space flight guidance research facility.....	9,790,000	
CF 2	Atlantic Missile Range:		359,963,000
CF 2-A1	Location Summary		
CF 2-A2	Location plan		
	Existing Area:		
CF 2-A3	Modifications to Saturn launch complex No. 34.....	3,765,000	
CF 2-B1	Modifications to Saturn launch complex No. 37.....	1,150,000	
CF 2-C1	Modifications to provide a launch complex for solid suborbital vehicles.....	1,717,000	
CF 2-D1	Supporting facilities.....	3,000,000	
CF 2-E1	Addition to assembly facility for unmanned spacecraft.....	2,000,000	
CF 2-F1	Explosive safe assembly facilities for unmanned spacecraft.....	450,000	
CF 2-G1	Apollo mission support facilities.....	22,510,000	
CF 2-H1	Modifications to Titan II launch complex.....	2,400,000	
CF 2-I1	Utility installations.....	800,000	

Page No.	Location and Project	Project Estimate	Location Total
	New Area:		
CF 2-J1	Advanced Saturn launch complex No. 39.....	$176,550,000(I)	
CF 2-K1	Advanced Saturn-Nova supporting facilities.....	39,121,000	
CF 2-L1	Apollo static test facility....	5,000,000	
CF 2-M1	Nova launch complex.....	79,500,000(I)	
CF 2-N1	Utility installations.....	22,000,000(I)	
CF 3-1	Facility Planning and Design.....	10,000,000	$10,000,000
CF 4	Flight Research Center:		1,807,000
CF 4-A1	Location Summary		
CF 4-A2	Location plan		
CF 4-A3	Building additions.....	1,332,000	
CF 4-B1	Visual flight simulator.....	475,000	
CF 5	Goddard Space Flight Center:		23,780,000
CF 5-A1	Location Summary		
CF 5-A2	Location plan		
CF 5-A3	Applied sciences laboratory.....	3,175,000	
CF 5-B1	Attitude control test facility...	915,000	
CF 5-C1	Conversion of dynamic test chamber.....	3,250,000	
CF 5-D1	Development operations building..	1,850,000	
CF 5-E1	Launch phase simulator.....	3,915,000	
CF 5-F1	Spacecraft operations facility...	7,500,000	
CF 5-G1	Tracking and telemetry laboratory	3,175,000	
CF 6	Jet Propulsion Laboratory:		10,360,000
CF 6-A1	Location Summary		
CF 6-A2	Location plan		
CF 6-A3	Addition to fabrication services building.....	605,000	
CF 6-B1	Data operations and command facility.....	2,420,000	
CF 6-C1	Engineering mechanics building...	3,045,000	
CF 6-D1	Additions to materials research laboratories.....	610,000	
CF 6-E1	Telecommunications laboratory....	2,860,000	
CF 6-F1	Utility installations.....	820,000	

Page No.	Location and Project	Project Estimate	Location Total
CF 7	Langley Research Center:		$8,092,000
CF 7-A1	Location Summary		
CF 7-A2	Location plan		
CF 7-A3	Addition to heating plant	$858,000	
CF 7-B1	Additional equipment for magnetoplasmadynamics research...	1,450,000	
CF 7-C1	Additional power supply and improved arc chamber for 10-megawatt arc tunnel.....	760,000	
CF 7-D1	Environmental research facilities for spacecraft components and materials.....	997,000	
CF 7-E1	Particle accelerator for simulation of micrometeoroid impact.....	936,000	
CF 7-F1	Stabilization and control equipment laboratory.....	1,366,000	
CF 7-G1	Vehicle antenna test facility.....	1,725,000	
CF 8	Lewis Research Center:		43,833,000
CF 8-A1	Location Summary		
CF 8-A2	Location plan		
CF 8-A3	Development engineering building...	4,650,000	
CF 8-B1	Hydrogen heat transfer facility....	2,400,000	
CF 8-C1	Lunar propulsion research facility.	6,275,000	
CF 8-D1	Modernization and reconditioning of Plum Brook service facilities.	1,508,000	
CF 8-E1	Nuclear rocket dynamics and control facility.....	3,500,000	
CF 8-F1	Space propulsion facility.....	25,500,000	
CF 9	Manned Spacecraft Center:		30,755,000
CF 9-A1	Location Summary		
CF 9-A2	Location plan		
CF 9-A3	Flight acceleration facility.....	10,630,000	
CF 9-B1	Thermochemical test facilities.....	6,000,000	
CF 9-C1	Lunar landing simulation facility..	6,500,000	
CF 9-D1	Site development and utility installations.....	7,625,000	
CF 10	Marshall Space Flight Center:		33,437,000
CF 10-A1	Location Summary		
CF 10-A2	Location plan		
CF 10-A3	Addition to computation division building.....	1,255,000	
CF 10-B1	Components test facility.....	4,000,000(I)	

Page No.	Location and Project	Project Estimate	Location Total
CF 10-C1	Components and subassembly acceptance building.....	$950,000	
CF 10-D1	Engineering and administration building.....	2,500,000	
CF 10-E1	Expansion of instrumentation systems in West Area.....	4,000,000	
CF 10-F1	F-1 engine test stand.....	4,500,000(I)	
CF 10-G1	Hydraulic test facility.....	340,000	
CF 10-H1	Low temperature facility.....	575,000	
CF 10-I1	Modification of West side of static test stand.....	2,000,000(I)	
CF 10-J1	Engineering building.....	1,000,000	
CF 10-K1	Instrument laboratory.....	2,000,000	
CF 10-L1	Support facilities in West Area.....	7,800,000	
CF 10-M1	Utility installations.....	2,517,000	
CF 11	Michoud Plant:		$18,400,000
CF 11-A1	Location Summary		
CF 11-A2	Location plan		
CF 11-A3	Modifications to Michoud Plant.....	11,400,000	
CF 11-B1	High pressure test facility.....	1,000,000	
CF 11-C1	Hydrostatic test and cleaning facility.....	3,000,000	
CF 11-D1	Vertical assembly building.....	3,000,000	
CF 12	Mississippi Test Facility:		92,500,000
CF 12-A1	Location Summary		
CF 12-A2	Location plan		
CF 12-A3	Advanced Saturn stage test facilities.....	36,000,000(I)	
CF 12-B1	Nova stage facilities.....	43,000,000(I)	
CF 12-C1	Utility installations and support facilities.....	13,500,000	
CF 13	Nuclear Rocket Development Station:		40,000,000
CF 13-A1	Location Summary		
CF 13-A2	Location plan		
CF 13-A3	Stage static test and maintenance facilities.....	20,205,000	
CF 13-B1	Stage demating, maintenance, and disassembly facilities.....	8,660,000	
CF 13-C1	Radiation effects facility.....	7,125,000	
CF 13-D1	Components test facilities.....	1,885,000	
CF 13-E1	Support facilities.....	2,125,000	

Page No.	Location and Project	Project Estimate	Location Total
CF 14	Various Locations:		$127,332,000
CF 14-A1	Location Summary		
CF 14-A2	Advanced antenna system Goldstone Station.....	$14,250,000	
CF 14-B1	Advanced Saturn dynamic test facility.....	2,100,000	
CF 14-CD1	Antenna facility, Johannesburg Station.....	5,000,000	
CF 14-CD1	Antenna facility, Woomera Station..	5,000,000	
CF 14-E1	Data acquisition facility, Far East Station.....	6,000,000	
CF 14-F1	Data acquisition facility, Rosman Station.....	3,500,000	
CF 14-G1	Facilities for F-1 engine program..	25,000,000(I)	
CF 14-H1	Facilities for J-2 engine program..	4,000,000(I)	
CF 14-I1	Facilities for M-1 engine program..	16,000,000(I)	
CF 14-J1	Manned space flight control centers	18,000,000(I)	
CF 14-K1	Space radiation effects laboratory.	12,382,000	
CF 14-L1	Nova stage manufacturing facilities	16,100,000(I)	
CF 15	Wallops Station:		4,300,000
CF 15-A1	Location Summary		
CF 15-A2	Location plan		
CF 15-A3	Advanced data acquisition system...	1,500,000	
CF 15-B1	Modification and expansion of range control, safety, and support systems and equipment.....	2,000,000	
CF 15-C1	Vehicle checkout facilities and equipment.....	800,000	
	TOTAL, 1963 PROGRAM.....		$818,998,000

(I) Incrementally funded project.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

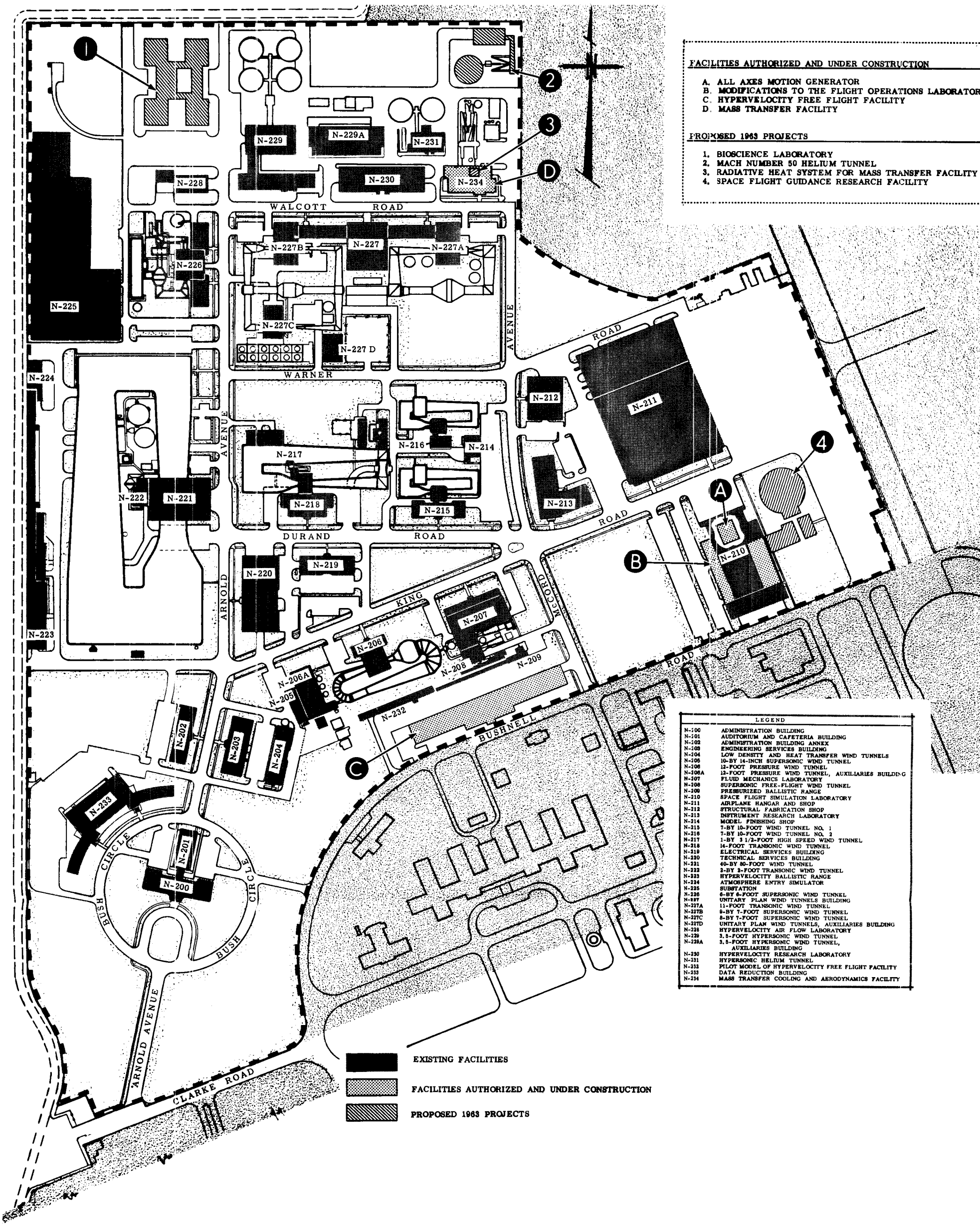
CONSTRUCTION OF FACILITIES - 1963 PROGRAM

AMES RESEARCH CENTER

Page No.		
CF1-A2	Location plan	
CF1-A3	Bioscience laboratory.....	$924,000
CF1-B1	Mach number 50 helium tunnel.....	1,500,000
CF1-C1	Radiative heat system for mass transfer facility.....	2,225,000
CF1-D1	Space flight guidance research facility.....	9,790,000
	Total.....	$14,439,000

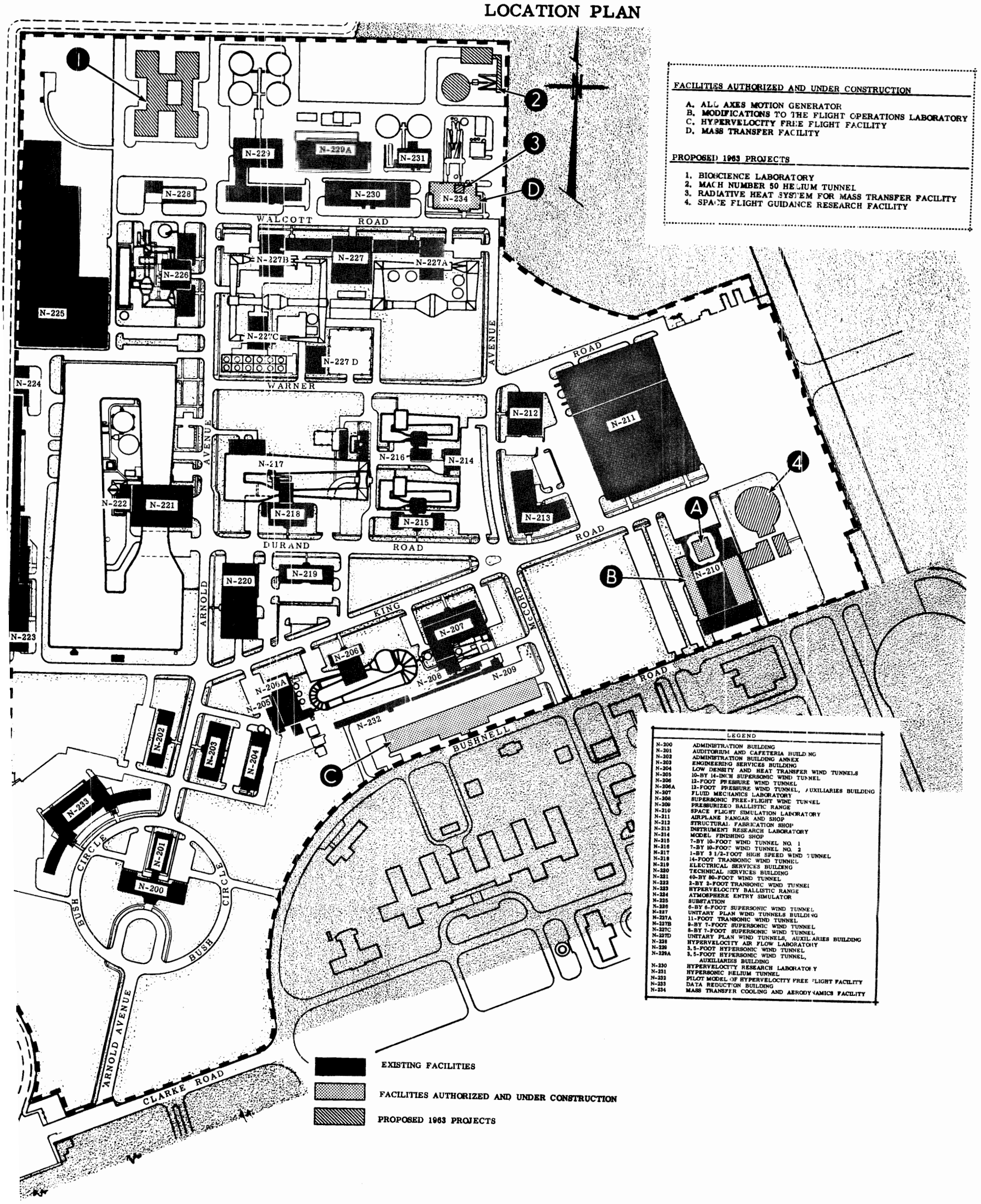
AMES RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN



AMES RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN



AMES RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

BIOSCIENCE LABORATORY

DESCRIPTION:

A bicscience laboratory is proposed for construction to provide the research facilities, offices, and support functions for systemic and subsystemic research in the separate but related fields of immunology and genetics, radiobiology, and exobiology. The laboratory structure will provide approximately 26,900 square feet of space in the general arrangement shown in the sketch on the next page.

JUSTIFICATION:

Life sciences, from the space point of view, comprise the functions involved in the basic biological exploration of space and those aero-space medicine activities required for manned space flight. The proposed facility is necessary to permit a modest in-house capability to be acquired in the area of space biology similar to the manner in which in-house capability has been provided for other scientific disciplines in the physical and engineering sciences. Aero-space medicine activities, as such, will not be conducted in the facility although limited specialized investigations may be undertaken in physiological and behavioral sciences. Necessary data in the aero-space medicine field will be acquired by grants and contracts with universities, or contracts with industry, and by use of the extensive aero-space medicine facilities already in existence at various Department of Defense installations.

The research programs to be conducted in the proposed facility will concentrate on the mechanisms underlying biological phenomena of hypersensitivity, immunological paralysis and immunological tolerance, and how the space environment interacts with these responses. The genetic basis of individual differences in responses to particle radiation will be investigated. The responses to particle irradiation will be studied at the organismal, tissue, cellular, subcellular, and molecular levels.

These studies require basic research in the fields of immunogenetics, immunochemistry, classical, cellular, and molecular genetics, and radiobiology. The research will be designed to use the unique features of the space environment, such as heavy particle irradiation and weightlessness, as research tools. The evolution of immunological and genetic systems will be studied in reference to their possible presence and state of development on extraterrestrial bodies. Emphasis will be on in-house experimentation to provide the competence to monitor contractual efforts. An operationally flexible laboratory building with facilities for prolonged experimentation is therefore planned.

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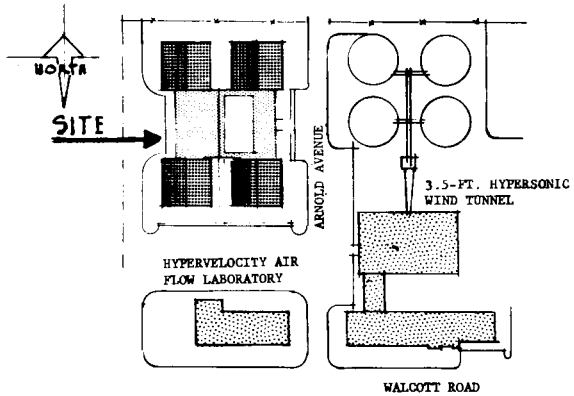
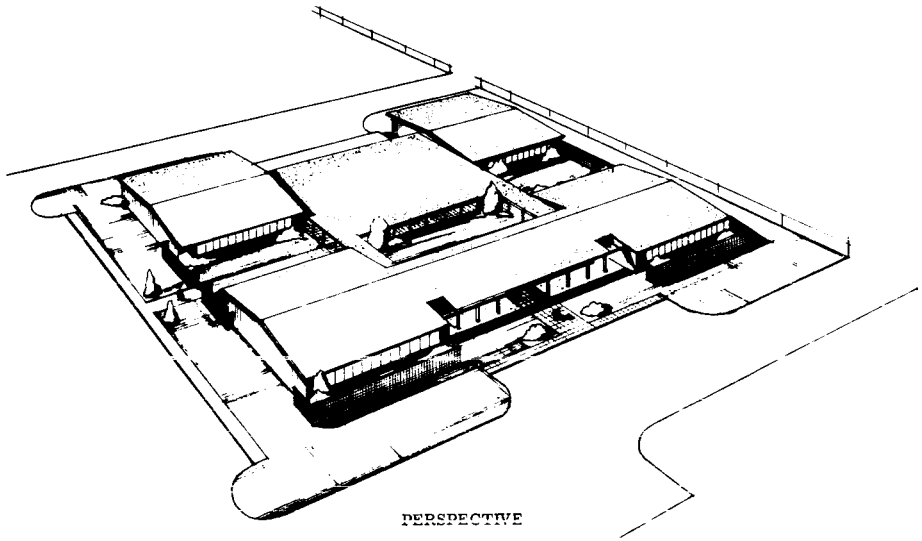
FISCAL YEAR 1963 ESTIMATES

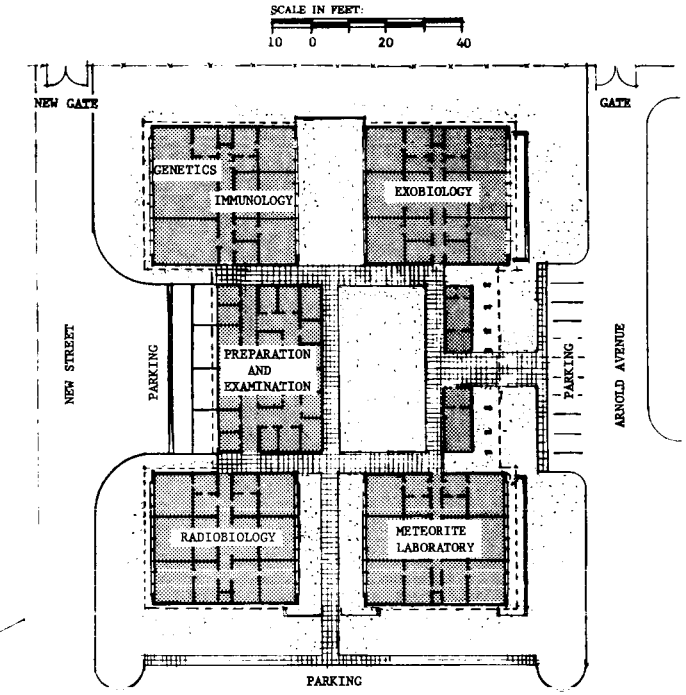
BIOSCIENCE LABORATORY



PLOT PLAN



PERSPECTIVE



GENERAL ARRANGEMENT

A brief description of the major research areas to be pursued follows:

(a) Genetics: Research will be carried out on the effects of particle irradiation on genetic systems in bacteria, fruit flies (Drosophila) and inbred mice. The mechanism of genetic change will be studied at the cellular and molecular level.

(b) Immunogenetics: Research will be performed on the mechanisms involved in the determination of immunologically specific, genetically controlled, reactions, and the effects of the space environment on these reactions.

(c) Radiobiology: Research on the basic reactions between ionizing radiation and living material will be studied, especially in reference to the heavy and highly energetic radiations found in space.

(d) Exobiology: The functional organization of genetic systems will be studied to understand their evolution and to correlate terrestrial systems with those to be found on extraterrestrial bodies. The analysis of organic materials found in meteorites will be carried on and integrated with other studies on the presence and evolution of life systems in the universe.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$57,200
	Streets and parking area	$37,200	
	Utility connections	20,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		709,700
	Building...(26,900 square feet at $26.40 per square foot)	709,700	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		107,100
	Special built-in equipment, cold boxes vacuum pumps, and sterilizers	42,350	
	Laboratory equipment	44,750	
	Office furniture	20,000	
E.	DESIGN AND ENGINEERING SERVICES		50,000
	Total estimated cost		$924,000

AMES RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

MACH NUMBER 50 HELIUM TUNNEL

DESCRIPTION:

It is proposed to construct a Mach number 50 helium tunnel of the blowdown type with a test section 48 inches in diameter. The tunnel will utilize interchangeable axisymmetric nozzles to obtain test Mach numbers of 30 and 50 at test Reynolds numbers from 0.1 to 1.4 million. It will be capable of producing 10 consecutive 60-second runs before requiring a 3-hour pump time to refill high-pressure storage vessels. If running times longer than 60 seconds are required for special test purposes, one 10-minute run can be obtained every three hours. The tunnel will operate at reservoir pressures of 5000 pounds per square inch and at a maximum temperature of 1500° F. Helium from existing high-pressure storage vessels will flow through a small electric heater through the nozzle and test section, into a steam-ejector vacuum pumping plant. The helium will then pass from the outlet of the steam ejectors at near atmospheric pressure through a water-cooled heat exchanger, used to remove the steam, into a vacuum storage vessel. From this vessel the helium will be pumped to the existing high-pressure storage by the evacuator-compressor system used by the existing hypersonic helium tunnel. The sketch on the following page shows the general arrangement and location of the proposed facility.

The tunnel will utilize the following existing equipment:

(a) 1050 cubic feet of 6000-psia storage vessels.

(b) 48-inch diameter 7-stage evacuator-compressor system.

(c) Helium purifier.

(d) Steam boiler associated with the mass transfer facility.

(e) Transformer and electrical heater control equipment used in the hypersonic planetary gas test facility.

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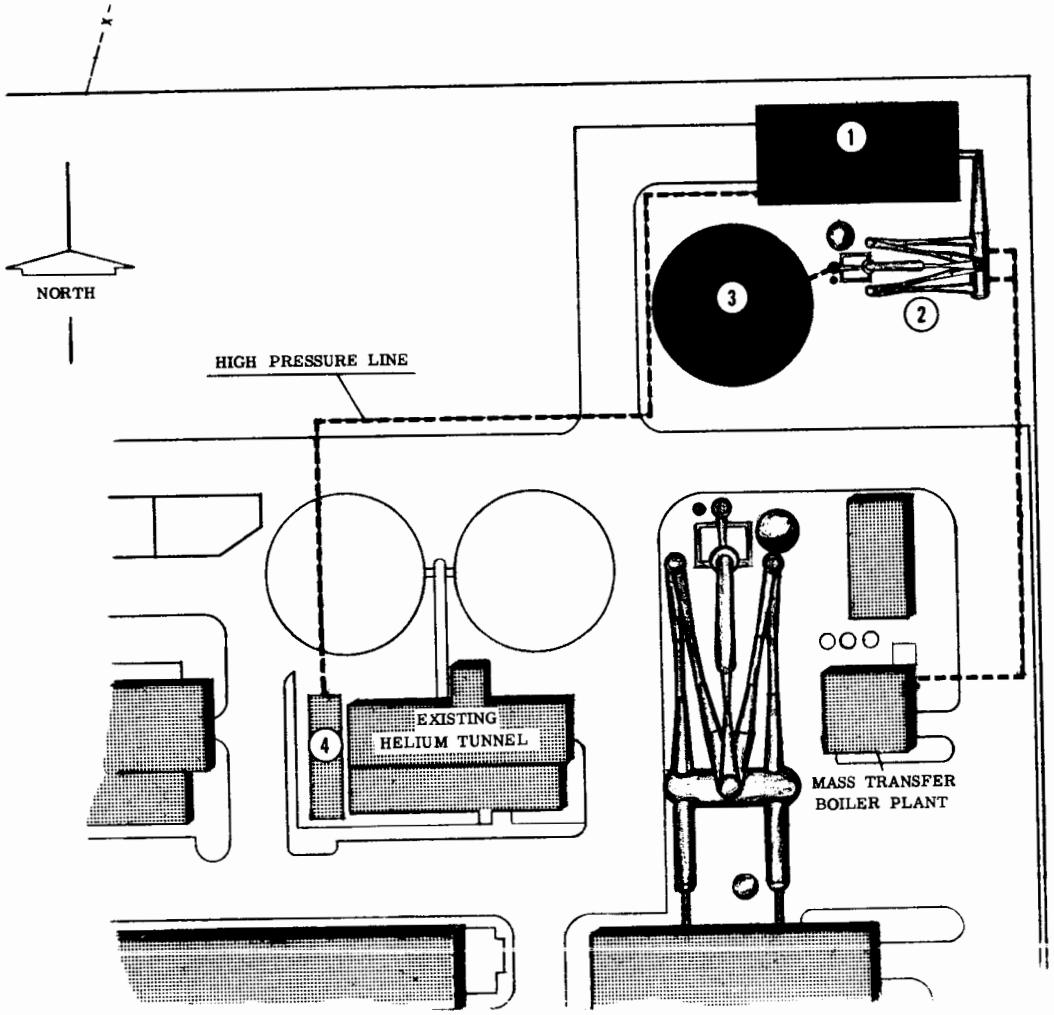
FISCAL YEAR 1963 ESTIMATES

MACH NUMBER 50 HELIUM TUNNEL



LEGEND

1. HEATER, NOZZLE AND TEST SECTION
2. EJECTOR SYSTEM
3. VACUUM STORAGE VESSEL
4. HIGH PRESSURE STORAGE

GENERAL ARRANGEMENT

This project includes the addition of the following new equipment:

(a) Test section and two 48-inch outlet-diameter nozzles to produce Mach numbers of 30 and 50.

(b) Small electric heater to produce 1500° F. outlet helium temperature (1 megawatt power requirement).

(c) Cryogenic desiccant bed to supplement present purifier to produce outlet helium purity of 99.98 percent.

(d) Steam-ejector system (0.2 lb per sec at 0.1 mm Hg absolute).

(e) Cooler to remove steam from helium.

(f) Small high-pressure control valves, one 48-inch vacuum valve and piping.

(g) Vacuum storage vessel (225,000 cubic feet).

(h) High-speed magnetic-tape data acquisition system.

(i) Building to house heater, nozzle, test section, and control room.

A steam-ejector pumping plant and a supply pressure of 5000 psia will provide a continuous pressure ratio of at least 250,000 during the runs. A cryogenic desiccant bed placed downstream of the present helium purifier will provide helium with a purity of 99.98 percent compared with the presently available purity of 99.4 percent.

Models will be mounted in the tunnel on a cantilevered sting-type support which will be moved to change model attitude over a wide range during a test blow. Forces and moments acting on the models will be measured with an internal strain-gage balance. Surface pressures will be measured by use of fast-acting pressure cells mounted inside the models. Surface temperatures will be measured with thermocouples, and heat transfer will be measured by use of heat plugs mounted inside the models. All data will be recorded with automatic recording equipment capable of about 2500 samples per second.

One building with an area of approximately 5000 square feet will house the equipment and control room for the tunnel.

JUSTIFICATION:

Past research has demonstrated the numerous advantages of facilities using models which are supported in an essentially fixed position during tests. These advantages, which accrue as a result of increased and improved instrumentation and as a result of accurate control of test conditions, are particularly evident in studies of pressure distributions, heat-transfer distributions, and control effectiveness. At the present time there is no existing facility of the fixed-model type which can generate

test Mach numbers greater than 26. For advanced projects such as project Apollo, tests at Mach numbers up to about 40 and possibly higher are required. The possibilities of obtaining such test streams with air as the medium (certainly the most desirable medium) are at present remote since such facilities would require equivalent ideal-gas stagnation temperatures in excess of 30,000 $^{\circ}$ F. For this reason, use of test media other than air has been considered. One of the more attractive gases from the standpoint of ease of facility development is helium. A helium tunnel capable of a Mach number of 50 requires stagnation temperatures of only about 1500° F. The primary shortcoming in the use of helium is that the gas is monatomic, while air under normal conditions is composed primarily of diatomic gases. For flight at Mach numbers in the neighborhood of 40, however, most of the diatomic molecules in air will be dissociated. In many respects this dissociated gas behaves very similarly to a monatomic gas. There are some shortcomings, however, and a helium facility for this Mach number range by itself would provide data of only questionable validity. It is planned, however, to use the proposed facility as a complement to the existing hypersonic free-flight facility which, with gun-launched models, is also capable of test Mach numbers up to about 50. This free-flight facility uses air as a test medium but can be used in the study of models of only limited complexity. The proposed facility will provide a useful complement to the existing free-flight tunnel for use in detailed studies in such areas as control effectiveness and pressure distributions. When questions arise as to the validity of a particular set of data from the proposed facility, they can be answered through coordinated tests in air in the free-flight tunnel. In particular, the proposed facility will be useful in providing the type of information (load distributions, hinge moments, etc.) required in the engineering design of a configuration finally selected for a particular mission. At present, such information cannot be obtained in this Mach number range with any other existing or planned facility. The proposed helium tunnel will produce results throughout the evolution and construction phases of the Apollo program.

COST ESTIMATE:

A. LAND ACQUISITION.....			---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$	45,000
Grading, parking lots and roads.....	$ 25,000		
Utility connections.....	20,000		
C. FACILITY CONSTRUCTION AND MODIFICATIONS			620,000
Building (5,000 square feet at $18.00 per square foot).....	90,000		
Test section and nozzles.....	185,000		
Piping and valves.....	140,000		
Vacuum storage vessel.....	205,000		

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		$ 765,000
Heater	$ 45,000	
Helium purifier	65,000	
Ejectors	385,000	
Data recording system	240,000	
Balances and general instrumentation	30,000	
E. DESIGN AND ENGINEERING SERVICES		70,000
Total estimated cost		$1,500,000

AMES RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

RADIATIVE HEAT SYSTEM FOR MASS TRANSFER FACILITY

DESCRIPTION:

The proposed radiative heat system will consist of radiative sources (stabilized, high-intensity electric arcs and imaging optical systems), a power supply, a cooling system, controls, and instrumentation. The radiative heat system will be installed in the mass transfer facility for the purpose of providing a radiative heat flux to a heat-shield material at the same time that it is being subjected to convective heating from an arc-heated high-velocity air jet. The system will provide radiative flux magnitude and spectral distribution representative of peak radiative heating conditions for a manned lunar vehicle entering the earth's atmosphere. This will require a flux magnitude of 500 Btu per square foot per second, with 50 per cent of the flux in the ultraviolet range of wave lengths and the remainder in the visible. The specified flux magnitude is for a 6-inch diameter model. Provision of the required spectral distribution at the specified flux levels will require the design and construction of a special radiation unit. Provision will be made for independent control of the convective and radiative heat fluxes. A schematic diagram of the proposed heat system is shown on the following page.

JUSTIFICATION:

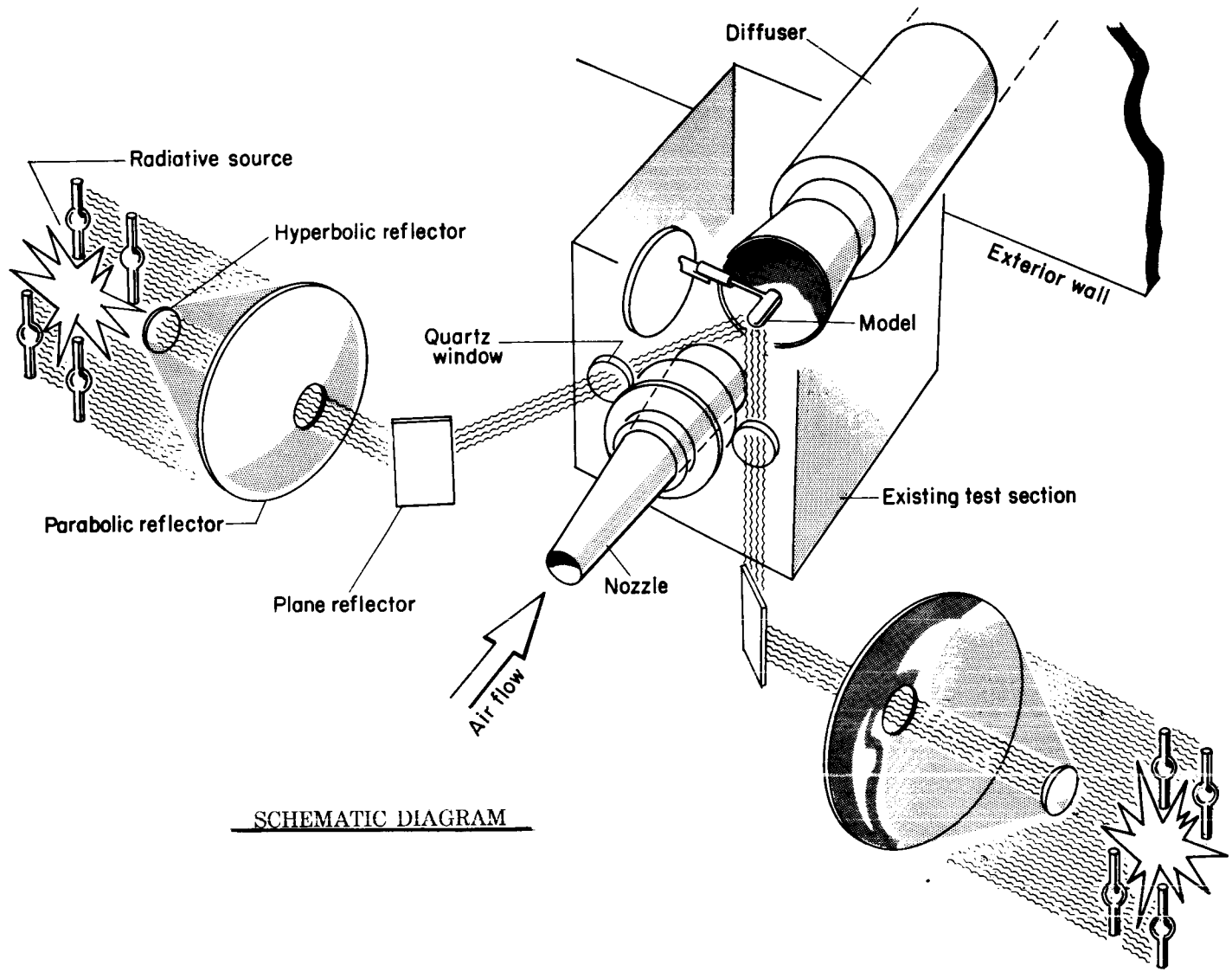
A manned vehicle entering the earth's atmosphere from a lunar mission will be exposed not only to the convective type of heating that ballistic missiles and satellite vehicles have encountered, but also to intense heating by radiation from the enveloping shock-heated air. The provision of adequate thermal protection for occupants and vehicle without incurring prohibitive weight penalties demands that heat-shield materials be tested under this combined heating environment.

Although it would be desirable to test full-scale heat shields, practical considerations dictate the use of scale models or small sections of the complete heat shields. Models of about 6-inch diameter are judged to be the smallest practical size for such tests. This size will allow testing of sections of the complete heat shield including the ablation material layer, the insulating layer, and the back-up structure.

An external radiative source is required to provide the required flux densities, and to provide independent control of the radiative and convective fluxes. Existing facilities which provide high-enthalpy gas streams can provide a large part of the convection heat

AMES RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

RADIATIVE HEAT SYSTEM FOR MASS TRANSFER FACILITY



SCHEMATIC DIAGRAM

flux but are incapable of providing the required radiative heat flux for two reasons: first, the radiation flux is extremely sensitive to the temperature or enthalpy level of the test gas - much more so than the convection heating - and the existing facilities provide gas streams with enthalpies significantly less than those matching atmosphere entry from a lunar mission; and second, the radiative heat flux is directly proportional to model scale even if test stream velocities and densities are equivalent to those occurring during entry. For example, the shock-layer radiation intensity for a 6-inch diameter model would only be 1/24 of that for a 12-foot diameter vehicle. Although considerable effort is being directed to increasing the enthalpy level of the test gas and, if successful, will remove the first limitation, the second limitation still presents a serious barrier to the adequate research and development of heat shields for spacecraft returning from deep space missions.

The spectral distribution of the radiation must match that to which a manned lunar vehicle is exposed because of the expectation that the most efficient thermal protection will be obtained from a material having a different sensitivity to radiation at different wave lengths.

Although the manned lunar mission is the problem of immediate concern, it is clear that the development of heat protection systems for spacecraft returning from other deep-space missions present equally difficult and important problems. It should be emphasized that the mass transfer facility when equipped with the proposed radiative heat system will be useful for research on a wide variety of problems as well as for specific research and development for the Apollo program.

COST ESTIMATE:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$75,000
Utility connections.....	$75,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		295,000
Modification to existing facility.....	145,000	
Power distribution within facility....	150,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		1,655,000
Radiation sources.....	915,000	
Power supply.....	280,000	
Optical system.....	120,000	
Cooling system.....	70,000	
Controls and instrumentation.....	270,000	

E. DESIGN AND ENGINEERING SERVICES.....	$200,000
Total estimated cost.....	$2,225,000

AMES RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

SPACE FLIGHT GUIDANCE RESEARCH FACILITY

DESCRIPTION:

Construction of a simulator is proposed to undertake research to obtain the information necessary to the integrated design of the guidance, stabilization, control, and crew support systems in advanced manned spacecraft, such as Apollo. The simulator will provide, within earth-based limits, a realistic simulation of the environment, accelerations, motion, and tasks for crew and equipment within a representative space capsule during take-off, midcourse flight, entry, and landing.

The proposed facility will consist of three major elements:

(a) A representative three-man space capsule containing the crew life-support system; the navigation, guidance and control equipment and such environmental conditions as can be represented with adequate realism; and the instrumentation necessary to present to the crew a realistic representation of the navigation problem.

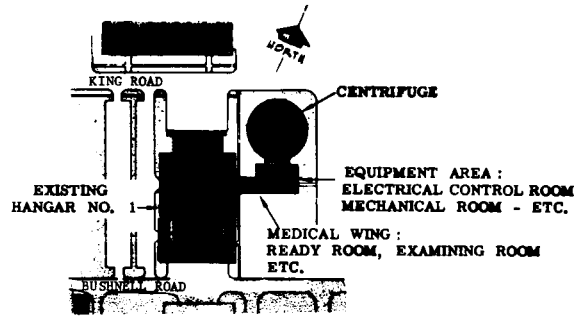
(b) A computer which will be capable of accepting inputs from the capsule and crew and of converting these inputs into appropriate capsule motion commands and visual presentations. To provide acceptable computer accuracy, it is expected that analog and digital computer techniques will be required in a combined operation.

(c) The support and drive mechanism for the capsule, consisting of a rotating centrifuge arm on which the capsule is mounted, a vertical travel mechanism for the capsule, a gimbal system and drive mechanism capable of rotating the capsule in complete freedom about the three axes, and a mechanical brake for simulating the impact decelerations of landing.

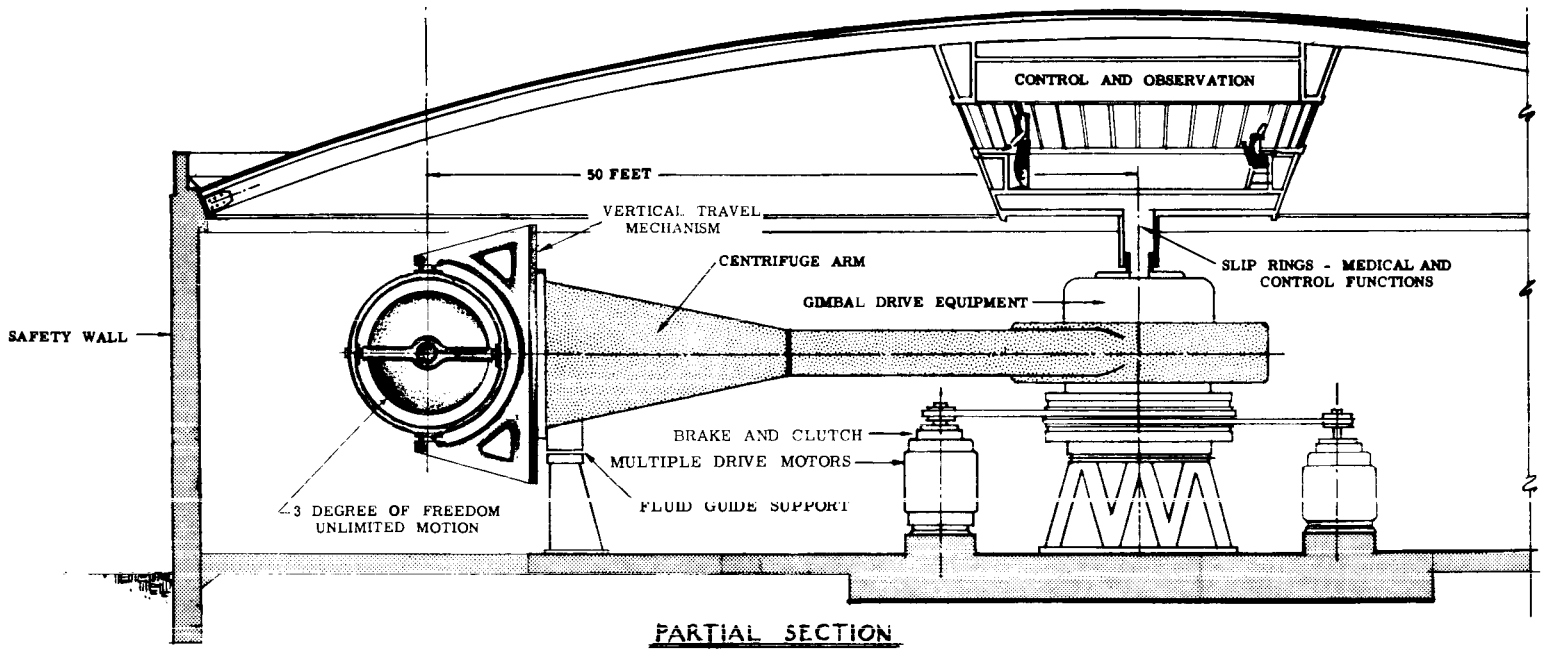
The figure on the following page shows schematically one possible capsule suspension, drive, and braking system. The capsule will be suspended so that it has unlimited motion about three axes: roll, pitch, and yaw. The associated electric or hydraulic drive motors would be mounted on the pitch gimbal, yaw gimbal, and outer frame, respectively. The gimbaled system capable of vertical movement will be attached to the centrifuge arm and will be supported vertically by fluid guides. The centrifuge arm may be driven by a single or multiple electric motors operating through multiple chain drives. The simulation of impact decelerations will be accomplished by a mechanical brake or negative torque input.

AMES RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

SPACE FLIGHT GUIDANCE RESEARCH FACILITY



PLOT PLAN



PARTIAL SECTION

The centrifuge arm drive system will be capable of centrifugal onset acceleration rate of 5g per sec to a maximum of 50g, will be capable of maintaining the 50g loading for a minimum of 10 minutes and will be capable of a 5g per sec deceleration rate. Below a peripheral speed of 60 feet per second the brake will be able to decelerate the centrifuge arm in a manner equivalent to an impact landing. With regard to design and construction, although the described system consists of a number of fairly well proven subsystems (such as the chain drive and mechanical brake), the required acceleration rates in combination with the required dynamic response result in large structural and drive system loads. Due to these extreme requirements aggravated by gyroscopic effects, a thorough engineering study will be required to determine the feasibility of various approaches.

A circular room about 130 feet in diameter with special foundations will house the simulator. Associated medical, equipment, shop, and control areas will be included in a new building adjacent to the circular room. Office space for professional operating personnel is currently available.

Combining the operation of these three elements will make it possible to examine realistically, with one exception, the most important research problems associated with the interrelation of the elements, mechanical, electrical, optical, and physiological, of the space flight mission from take-off to landing. The one exception is, of course, the question of weightlessness during midcourse flight which cannot be reproduced acceptably under laboratory conditions. To minimize the effects of earth gravity during midcourse simulation, it is proposed to hold the crew attitude close to that judged most nondistracting, to provide rotational acceleration cues by means of washout controls (initial cue followed by angular-acceleration fade-out so that little motion results), and to provide important attitude cues by visual presentation. The centrifuge arm will supply the moderate vertical and longitudinal acceleration cues associated with midcourse corrective action. Because the midcourse accelerations will be small, it appears entirely possible to mount the proposed capsule on the existing Ames centrifuge equipment for this purpose, and early construction of the capsule and gimbal will allow research to be expedited. It is impractical, however, to consider combining the proposed capsule and the existing Ames centrifuge to study launch, abort, or re-entry.

JUSTIFICATION:

It is apparent that extrapolating past experience will not be an adequate basis for solving the guidance and control problems of manned space flight. Since at least the major problems must be solved before the vehicle flies, piloted simulators are the only recourse. As the first step in defining requirements, the mission can be divided into

four segments or types of operation: launch control, midcourse maneuvering, atmosphere entries, and landings, including impact. In each of these operations there are requirements for both normal and for abort or emergency conditions. In addition to the applicable control task, an effective simulator must provide the proper levels of stress: linear acceleration, angular motion, heat, vibration, noise, pressure, impact, duty time (fatigue), appropriate to each segment of the mission.

It is possible with existing equipment to study individually the various aspects of a long-term space flight problem, that is, the life-support systems, the guidance and control systems, the attitude control systems, the navigational instrumentation, etc. Such studies are being pursued actively. They will serve to separate promising from unpromising or unacceptable systems and to pursue research on promising systems.

However, the interdependence of these various systems will be great. Thus, it can be anticipated that a system which appears wholly acceptable when evaluated separately may well prove unacceptable in whole or in part as a consequence of incompatibility with other parts of the system. Representative areas of concern in this regard can be suggested:

(a) Are the activities of the crew while performing the information-acquiring function compatible with the attitude-control system and its power requirements?

(b) In what way should information be supplied the crew so that it can be used most effectively for normal and for emergency conditions?

(c) How is crew failure recognized and how is automatic or ground control integrated into the system to take over in event of crew or on-board-equipment failure?

(d) How well can crew, navigation, and control systems function as a unit during the critical period of velocity corrections?

(e) Are the navigational and control duties of the guidance system compatible with the pilot's physiological state when well into the mission and particularly under emergency conditions?

(f) Is the over-all precision and effectiveness, determined experimentally, as good as predicted from synthesis of component results; if not, where will improvement pay off most?

In considering the questions raised by a study of the research requirements for an integrated examination of the guidance, stabilization, control and crew support systems, two requirements stand out which are not met by existing equipment.

First is the requirement to place the crew in the most realistic environment possible in order to study the compatibility of the crew under environmental conditions with the various aspects of the guidance, navigation and control systems. Regardless of the final decision as to the primary source of vehicle command, earth-based or on-board, there is a need to study on-board control, either as primary or as back-up. Therefore, a research capability is required which will enable the crew to be faced with these tasks under a most realistic physiological and psychological environment. Existing evidence shows that crew performance depends heavily on these factors; only when they are taken into account can adequate research be carried out on the problem of matching system and crew capabilities.

The second requirement is the need to reproduce motions and accelerations associated with the complete mission. Linear and angular accelerations are the two responses most closely associated with the pilot control, suggesting a multiple-degree-of-freedom centrifuge as the basis for the proposed simulator. In the past several years centrifuges have been used extensively as pilot-controlled simulators, both for basic research and in specific preparations for the X-15 and the Mercury operations. Their value has been clearly demonstrated not only by the research data but by the opinions of the experimental test pilots used as subjects. The Mercury astronauts have cited the several series of tests on the Navy's Johnsville centrifuge as the most valuable part of their preparation.

The proposed facility will have the capability desired for lunar and other advanced missions. The suggested design is based on operating experience with existing centrifuges which were nearly all designed ten or more years ago for medical tests where the subjects were not required to control the device. The major requirements arising from the shortcomings revealed in existing equipment and the changes introduced by the lunar mission are summarized in the tables on the following two pages entitled, "Dynamic Performance Characteristics," and "Environmental Capabilities."

Before considering each characteristic and capability separately, it should be emphasized that the basic concept is a single device simulating a complete mission in real time by providing nearly all stresses except zero-g in their proper sequence. The table entitled "Environmental Capabilities" has been prepared to show in a qualitative sense the stress history a crew would be expected to encounter during a complete lunar mission. It is the opinion of the medical profession that it would be unwise and that dangerously erroneous conclusions could

DYNAMIC PERFORMANCE CHARACTERISTICS

	"g" Onset	"g" Sustained	Deceleration	Degrees of freedom	Dynamic response of gimbals (closed loop)
Proposed facility	5g per second	50g	5g per second 300g per second below 1/5 rps	5	Flat to 3 cycles per second
Open loop centrifuges	6g per second maximum	9 - 20g with payload	0.8g per second	1-1/2	---
Angular motion devices	---	1g	---	3	2 cycles per second
Air Force Holloman Sled	7g per second	80g (Few Seconds)	1800g per second (Human limit)	1	---
Navy Johnsville centrifuge	5-10g per second with payload	40g for 60 seconds 20g indefinite	5g per second	3	1 cycle per second
Ames centrifuge	6g per second	6g	6g per second	5	2 cycles per second

ENVIRONMENTAL CAPABILITIES

	Crew Number	Pressure	Temperature	Vibration and noise	Long work cycle	Interchange of cab
Proposed facility	3	Yes	Yes	Yes	Yes	Yes
Open loop centrifuges	1	No	Yes	No	Yes	No
Angular motion devices	1	No	No	No	No	No
Air Force Holloman Sled	1	No	No	Yes - Natural	No	Yes
Navy Johnsville centrifuge	1 (2 proposed)	Yes	Yes (proposed)	Yes	Yes	No (Yes proposed)
Ames centrifuge	1	No	No	No	No	No (Yes proposed)

be reached if the ability of the crew to perform under any given stressful conditions were not studied under conditions where the crew had experienced in a continuous manner the stress history preceding the situation under study. For example, study of the lunar landing maneuvers must be preceded by the stresses imposed by the midcourse phase; study of lunar activity must be preceded by not only the midcourse phase but by the lunar landing maneuver, including landing impact; and the lunar launch study must be preceded by the stress situations outlined above. It is emphasized again that medical opinion does not admit to the validity of human capability studies where the stress history is incomplete or discontinuous. Therefore, to assess human control capabilities accurately where the crew successively copes with precise attitude orientation, retrorocket firing, landing impact, and take-off control, it is considered mandatory to experience such phenomena in the correct continuous time sequence.

A discussion of the requirements in the table entitled "Dynamic Performance Characteristics," follows:

"g" onset: The proposed rate is based on the existing capability of the Saturn booster under abort conditions.

"g" sustained: The choice here is really how severe an emergency atmosphere-entry maneuver the human pilot will be allowed to consider and prepare for. Existing entry vehicle designs could develop up to 340g for limited times for straight-in entries in unmanned missions; such an entry is obviously impractical for a manned vehicle. For the proposed research facility, therefore, it was decided to assume the pilot might be required to maneuver to the maximum human tolerance limit. The design value of 50g was selected as a reasonable state-of-the-art advance from the 36g already tolerated by a human pilot in the water capsule on the Johnsville centrifuge. Any specific lunar mission in non-emergency conditions would obviously require much less capability, but the research value of the proposed device would be seriously compromised if its capability were based on these lesser requirements.

Deceleration: Two deceleration rate conditions must be considered: that related to simulation of the re-entry or landing maneuver and which has a relatively low maximum value (5g per sec), and that related to final touchdown which is, in effect, an impact deceleration. The capability of producing the first of these to the level required follows

directly from the ability to achieve the necessary "g" onset rate and thus requires no special design consideration. The second, the ability to bring the capsule to an abrupt stop from some appropriate approach velocity to represent the lunar or earth landing impact, does require some special design consideration. Although it is possible to provide crew support for impact rates of 1800g per sec, it is probable that vehicle design could not countenance rates of this order if vehicle re-use were required. Therefore, a lower value of 300g per sec was chosen as the maximum required. The maximum velocity from which this deceleration would start was chosen as 60 feet per second, considered an upper limit of vertical descent rates for spacecraft landing. Thus, a braking system is required which will bring the arm to a stop from a maximum of 12 rpm in 0.2 or 0.3 of a second. It is expected that a straightforward mechanical braking system will provide the desired deceleration stress necessary for research on the integration of the pilot restraint system with other flight requirements.

Degrees of freedom: The degrees of freedom are significant in that they proportionally reduce the false or missing motions introduced by an incomplete simulator. Experience with the three-degree-of-freedom Johnsville centrifuge and with analytical studies have stressed the importance of this problem. Only five degrees of freedom are proposed simply because we do not know how to build a complete six-degree-of-freedom device.

Dynamic response of gimbals: A dynamic response that is constant to a frequency of three cycles per second has been chosen to match the short-period dynamics of proposed vehicles, and to position the pilot properly with respect to the "g" vector.

The items in the table entitled "Environmental Capabilities," are discussed in the following paragraphs:

Crew number: This item obviously can be a compromise in the engineering design study. However, a careful review of three design studies for a proposed manned lunar vehicle indicates sufficient overlapping of crew stations and duties to warrant an intensive

effort to provide a device capable of operating all three crew stations simultaneously. The real justifications for a three-man cab are probably intangible psychological effects and the need for emergency-control procedures; therefore, the crew number should be reduced only if a detailed study shows an inordinate cost.

Pressure: Existing techniques for emergency de-pressurization, such as pressure suits or cocoons, must be considered an integral part of the control-station design problem and included in the simulation. The possibility of exercising such equipment is also a useful mental stress which helps compensate for the lack of any real anxiety on the part of the test subjects in a simulation device.

Temperature: This is an important fatigue producing environmental stress and becomes increasingly so in longer missions.

Vibration and noise: The same considerations as above apply and these stresses must be included in any study of the cumulative total effect of a flight.

Long work cycle: When missions of the length of a lunar flight are considered, the simulator must incorporate a life-support system, and provisions must be made for testing actual flight hardware.

Interchange of cab: Experience has shown that this feature will be required for a reasonable rate of utilization for a facility of this size and cost. Successive investigations on this type of simulator very often are directed toward different specific vehicles and the downtime would become prohibitive if it were necessary to modify continuously one cab or shell mounted permanently on the simulator. The present proposal does not include the furnishing of additional cabs but does contemplate design so that interchangeability will be possible. The decision on the need for the characteristics of an additional cab, as well as procurement of such a cab, will be a part of the planning and funding of future major investigations undertaken with the proposed facility.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$350,000
	Utility connections, parking lots, and roads	$90,000	
	Electrical connections and distribution system	260,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		7,340,000
	Centrifuge system	2,880,000	
	Vertical drive	660,000	
	Programmed braking device	220,000	
	Fluid bearing	620,000	
	Three-degree-of-freedom drive	400,000	
	Three-degree-of-freedom gimbal structure	550,000	
	Capsule structure with internal controls	450,000	
	Centrifuge controls	440,000	
	Capsule external controls (less navigation instrumentation)	435,000	
	Buildings	685,000	
	Main centrifuge area and foundations (17,500 square feet at $22.00 per square foot)	385,000	
	Control room and support building (12,800 square feet at $23.44 per square foot)	300,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		1,450,000
	Navigation equipment, optical instruments, and simulated display equipment	750,000	
	Digital-analog computer conversion equipment	700,000	
E.	DESIGN AND ENGINEERING SERVICES		650,000
	Preliminary design	250,000	
	Final detailed design	400,000	
	Total estimated cost		$9,790,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES - 1963 PROGRAM

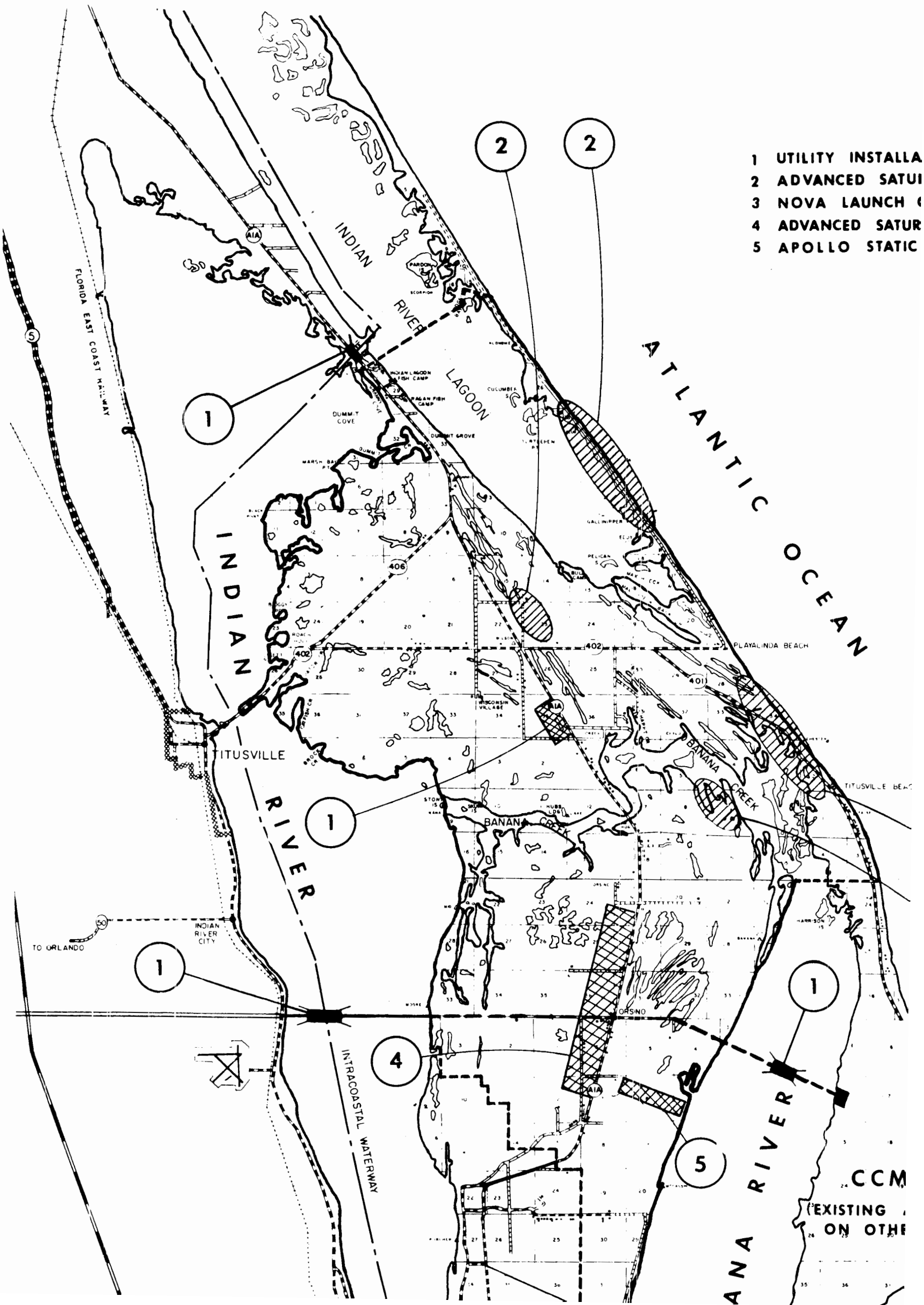
ATLANTIC MISSILE RANGE

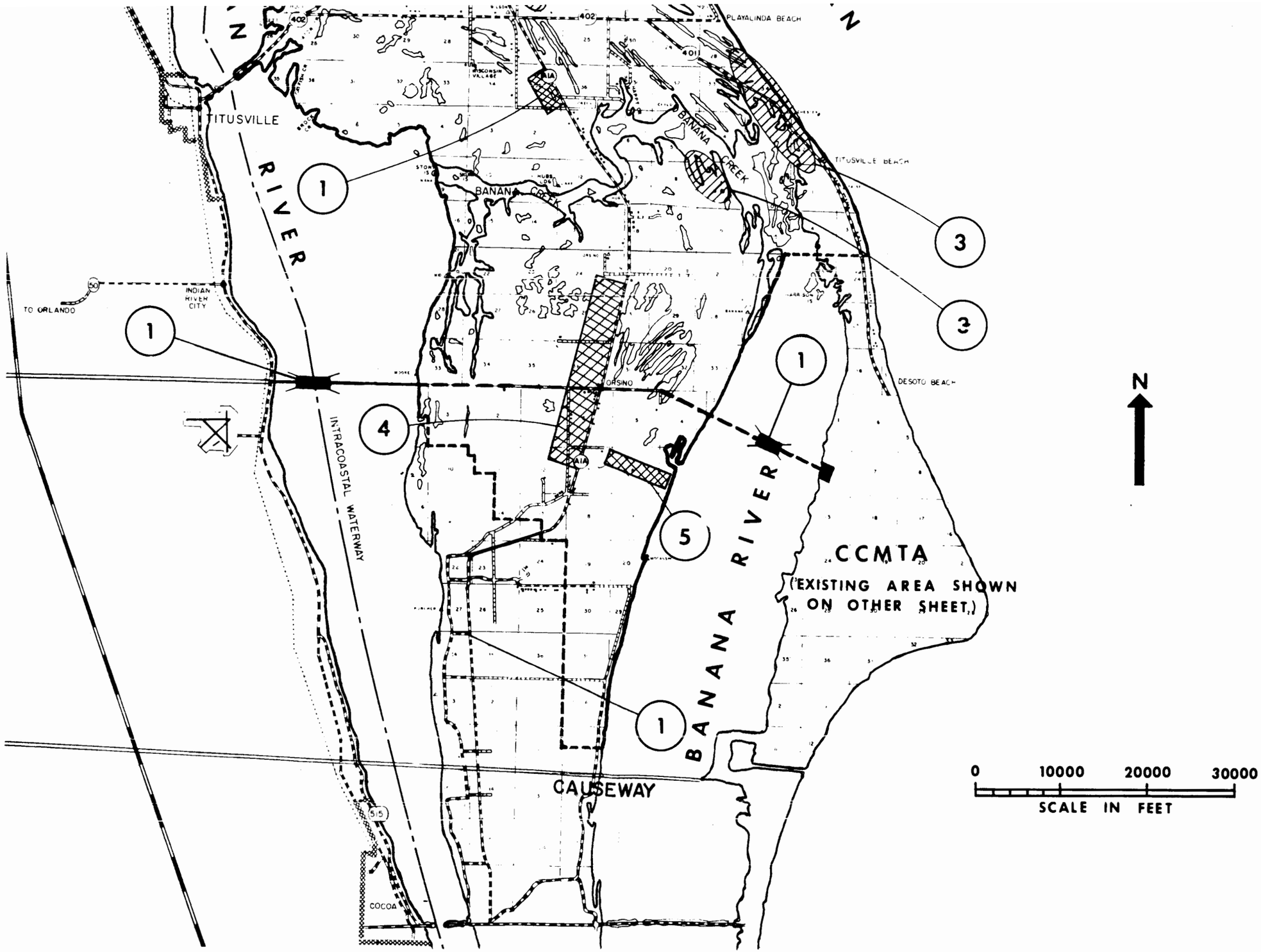
Page No.		
CF2-A2	Location Plan	
	Existing Area:	
CF2-A3	Modifications to Saturn launch complex No. 34...	$3,765,000
CF2-B1	Modifications to Saturn launch complex No. 37...	1,150,000
CF2-C1	Modifications to provide a launch complex for solid suborbital vehicles.....	1,717,000
CF2-D1	Supporting facilities.....	3,000,000
CF2-E1	Addition to assembly facility for unmanned spacecraft.....	2,000,000
CF2-F1	Explosive safe assembly facilities for unmanned spacecraft.....	450,000
CF2-G1	Apollo mission support facilities.....	22,510,000
CF2-H1	Modifications to Titan II launch complex.....	2,400,000
CF2-I1	Utility installations.....	800,000
	New Area:	
CF2-J1	Advanced Saturn launch complex No. 39.....	176,550,000
CF2-K1	Advanced Saturn-Nova supporting facilities.....	39,121,000
CF2-L1	Apollo static test facility.....	5,000,000
CF2-M1	Nova launch complex.....	79,500,000
CF2-N1	Utility installations.....	22,000,000
	Total.....	$359,963,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN (NEW AREA)

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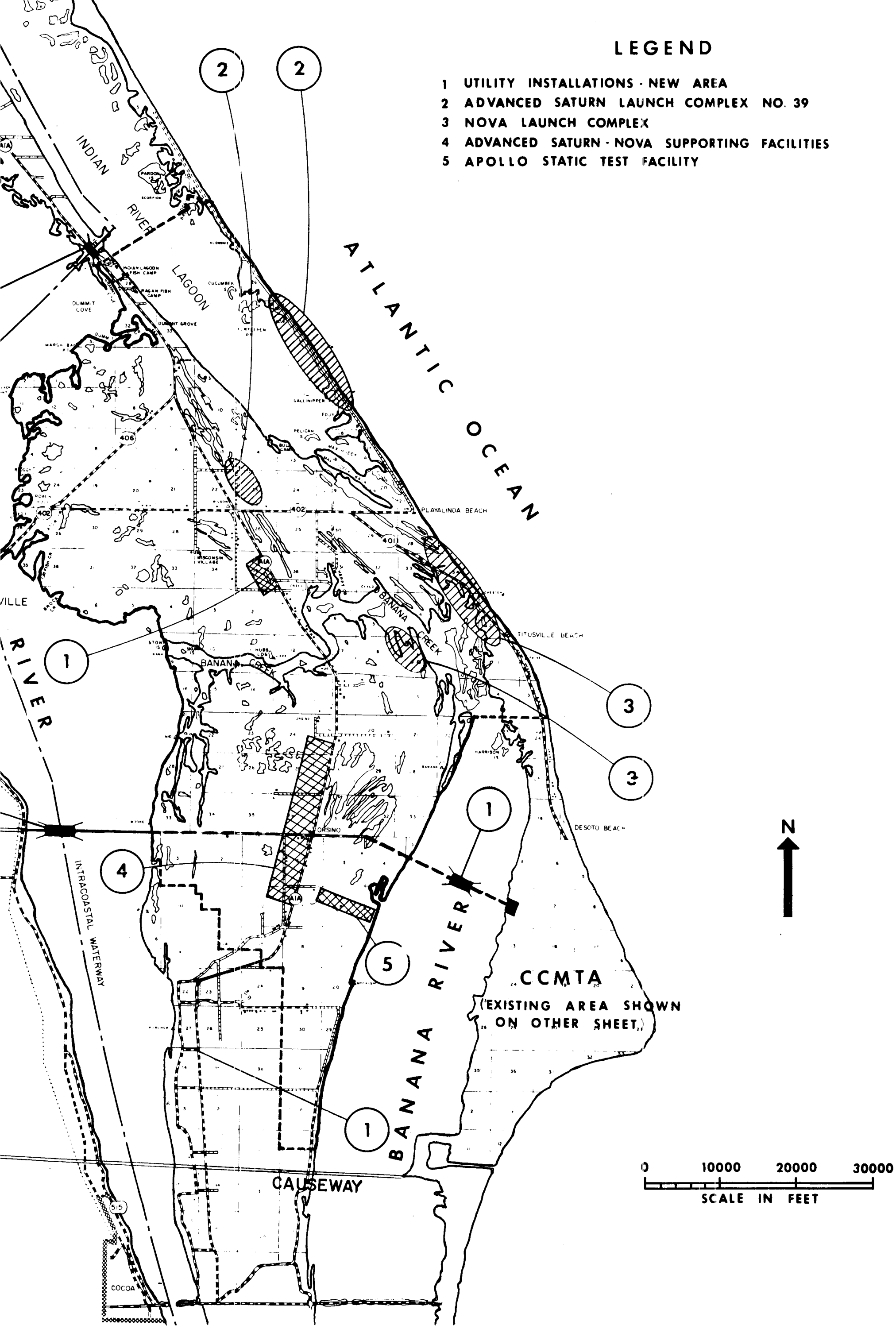
LEGEND
1 UTILITY INSTALLATIONS - NEW AREA
2 ADVANCED SATURN LAUNCH COMPLEX NO. 39
3 NOVA LAUNCH COMPLEX
4 ADVANCED SATURN - NOVA SUPPORTING FACILITIES
5 APOLLO STATIC TEST FACILITY
ATLANTIC OCEAN
INDIAN RIVER
INDIAN LAGOON
LAGOON
PLAYALINDA BEACH
TITUSVILLE BEACH
DESOTO BEACH
BANANA CREEK
BANANA RIVER
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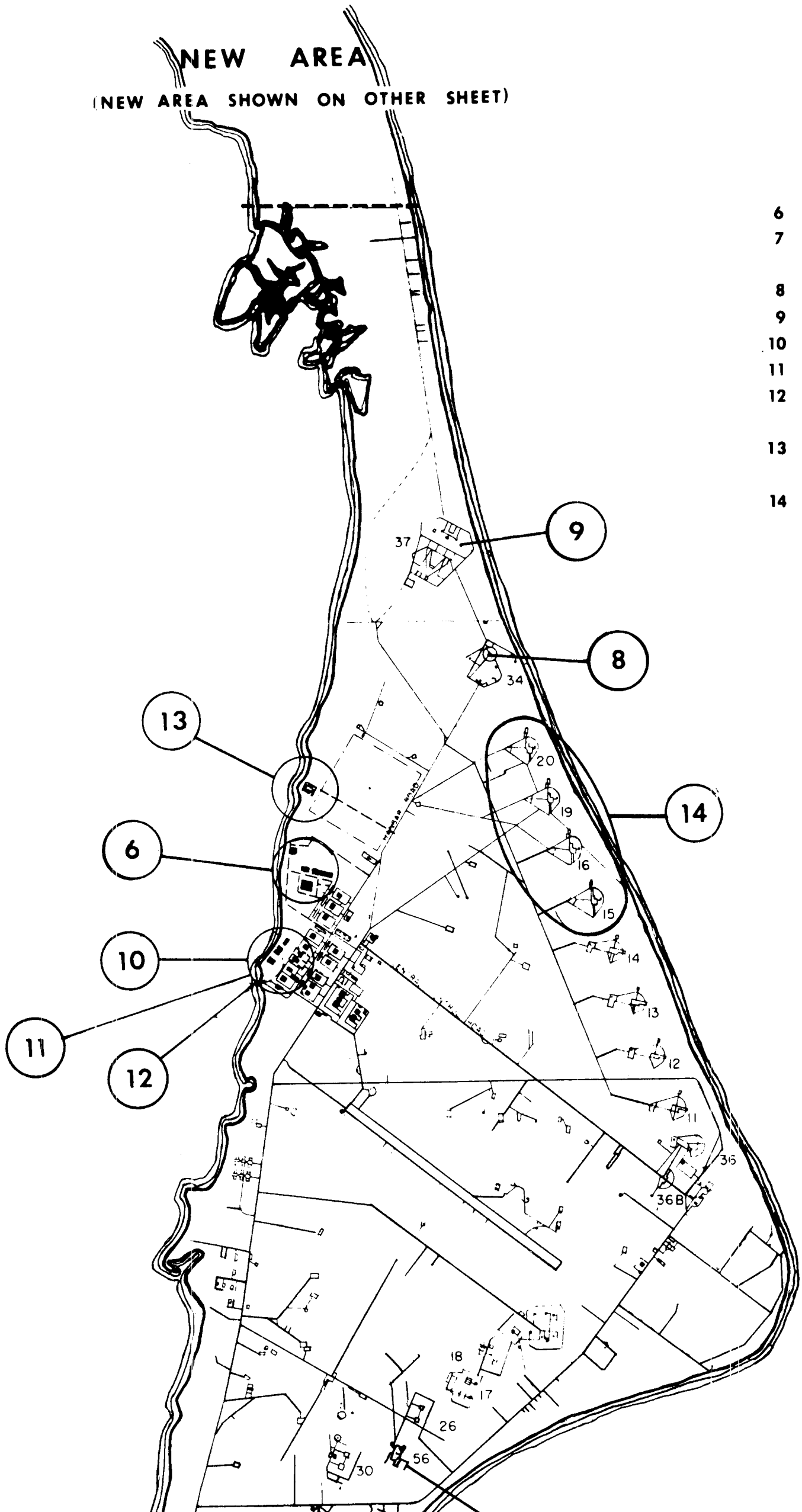
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN (EXISTING AREA)



LEG

6 APOLLO MISSION SUPPO
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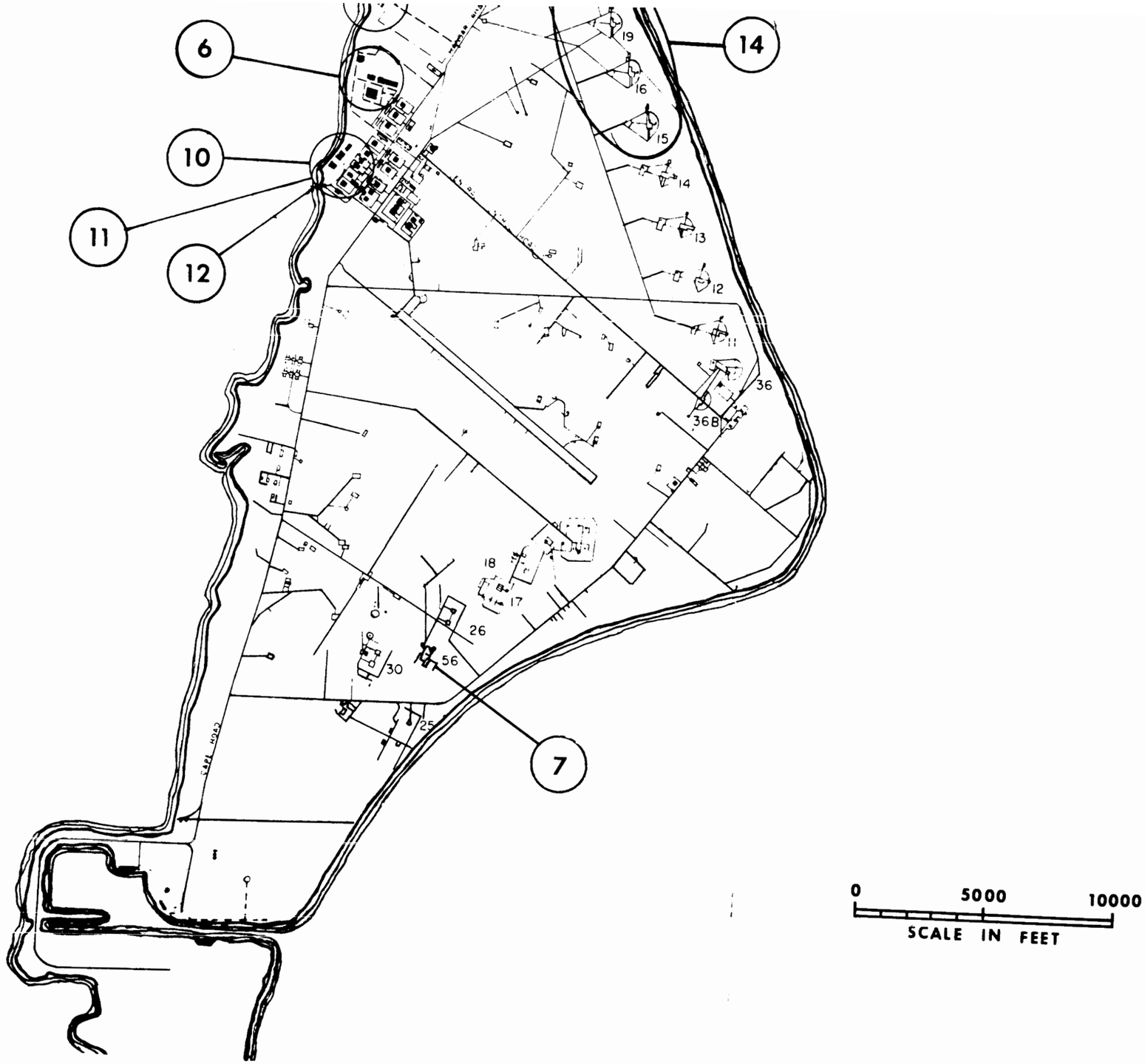
8 MODIFICATIONS TO SATUR
9 MODIFICATIONS TO SATUR
10 UTILITY INSTALLATIONS
11 SUPPORTING FACILITIES
12 ADDITION TO SPACECRAFT
UNMANNED SPACECRAFT
13 EXPLOSIVE SAFE ASSEMBL
SPACECRAFT
14 MODIFICATIONS TO TITA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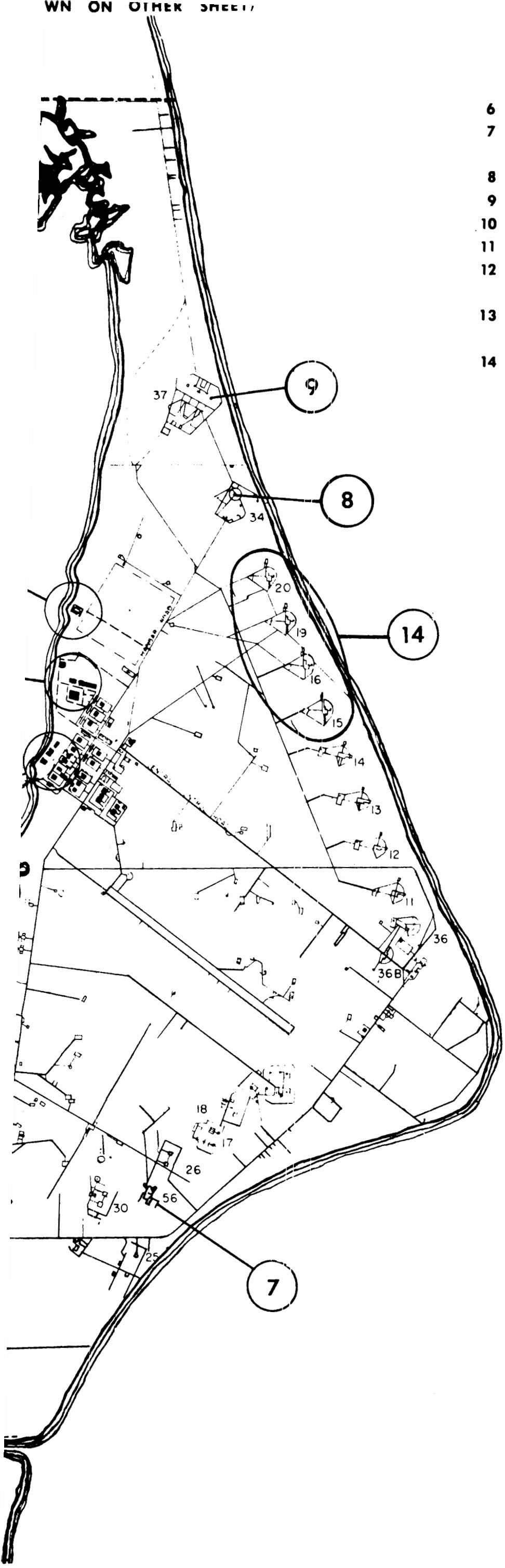

LEGEND

6 APOLLO MISSION SUPPORT FACILITIES
7 MODIFICATIONS TO PROVIDE A LAUNCH COMPLEX FOR SOLID SUBORBITAL VEHICLES
8 MODIFICATIONS TO SATURN LAUNCH COMPLEX NO. 34
9 MODIFICATIONS TO SATURN LAUNCH COMPLEX NO. 37
10 UTILITY INSTALLATIONS
11 SUPPORTING FACILITIES
12 ADDITION TO SPACECRAFT ASSEMBLY FACILITY FOR UNMANNED SPACECRAFT
13 EXPLOSIVE SAFE ASSEMBLY FACILITY FOR UNMANNED SPACECRAFT
14 MODIFICATIONS TO TITAN II LAUNCH COMPLEX

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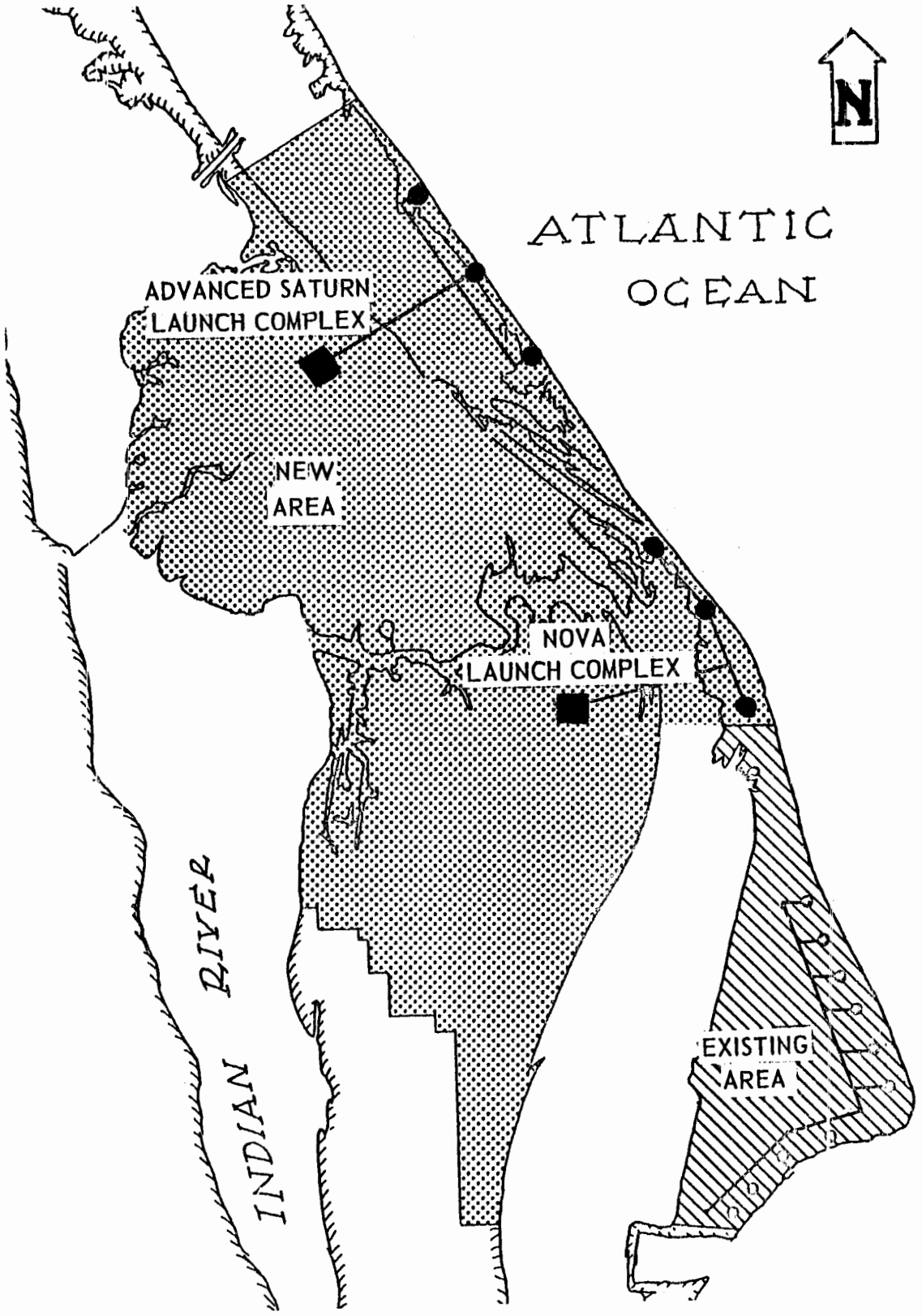
ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN



CF 2-A2c

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO SATURN LAUNCH COMPLEX NO. 34

DESCRIPTION:

Additions and modifications are required to Saturn launch complex No. 34 to accommodate operational C-1 Saturn vehicle design configurations. The project includes additional liquid propellant blast protection; an extension of the service structure rail beams; modifications to air conditioning, ventilation, and vehicle environmental systems; extension of the high-pressure gas and transfer system facilities; alterations to the service structure; and modifications to the umbilical tower to incorporate an escape system, as follows:

(a) Extension of the service structure rail beams: The service structure rail beams will be extended from 600 feet to 1200 feet from the launch area to park the structure a safe distance from potential combined blast effects of hydrogen and other propellants in event of detonation with larger launch vehicles. The project will also include vibroflotation compaction to increase earth bearing values, and installation of concrete support beams.

(b) Liquid propellant systems blast protection: The existing liquid oxygen storage sphere will be "Hardened" by the installation of a structural tie-down ring on the sphere with steel cable ties extending from this ring to concrete deadmen. The protective emplacements for liquid oxygen transfer equipment will also be expanded. The existing liquid hydrogen emplacement will be increased to provide an installation with concrete footings for one additional storage sphere. Protection for the liquid hydrogen transfer pumps and related equipment will be provided by construction of an earth berm against a concrete revetment. Increased utility services with the necessary underground cables and ducts will also be provided at the liquid hydrogen storage and transfer facility.

(c) Modifications to air conditioning, ventilation, and vehicle environmental systems: Modifications to the systems will be required to accommodate the advanced C-1 vehicle configurations.

(d) High-pressure gas systems and transfer facilities: The existing high-pressure gas systems and transfer facilities will be augmented and the scope and capacities of the existing transfer facilities will be increased.

(e) Modifications to service structure: The service structure for vehicle handling and erection will be modified to accommodate various vehicle configurations. Modifications will provide new or relocated service platforms, clearance changes between vehicle and structure, guying, and wind protection.

(f) Umbilical tower escape system: The structural members of the umbilical tower will be modified and redesigned to incorporate a mechanized escape system to enable the astronaut to leave the spacecraft after the service structure has been retracted from the space vehicle.

Sketches indicating the location of the proposed work are shown on the following two pages.

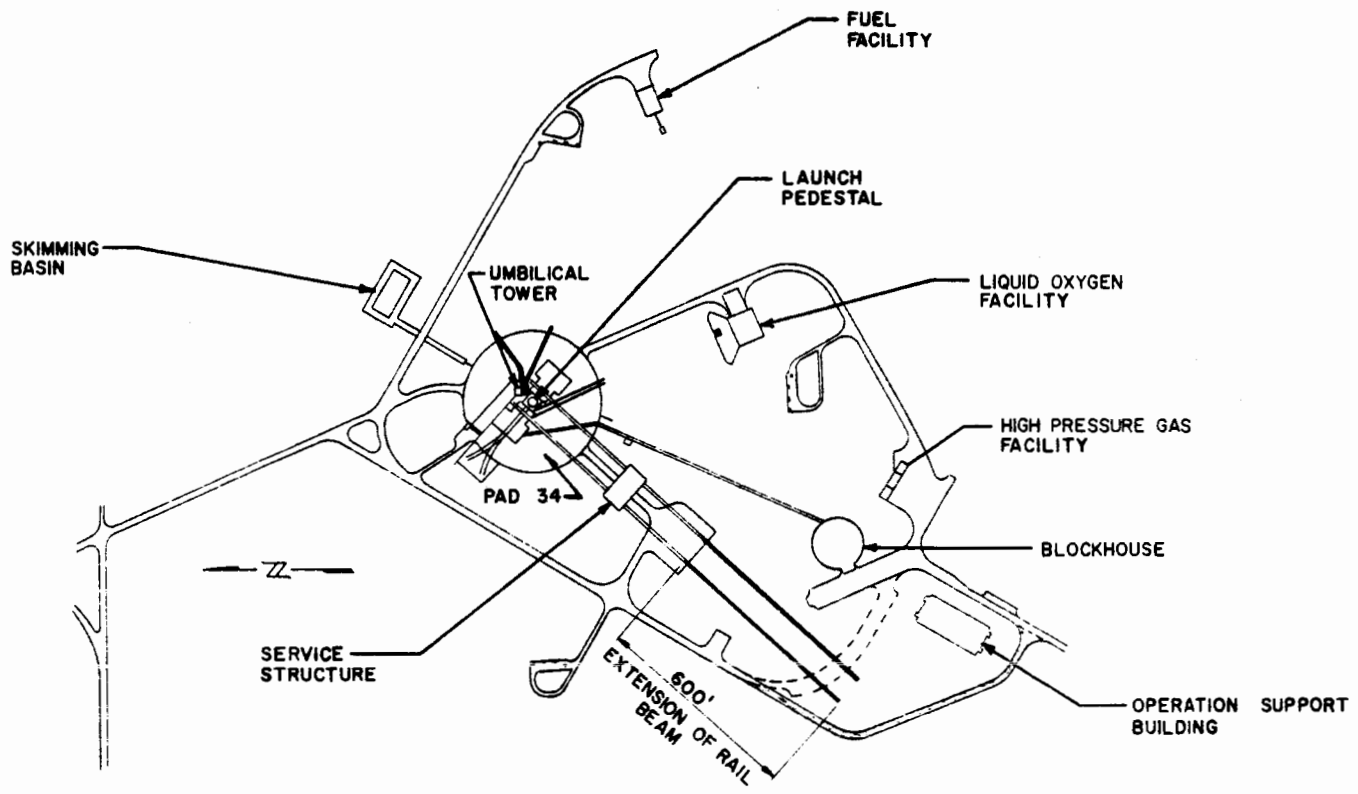
JUSTIFICATION:

The basic Saturn launch complex No. 34 includes all necessary facilities for handling, storing, servicing, checking out, erecting, and launching early Saturn vehicles, as well as the required administrative and logistical facilities, and the special research laboratory facilities to support various projects included in the initial phase of the Saturn program. The objectives of the Saturn project were originally limited to developing and launching large clustered boosters with dummy upper stages to establish feasibility. Criteria for a minimum type facility were developed with minimum guidelines, and construction of the complex was initiated. As the program developed, the need for servicing live upper stages became a requirement, making it necessary to provide capability for upper-stage propellant loading, control and servicing pneumatics, and additional control and monitoring facilities for upper stages. This work is proceeding with funds provided in the fiscal year 1962.

The need for larger vehicles and increased payload capabilities now requires a further modification of the basic complex. The fiscal year 1962 project did not take into account the, then undeveloped, criteria on the blast potential of liquid hydrogen fuels. A recent study produced new criteria which indicated that the fiscal year 1962 project provided inadequate funds to meet the requirement for safety represented in this project by extension of service structure rail beams and protection of the propellant system. The study also produced criteria which necessitates modifications to the air-conditioning, ventilating, and environmental systems. Modifications to the high-pressure gas system are

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

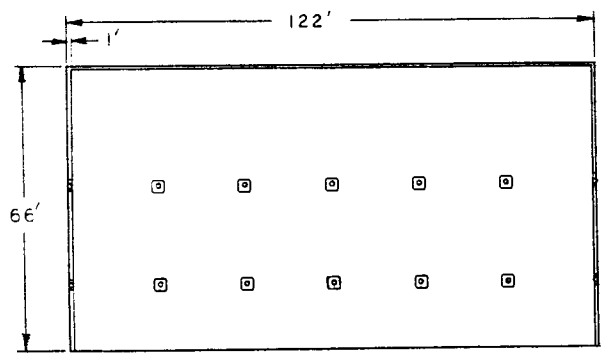
MODIFICATIONS TO LAUNCH COMPLEX NO. 34



ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

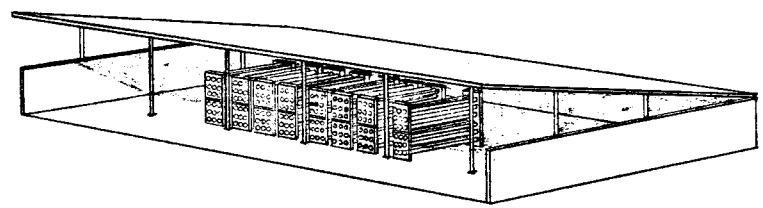
MODIFICATIONS TO SATURN LAUNCH COMPLEX NO. 34

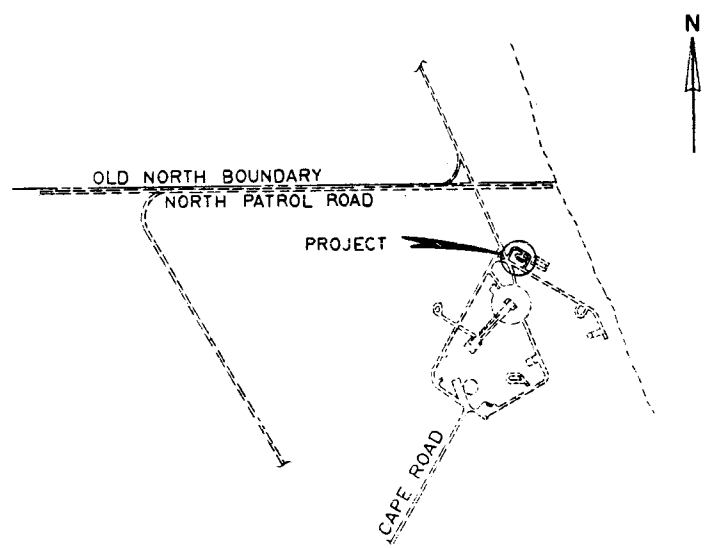


FLOOR PLAN

20 10 0 20 40

SCALE-FEET





MODIFICATIONS TO HIGH PRESSURE GAS SYSTEM

SITE PLAN

connected with the environmental systems modifications and with the employment of helium as a pressurization agent for upper stages. The modifications to the service structure will provide for hurricane protection to the vehicle and for explosive measures in critical areas of the service structure. The requirement for the umbilical tower escape system is dictated by safety considerations. With the advent of larger, higher thrust vehicle concepts, launch facilities and support systems must undergo continuous modification to provide the required additional capabilities.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$50,000
	Site preparation	$50,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		1,785,000
	Extension of service structure rail beams	1,030,000	
	Modifications to service structure	480,000	
	Modifications to umbilical tower	275,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		1,555,000
	Protection of propellant systems	185,000	
	Modifications to ventilation, air conditioning, and environmental systems	370,000	
	Modifications to high pressure system	1,000,000	
E.	DESIGN AND ENGINEERING SERVICES		375,000
	Total estimated cost		$3,765,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO SATURN LAUNCH COMPLEX NO. 37

DESCRIPTION:

Additions and modifications are required to the facilities within the dual pad Saturn launch complex No. 37. A drawing of this complex is shown on the next page. The project includes:

High pressure gas system: Additional gas distribution lines are necessary to provide services to pad 37A. This system will be used for checkout, purge, and pressurization of the vehicle and for the functional operation of the ground support equipment.

Umbilical tower escape systems: The umbilical towers on both launch pads will be modified and redesigned to incorporate mechanized escape (or rescue) systems to enable the astronaut to leave the spacecraft after the service structure has been retracted from the space vehicle on either pad.

Modifications to service structure: The service structure for vehicle handling and erection will be modified to accommodate various vehicle configurations. The modifications will include changes to the structure to provide new service platforms, the addition of elevators, and clearance changes.

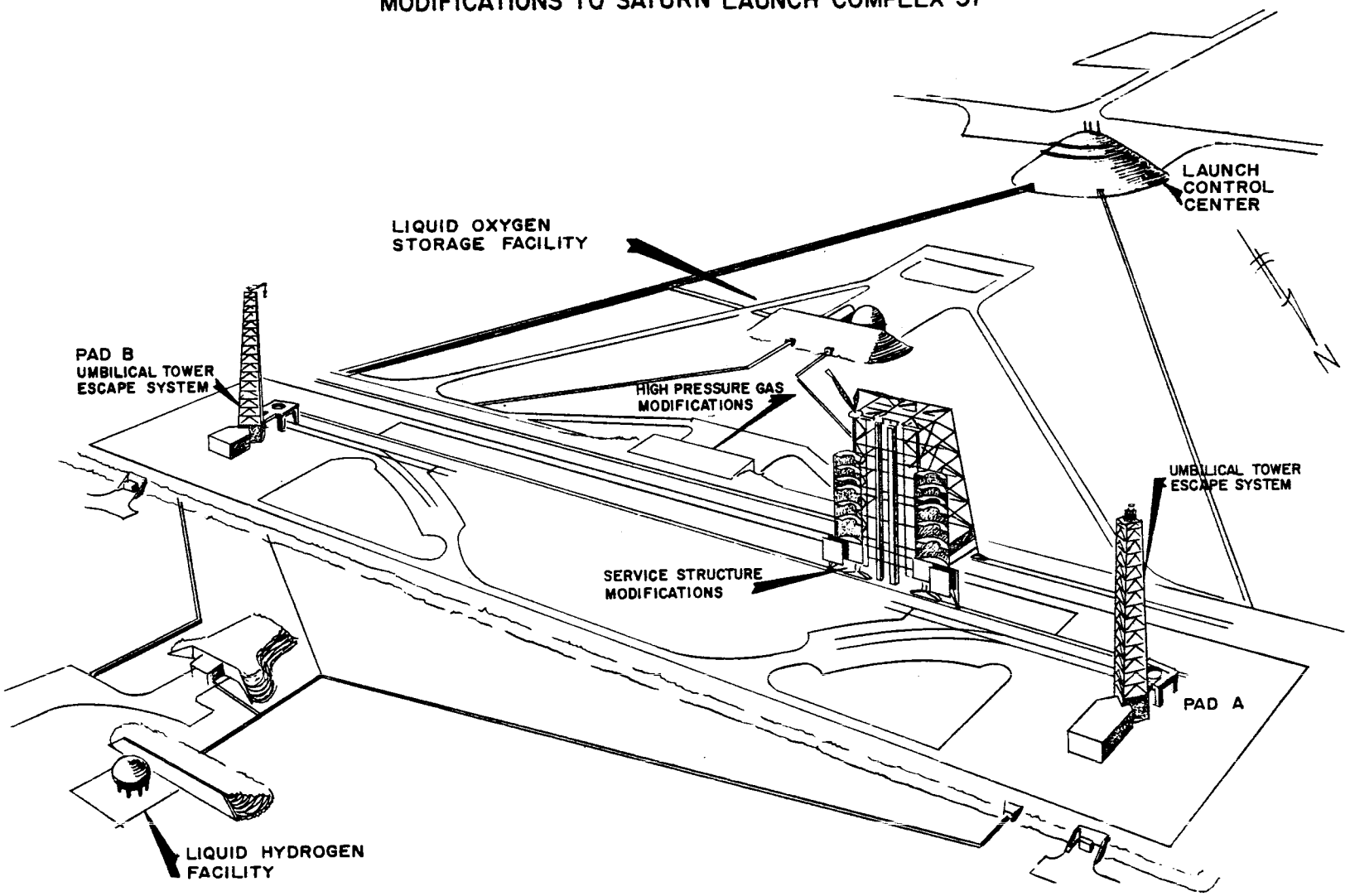
JUSTIFICATION:

The improvements covered by this project are required for launching Advanced Saturn vehicle configurations. The objectives of the Saturn project were originally limited to developing and launching large clustered boosters with dummy upper stages to establish feasibility. Fiscal year 1962 funds provided dual pad capability for Saturn launch complex No. 37; all necessary facilities for handling, storing, servicing, checking out, erecting, and launching the early Saturn vehicles; the required administrative and logistic facilities; and special research laboratory facilities to support various projects included in the initial phase of the Saturn program. Criteria for a minimum type facility were developed with minimum guidelines, and construction, of the complex was initiated. As the program developed, the need for servicing live upper stages became a requirement, making it necessary to provide capability for upper stage propellant loading, control

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO SATURN LAUNCH COMPLEX 37



and servicing pneumatics, and additional control and monitoring facilities for upper stages. With the advent of larger, higher thrust vehicle concepts, launch facilities and support equipment must undergo continuous modification and redesign to provide the required additional capabilities.

COST ESTIMATE:

A.	LAND ACQUISITION.....		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		---
C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		$184,000
	Modifications to service structure.....	$184,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		828,000
	High pressure gas system.....	276,000	
	Umbilical tower escape system, Pad A..	276,000	
	Umbilical tower escape system, Pad B..	276,000	
E.	DESIGN AND ENGINEERING SERVICES.....		138,000
	Total Estimated Cost.....		$1,150,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO PROVIDE A LAUNCH COMPLEX FOR SOLID SUBORBITAL VEHICLES

DESCRIPTION:

Modifications are required to the existing Redstone facilities at launch pad No. 5 to provide a launch facility for solid suborbital rocket boosters to be used in Apollo development testing. The modifications will consist of: removing the present Redstone holding mechanism and installing a new holding mechanism for the solid fueled booster; installing new instrumentation cabling from launch pad No. 5 to the existing blockhouse; modifying the existing service tower to install a new white room which will be required at the level of the capsule that will be on top of the booster (this white room is required to provide a dust free, humidity control area where capsule checkout and minor repair can be accomplished); modifying the present umbilical tower if possible, or fabricating a new one; constructing a revetment between the modified pad No. 5 and the existing blockhouse; and relocating a present road and parking area.

A sketch of the proposed facility is shown on the following page.

JUSTIFICATION:

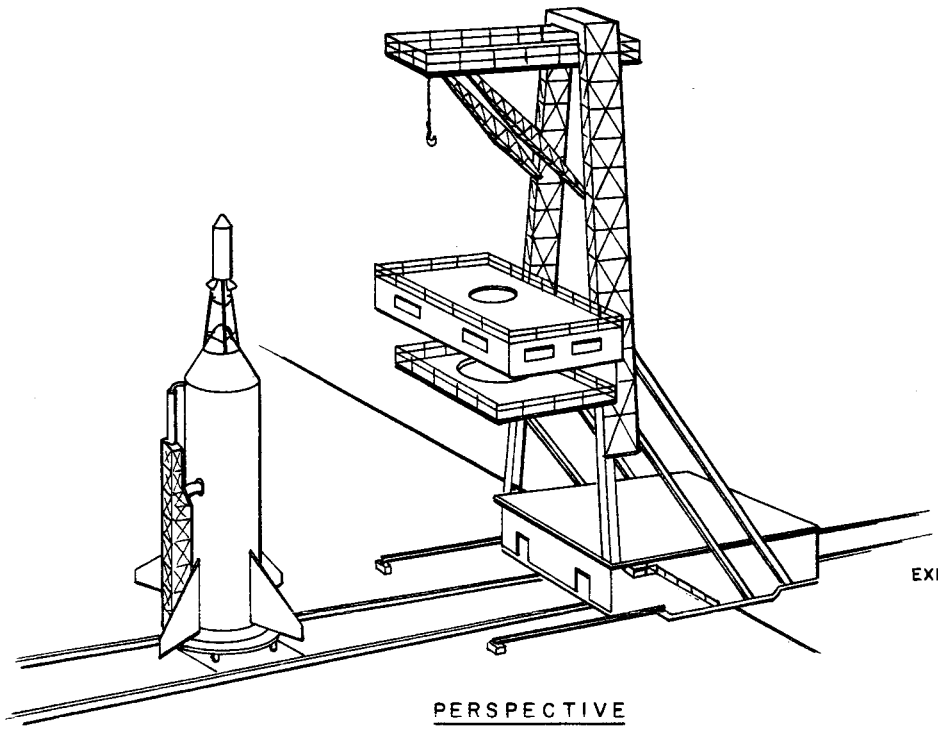
The existing pad No. 5 is used for the Redstone (maximum thrust of 78,000 pounds) program. To utilize to the maximum feasible extent existing facilities in this area, it is proposed to modify launch pad No. 5 to handle the greater thrust of a solid fueled booster (maximum thrust of 250,000 pounds using seven engines). This greater thrust requires that the holding mechanism for the Redstone be removed and a new holding mechanism be installed. The fuel to be used by the booster requires safety precautions and safety distances for the supporting facilities; this condition requires that a revetment be constructed to protect the existing blockhouse, and that a road and parking area be relocated.

The conduct of Project Apollo requires the flight qualification of spacecraft modules and systems prior to the first manned flight. Many of these items can be partially or completely qualified with suborbital flights with relatively inexpensive launch vehicles. The proposed boosters will be clusters of available solid fuel rocket engines (as many as 7) mounted in a fin stabilized airframe. These boosters will be used to qualify the following components:

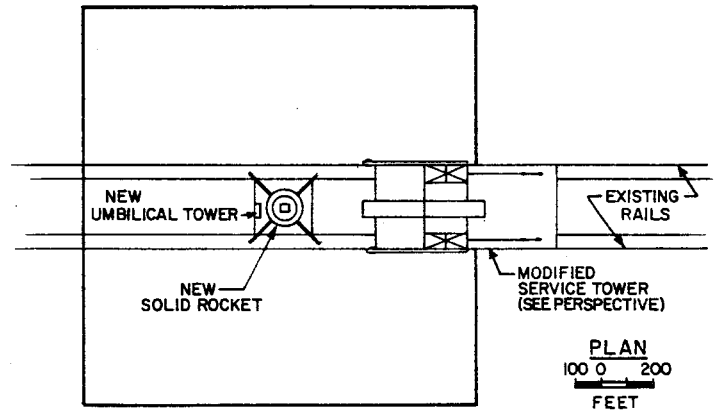
ATLANTIC MISSILE RANGE

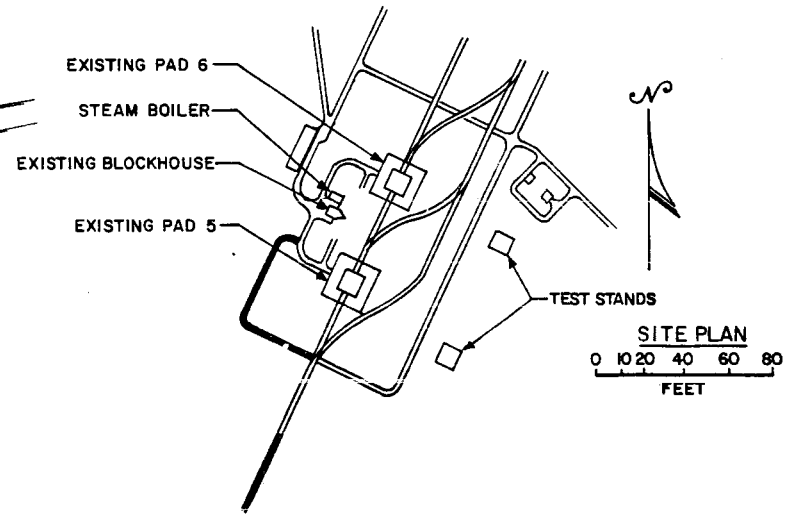
FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO PROVIDE A LAUNCH COMPLEX FOR SOLID SUBORBITAL VEHICLES



PERSPECTIVE





(a) Command service module:

Launch escape system
Earth landing system
Structural system (partial qualification)
Service propulsion system (partial qualification)
Stabilization

(b) Lunar landing module (partial qualification):

Structural system
Propulsion system
Stabilization system

(c) Lunar landing propulsion module:

Structural system
Propulsion systems
Stabilization systems

COST ESTIMATE:

A. LAND ACQUISITION			---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS			$226,000
Site preparation		$30,000	
Roads and parking areas		55,000	
Utility connections		141,000	
Water	$42,000		
Sewage	17,000		
Electrical	82,000		
C. FACILITY CONSTRUCTION AND MODIFICATIONS			852,000
Modifications to launch pad No. 5		495,000	
Pad modifications and holding mechanism	465,000		
Umbilical tower	30,000		
Service structure modifications		350,000	
Extension and modification of boom	40,000		
Outriggers and tower	100,000		
Dust and humidity control	170,000		
Addition to work platform	40,000		
Blockhouse revetment		7,000	

D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$429,000
	Booster air conditioning system.....	$120,000	
	Fire protection system.....	150,000	
	Communication system.....	9,000	
	Telemetering and command monitoring instrumentation.....	50,000	
	Capsule and monitoring cable systems.....	100,000	
E.	DESIGN AND ENGINEERING SERVICES.....		210,000
	Total estimated cost.....		$1,717,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

SUPPORTING FACILITIES - EXISTING AREA

DESCRIPTION:

This project requests funds for the construction of four support facilities in the NASA industrial area at the Atlantic Missile Range. Three engineering and laboratory type facilities and a consolidated supply and storage building, are required in support of all NASA programs. A sketch of the facilities is shown on the next page. The scope of the project is as follows:

(a) Launch operations facility: An air conditioned five-story engineering and laboratory building 52 feet wide by 173 feet long will be constructed with a total gross area of 45,000 square feet. Building construction will be reinforced concrete with masonry walls. It will provide urgently required engineering and laboratory space for NASA scientific, technical, project engineering, and coordination personnel required to support NASA launch operations at the range.

(b) Addition to engineering operations building: A two-story addition of 15,300 square feet gross area will be constructed on the north end of the existing engineering operations building to provide engineering office space for 140 technical personnel. The addition will be air conditioned and will conform with the architecture of the existing facility.

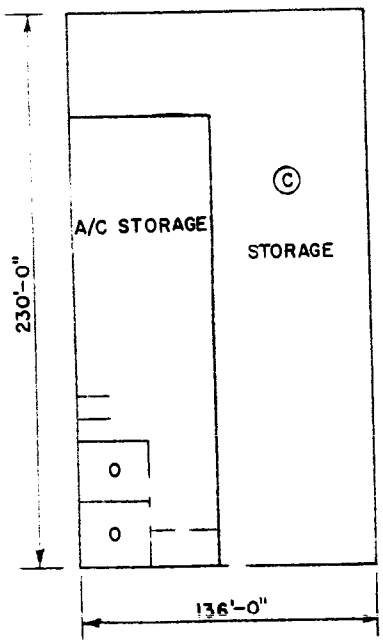
(c) Central supply facility: This facility will be a partially air conditioned central supply building approximately 136 feet wide by 250 feet long with a gross area of 33,600 square feet. The building will be constructed of prefabricated sections on concrete foundations and a concrete floor slab. It will permit NASA operations to consolidate their presently widely separated general supply activities and to provide a more efficient supply and storage function for such items as electronic equipment, and booster, upper-stage, and spacecraft spare parts and assemblies.

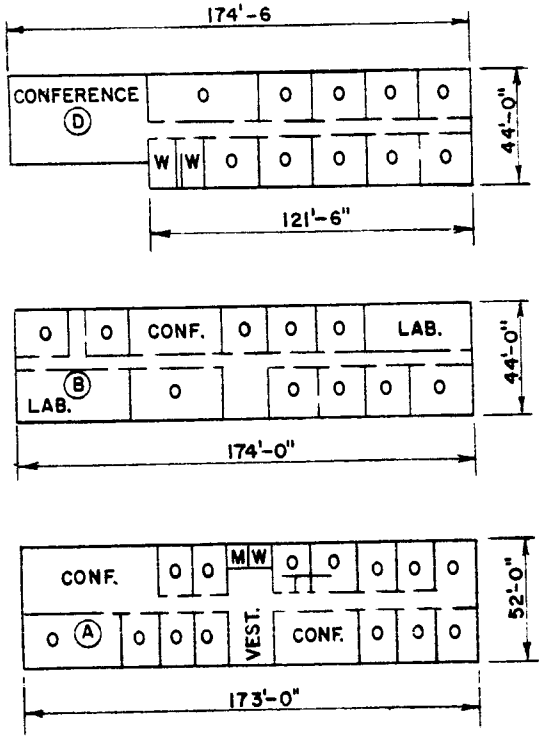
ATLANTIC MISSILE RANGE

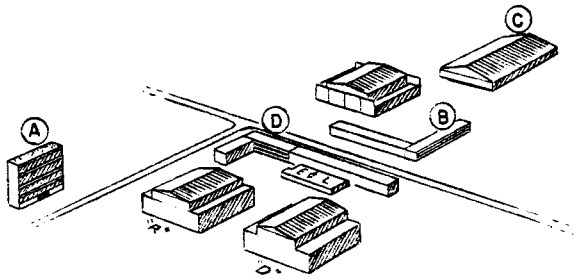
FISCAL YEAR 1963 ESTIMATES

SUPPORT FACILITIES EXISTING AREA

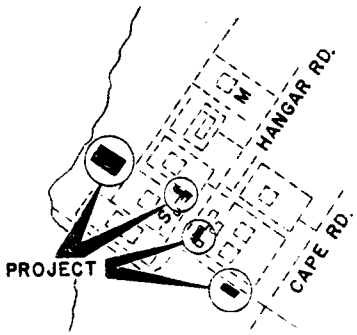
A LAUNCH OPERATIONS FACILITY
B ADDITION TO ENGINEERING OPERATIONS BUILDING
C CENTRAL SUPPLY FACILITY
D ENGINEERING & LABORATORY ANNEX







PERSPECTIVE



SITE PLAN

LEGEND

O-OFFICE
VEST.-VESTIBULE
LAB.-LABORATORY
CONF.-CONFERENCE

25' 0 75'
SCALE-FEET

(d) Engineering and laboratory annex: This facility will be an air conditioned building of two-story construction, adjoining and connecting the existing engineering and laboratory building and the existing NASA supply building. The annex will be constructed of reinforced concrete frame with masonry curtain walls and glass block inserts in conformance with the existing architecture of the engineering and laboratory building. It will provide 13,760 square feet gross area. The annex will be used for the preparation, coordination, and reproduction of technical information, including documentation, publications, reports, technical exhibits, and presentations.

JUSTIFICATION:

NASA's expanding activities at the Atlantic Missile Range require additional support facilities in the existing industrial area. The large influx of personnel, supplies, and materials in support of the program will require adequate space for the pursuit of this project.

Existing NASA facilities of the engineering, laboratory, supply, and storage, type, are occupied to the saturation point. There are no available facilities to accommodate any part of the planned increases in NASA or contractor personnel, or to handle the increased volume of supplies and materials that will be required to support NASA programs. Timely construction of these support facilities is an urgent requirement.

COST ESTIMATE:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$457,000
Site preparation, grading, and filling.....	$171,000	
Roads and parking areas.....	73,000	
Utility connections.....	213,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		1,877,000
Launch operations facility..(45,000 square feet at $23 per square foot).....	1,035,000	
Addition to engineering operations building..(15,300 square feet at $19 per square foot).....	291,000	
Central supply facility..(33,600 square feet at $9 per square foot).....	303,000	

Engineering and laboratory annex (13,760 square feet at $18 per square foot).....	$248,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$324,000
Equipment.....	202,000	
Furniture.....	122,000	
E. DESIGN AND ENGINEERING SERVICES.....		342,000
Total estimated cost.....		$3,000,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADDITION TO ASSEMBLY FACILITY FOR UNMANNED SPACECRAFT

DESCRIPTION:

This project discusses the need for the construction of an air-conditioned addition to the first section of the spacecraft assembly building. The addition will consist of a second floor to the laboratory area and a new two-story engineering and laboratory building with an attached high-bay checkout and assembly area at the rear. A sketch of the addition is shown on the following page.

The engineering and laboratory portions of the addition (26,960 square feet) will be constructed of reinforced concrete with masonry curtain walls. The high bay area (18,225 square feet) will be of steel frame construction, with masonry and asbestos siding for the curtain walls. Two 15-ton bridge cranes, each having a hook height of 45 feet, will be provided in the high bay area for the handling of spacecraft.

JUSTIFICATION:

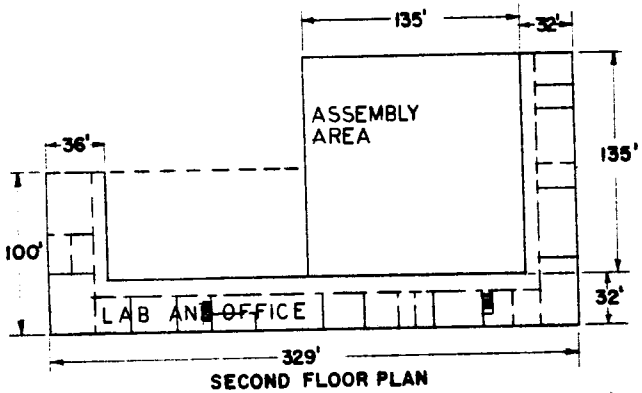
Additional laboratory assembly and checkout facilities are required for the advanced and timely preparation, sterilization, evaluation, and performance of spacecraft and flight components under closely controlled environments of temperature, humidity, pressure, fungus and spore-free ambients, and radiation to simulate expected actual flight conditions. Larger future spacecraft configurations will also be accommodated in this addition.

The existing spacecraft preparation facilities are inadequate in both scope and size to meet the 1964 calendar year flight schedules. The inadequacy of the existing spacecraft facilities is further emphasized by the concurrent requirements of the Agena-B and Centaur-based flight programs, including earth orbiter, lunar soft landing, and Venus and Mars fly-by missions. Provision must be made for the simultaneous preparation of as many as four space vehicles with the additional possible requirement of providing back-up vehicles. Longer preparation time schedules plus over-lapping launching schedules for lunar and planetary missions, create the requirement for additional payload preparation and checkout facilities.

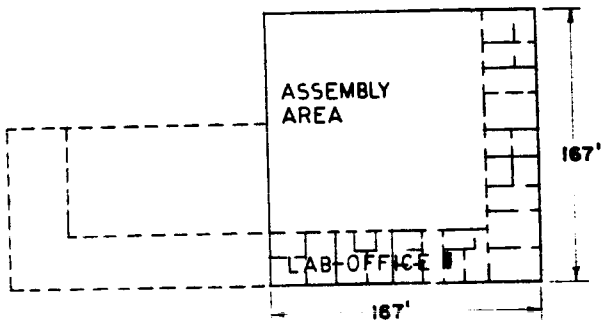
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADDITION TO ASSEMBLY FACILITY FOR UNMANNED SPACECRAFT



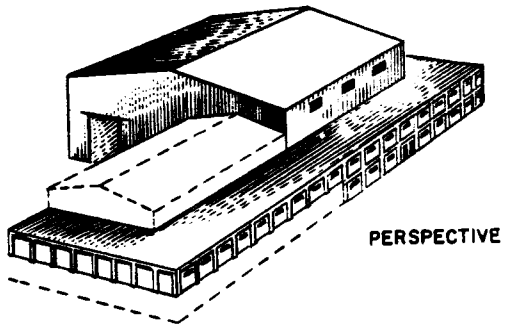
SECOND FLOOR PLAN



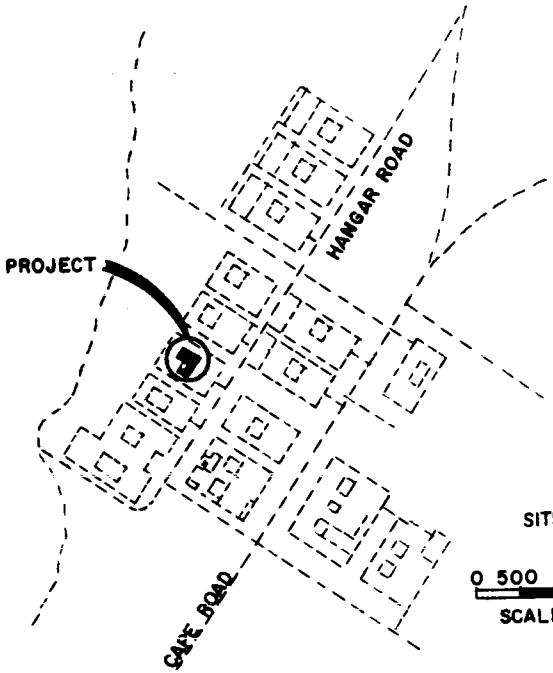
FIRST FLOOR PLAN

0 20 40 80 200

SCALE IN FEET



PERSPECTIVE



SITE PLAN

0 500 1000 2000

SCALE IN FEET

COST ESTIMATE:

A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATION		$174,800
Site preparation	$55,200	
Parking areas	18,400	
Utility connections	101,200	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		1,408,800
Building (45,185 square feet at $31.18 per square foot)	1,408,800	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		183,700
Bridge cranes (2)	130,000	
Furniture	25,000	
Special equipment	28,700	
E. DESIGN AND ENGINEERING SERVICES		232,700
Total estimated cost		$2,000,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

EXPLOSIVE SAFE ASSEMBLY FACILITIES
FOR UNMANNED SPACECRAFT

DESCRIPTION:

This project requests funds for the construction of explosive safe facilities for the final assembly, dynamic and static balancing, and sterilization of unmanned spacecraft. The project includes:

(a) Final assembly and sterilization laboratory: A laboratory of approximatley 2,400 square feet of gross floor area is required. The structure will be of reinforced concrete and revetted as required to provide blast protection. The building will be dust-free, air conditioned, and equipped with the necessary spacecraft handling equipment to prepare the spacecraft for flight.

(b) Capsule laboratory: Approximately 1,200 square feet of air-conditioned and dust-free space is needed for the assembly, checkout, and dynamic balancing of the instrumentation capsule and the solid propellant retromotors. The building will be constructed of reinforced concrete and revetted as required to afford proper blast protection. The project also includes handling, checkout, dynamic test, and sterilization equipment.

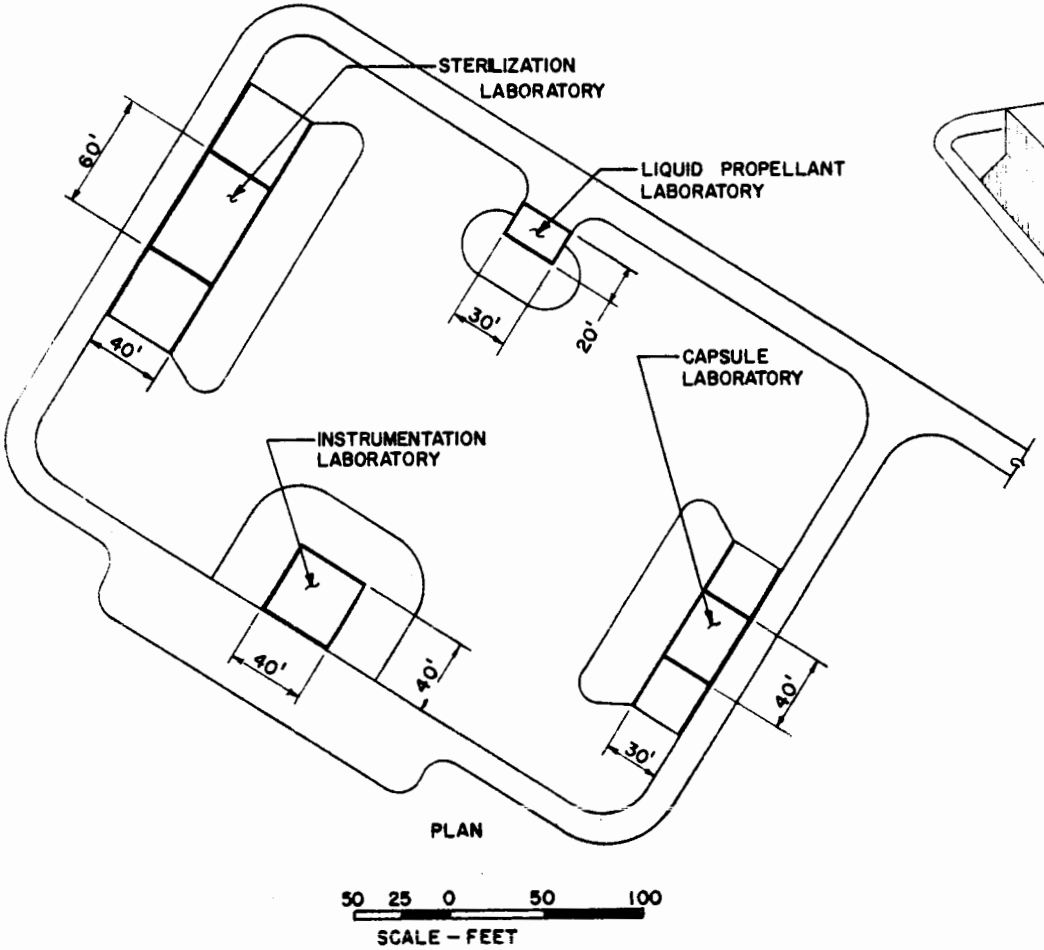
(c) Storable liquid propellant motor laboratory: This structure will provide approximately 600 square feet of space for the checkout, loading, and pressurizing of the storable spacecraft liquid propellant motors. The building will be of reinforced concrete design and revetted as required to afford blast protection. The area will be equipped with the necessary test and fueling equipment, and will provide for the protection of personnel against toxic propellants.

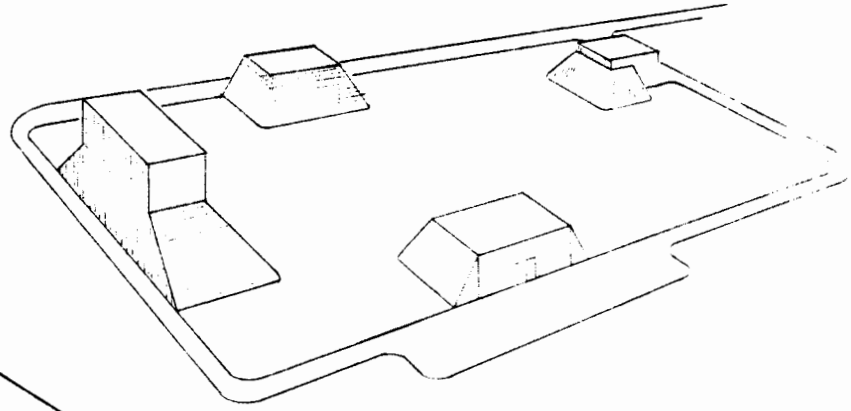
(d) Instrumentation laboratory: This laboratory containing 1,600 square feet of space will provide the necessary facility to house electronic instrumentation racks, consoles, and engineering personnel. The building will be constructed of reinforced concrete or masonry and

ATLANTIC MISSILE RANGE

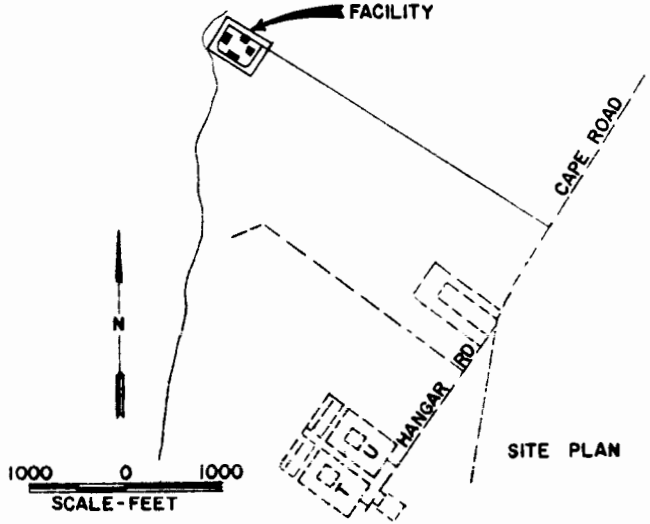
FISCAL YEAR 1963 ESTIMATES

EXPLOSIVE SAFE ASSEMBLY FACILITIES FOR UNMANNED SPACECRAFT





PERSPECTIVE



SITE PLAN

revetted to afford blast protection. It will be separated from the other laboratories to provide maximum protection of personnel during test phases, and to provide protection in case of an explosion. The building will be air conditioned.

This project also includes the site preparation, utility connections, roads, and parking areas to provide a complete and operable facility. A drawing indicating the location of the various laboratories is shown on the preceding page.

JUSTIFICATION:

The facilities that comprise this project are required to provide the laboratory space to handle and checkout spacecraft utilizing solid and storable liquid propellant motors. With the advent of Ranger, Mariner, Surveyor, Voyager, and other large spacecraft programs, it is essential that additional explosive safe assembly facilities be provided. The existing facilities do not have the laboratory space or the height capability to meet the requirements for handling or checking out large spacecraft.

COST ESTIMATE:

A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$150,000
Site preparation	$80,000	
Roads and parking areas	18,500	
Utility connections	51,500	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		196,000
Building..(5,800 square feet at $33.80 per square foot)	196,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		50,000
Bridge crane	35,000	
Furniture	15,000	
E. DESIGN AND ENGINEERING SERVICES		54,000
Total estimated cost		$450,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

APOLLO MISSION SUPPORT FACILITIES

DESCRIPTION:

Several technical facilities are required for the preflight operational phase of the Manned Lunar Program. The facilities will be located in the NASA industrial area at the Atlantic Missile Range. The project includes the following facilities:

(a) Spacecraft operations and checkout facility: A facility is required for the modification, assembly, checkout, and preflight testing of manned spacecraft and their mechanical and electrical components and systems. A three story masonry and steel air conditioned engineering and laboratory building will be constructed. It will provide a high-bay assembly and test area and a low-bay fabrication and assembly area.

The high-bay area will be used for assembly and test and will adjoin all floors of the engineering and laboratory areas. It will contain two altitude chambers and two test pits. A crane hook height of 100 feet will be provided. The fabrication and assembly area will be located at the end of the high-bay area and will provide a total of 30,000 square feet of assembly area with crane hook heights of 35 feet.

Laboratories totalling approximately 30,000 square feet will provide facilities for testing mechanical, electrical, navigation, guidance, calibration, analysis, and environmental equipment. Data recording, processing, review, and quick-look analysis facilities will also be provided. A shop area of 4,400 square feet in the basement will provide shop service at a central point for the entire area. It will be suitable for the modification and refurbishing of spacecraft and will contain a machine shop, welding shop, sheet metal and plastics shop, electrical shop, and battery shop.

A biomedical facility of approximately 11,000 square feet is included for crew preflight operations

peculiar to manned spacecraft functions, and beyond the normal hospital and medical support to be provided by the range. Technical facilities include simulation and training equipment, medical facilities, sleeping quarters, and food preparation and dining facilities. Also included will be necessary briefing, examination, and suiting areas.

The main building includes office space of 75,000 square feet to provide engineering and laboratory space for approximately 1,000 personnel. The building includes conference rooms, a library, an auditorium and a cafeteria.

(b) Reaction control systems facility: A one story permanent type internally blast resistant laboratory type building of 4,000 square feet gross area will be constructed for testing full size space capsules. The facility will contain a test cell which will house reaction control system servicing equipment and the test equipment which is required in close proximity to the space vehicle. The facility will also include a control room, equipment storage room, personnel locker room, a special room for cleaning and storing parts removed from the spacecraft during process of testing, and external fuel handling and storage provisions.

(c) Environmental test and service facility: The project includes a one story permanent type building of 4,000 square feet gross area to provide facilities for checking and testing components and environmental systems installed in space capsules. The building will contain a test cell and control room, and areas for component storage, test equipment storage, work shops, locker rooms, cleaning and storage of capsule parts, and storage of high pressure gases.

(d) Supply, shipping, and receiving facility: It is proposed to construct a one story prefabricated partially air conditioned building of 40,000 square feet gross area at a central location. The building will provide facilities for shipping, receiving, storing and issuing materials and parts for spacecraft. It will also provide shop type facilities for the maintenance of ground support equipment and for modifications of this type of equipment to meet special requirements peculiar to each individual flight.

(e) Pyrotechnic test, and weights and balance facility: An explosive safe assembly facility will be constructed in the form of a one story blast protected and revetted masonry building of 18,000 square feet gross area. The facility will be used for the build-up of pyrotechnic components and for determining the weight and the center of gravity of the spacecraft with assembled pyrotechnic items. The building height will allow the vertical positioning of the spacecraft.

(f) Ordnance storage facility: A storage magazine is required for the safe storage of rocket motors and pyrotechnics. The facility will be used to store rocket motors for suborbital vehicles. The building will be constructed of reinforced concrete or concrete block, with a blow-off panel roof, and will be surrounded on all four sides by a blast deflecting wall of earth. An overhead crane will provide for the movement of the large solid rocket motors.

Sketches of the facilities proposed for construction in this project are shown on the following six pages.

JUSTIFICATION:

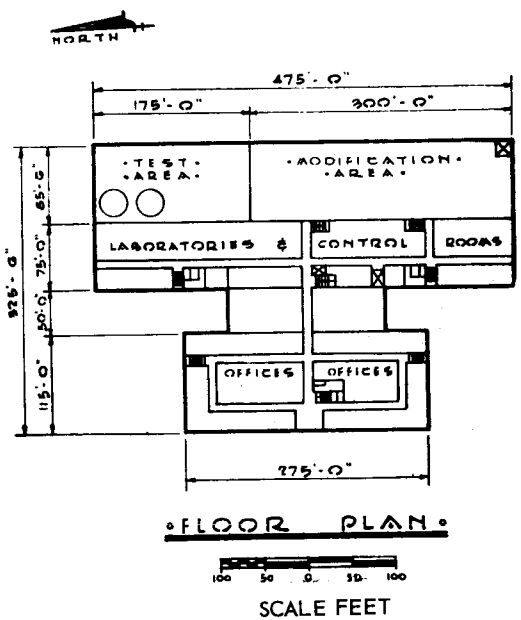
The facilities proposed for construction in this project are required to conduct tests of crews, performance and operational concepts, reliability, and readiness. The nature of the program will require extensive training of the crews and evaluation of the spacecraft in a coordinated program. The facilities will be designed to accomplish a series of highly technical operations as discussed in detail on the project description. The proposed rate of launch, and the size, weight, configuration, and complexity of the proposed spacecraft and their associated payloads, have dictated the size of the facilities being requested. There are no facilities in existence which can be utilized for spacecraft of the weight and size now planned. The proposed facilities are essential to insure reliability of the many elements which make up the entire flight vehicle.

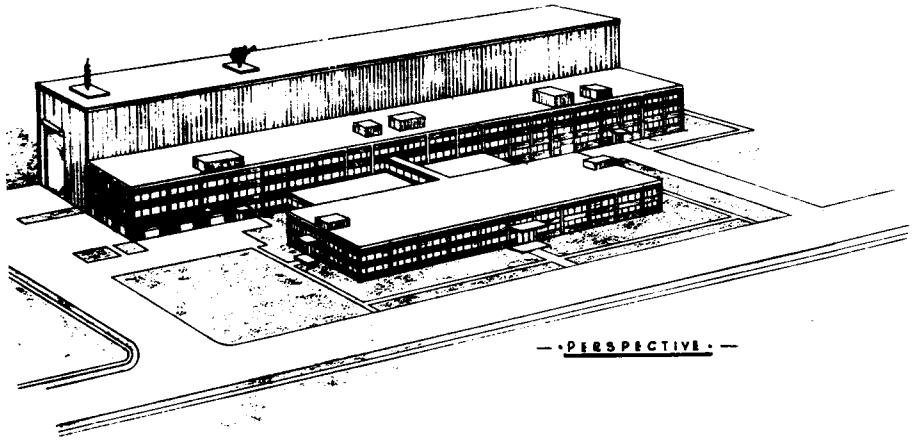
COST ESTIMATE:

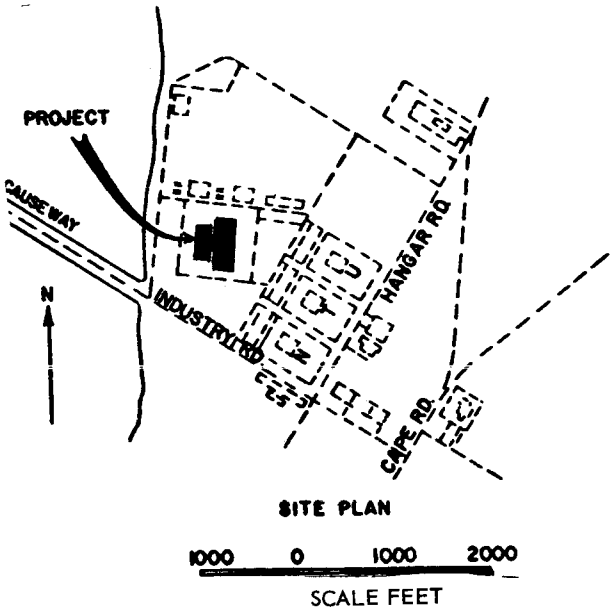
A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$4,010,000
Clearing	$150,000	
Excavation	100,000	
Filling	1,250,000	
Roads	370,000	
Parking areas	80,000	
Fencing	50,000	

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

APOLLO MISSION SUPPORT FACILITIES



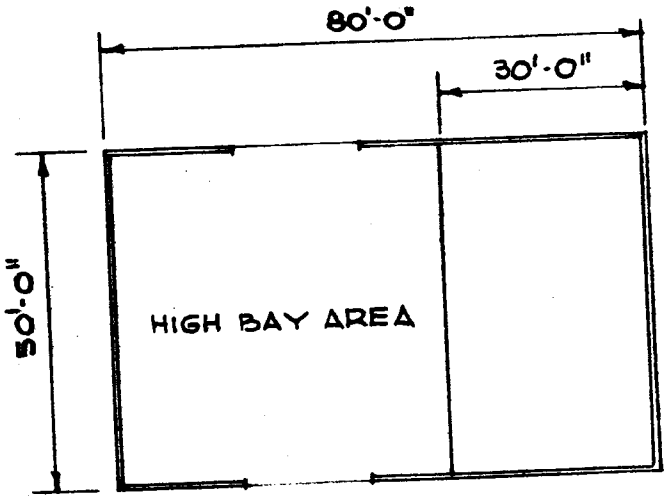




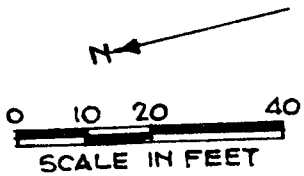
SPACECRAFT OPERATIONS AND CHECKOUT FACILITY

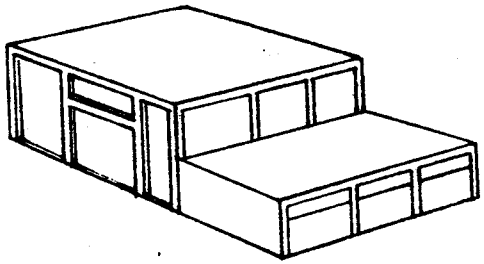
ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

APOLLO MISSION SUPPORT FACILITIES

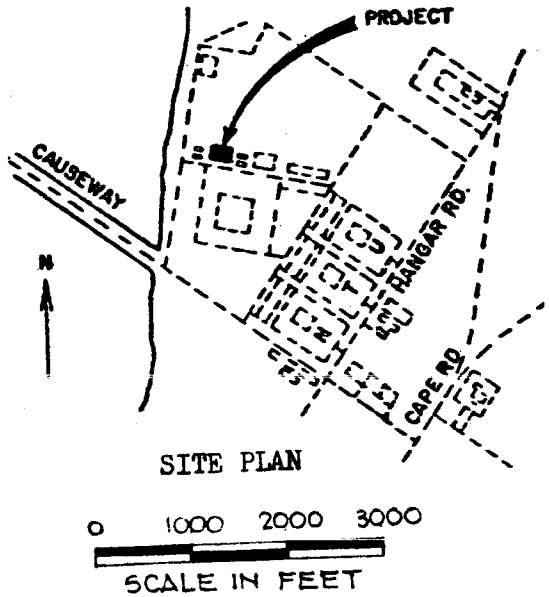


FLOOR PLAN





PERSPECTIVE

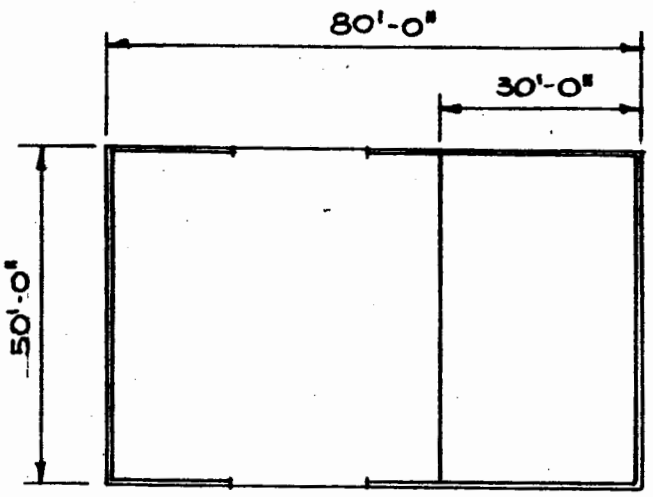


SITE PLAN

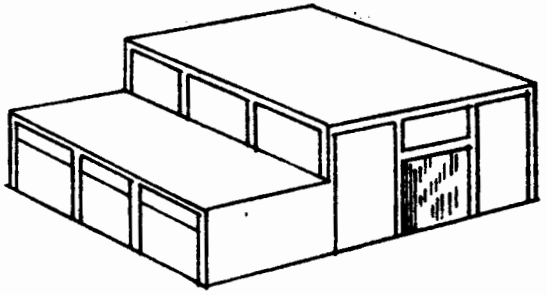
REACTION CONTROL SYSTEMS FACILITY

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

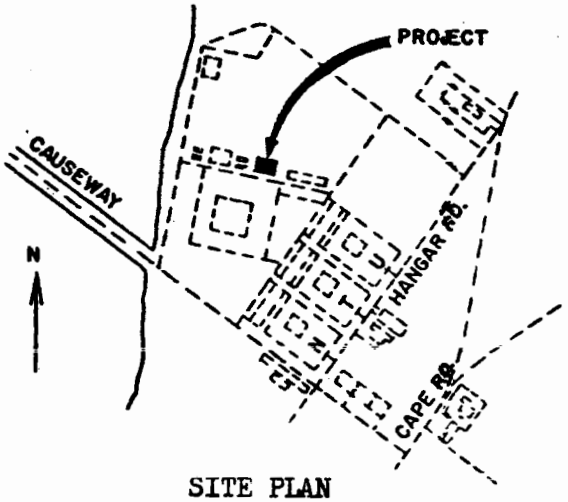
APOLLO MISSION SUPPORT FACILITIES



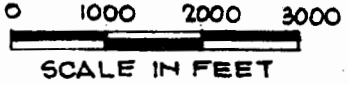
FLOOR PLAN



PERSPECTIVE



SITE PLAN

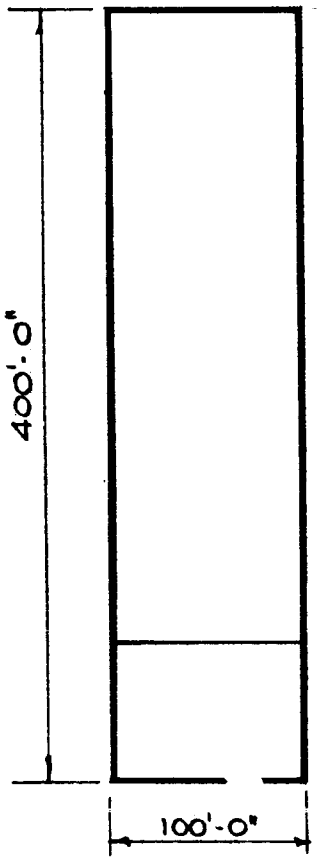


ENVIRONMENTAL TEST AND SERVICE FACILITY

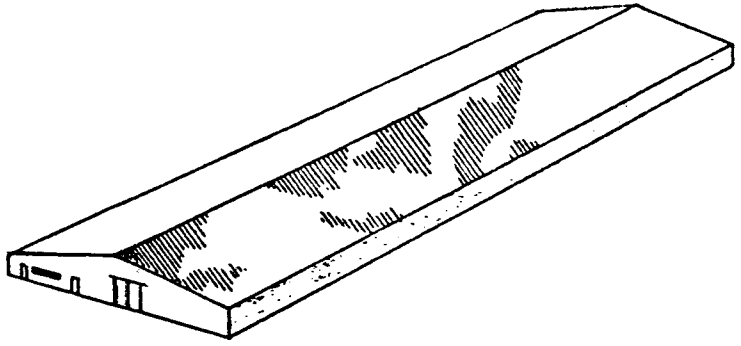
CF 2-96.

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

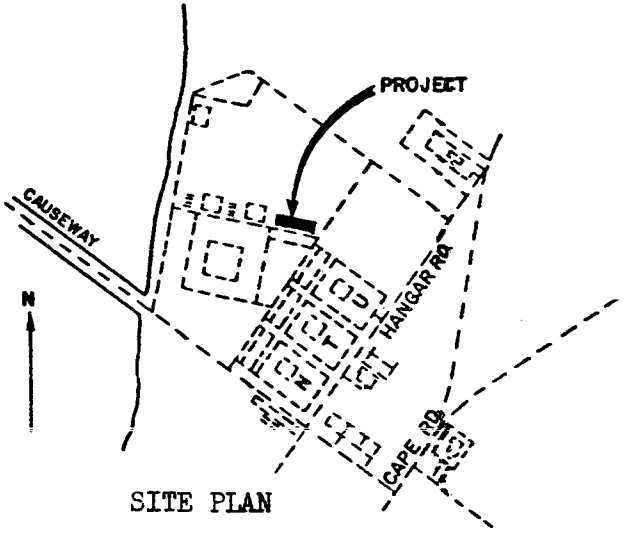
APOLLO MISSION SUPPORT FACILITIES



FLOOR PLAN



PERSPECTIVE



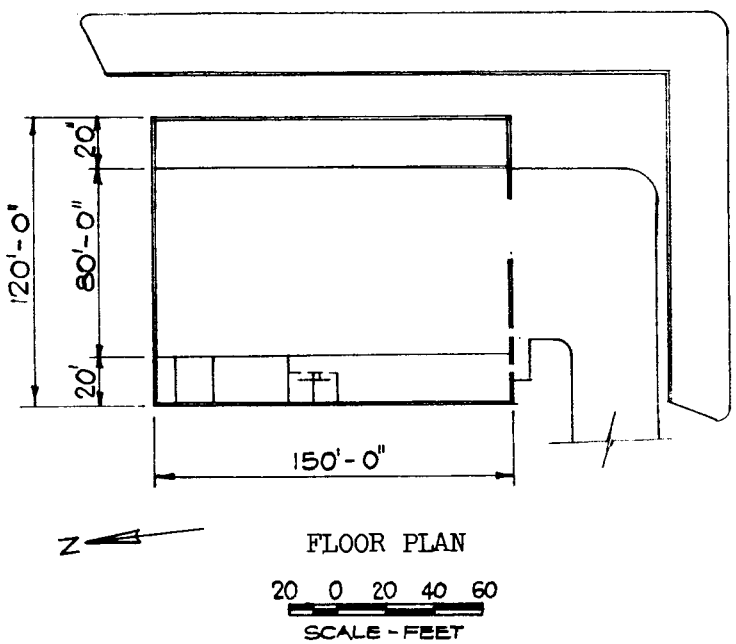
SITE PLAN

SUPPLY, SHIPPING, AND RECEIVING FACILITY

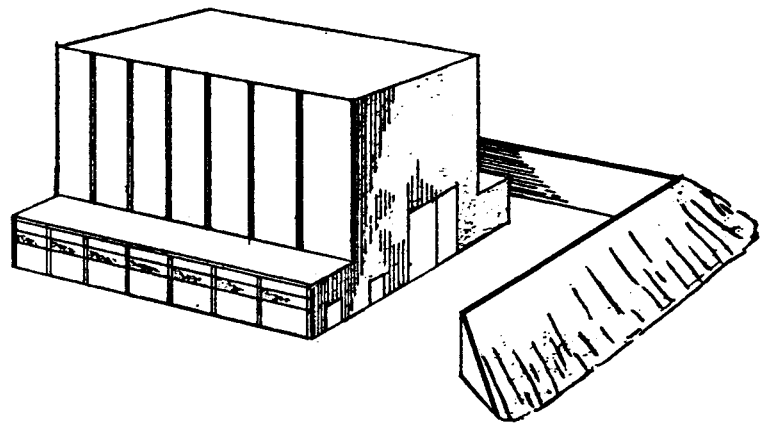
CF 2-G7

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

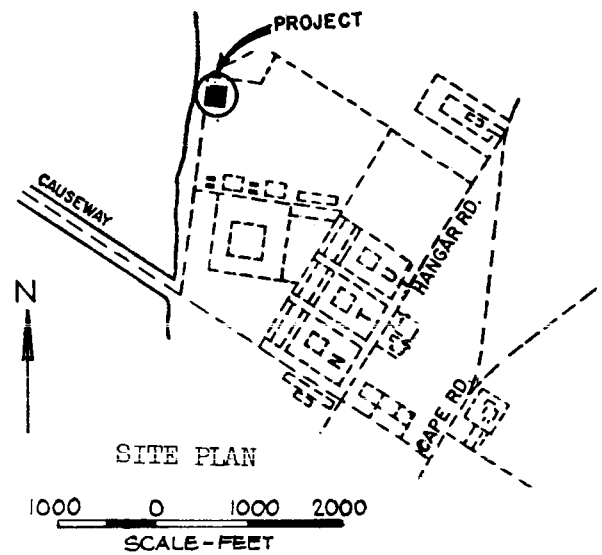
APOLLO MISSION SUPPORT FACILITIES



FLOOR PLAN



PERSPECTIVE



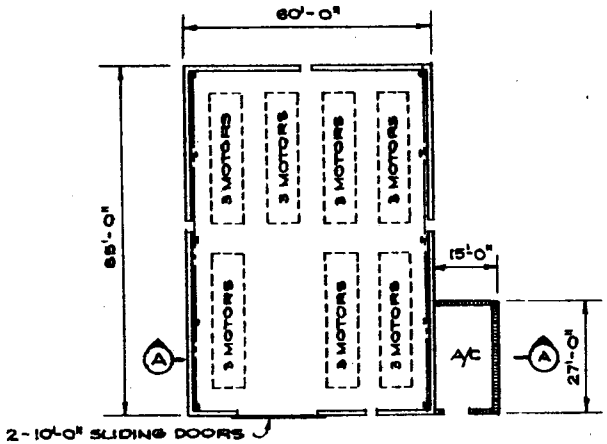
SITE PLAN

PYROTECHNIC TEST AND
WEIGHTS AND BALANCE FACILITY

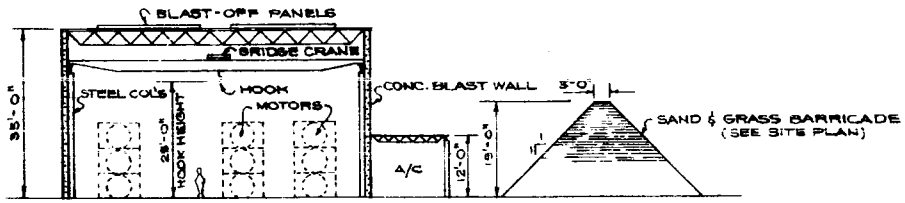
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

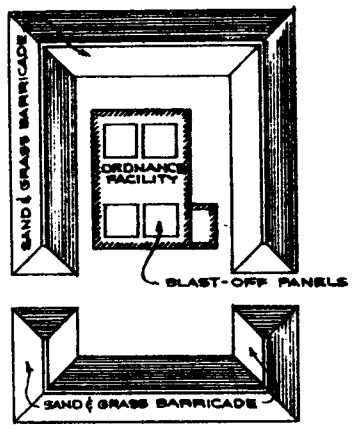
APOLLO MISSION SUPPORT FACILITIES



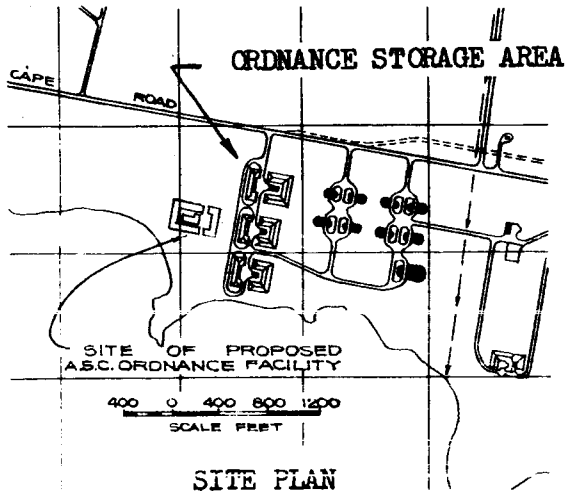
FLOOR PLAN



SECTION A-A



PLAN



SITE PLAN

ORDNANCE STORAGE FACILITY

CF 2-69

Domestic water lines	$146,500	
Fire protection water lines	123,500	
Water storage	450,000	
Sewage lines	225,000	
Industrial power lines	725,000	
Critical power lines	75,000	
Steam lines	200,000	
Communication lines	65,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		$10,645,000
Spacecraft operations and checkout facility (225,000 square feet at $38.00 per square foot)	8,550,000	
Reaction control systems facility (4,000 square feet at $56.00 per square foot)	225,000	
Environmental test and service facility (4,000 square feet at $56.00 per square foot)	225,000	
Supply, shipping, and receiving facility (40,000 square feet at $12.00 per square foot)	480,000	
Pyrotechnic test, and weights and balance facility (18,000 square feet at $56.00 per square foot)	1,008,000	
Ordnance storage facility (5,100 square feet at $30.00 per square foot plus $4,000 for blast revetment)	157,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		5,855,000
Spacecraft operations and checkout facility	4,685,000	
Control system power supplies	$150,000	
Control system air conditioning	150,000	
Heating and cooling system	500,000	
Elevators	75,000	
Cranes	175,000	
Altitude power system	875,000	
Vacuum pumps	330,000	
Laboratory equipment	1,300,000	
Shop equipment	330,000	
Service platform	800,000	
Reaction control systems facility	108,000	
Laboratory equipment	100,000	
Shop equipment	8,000	

Environmental test and service facility...		$175,000	
Laboratory equipment.....	$100,000		
Shop equipment.....	75,000		
Supply, shipping, and receiving facility..		167,000	
Crane.....	100,000		
Shop equipment.....	67,000		
Pyrotechnic test, and weights and balance facility.....		595,000	
Crane.....	125,000		
Laboratory equipment.....	250,000		
Shop equipment.....	20,000		
Service platform.....	200,000		
Ordnance storage facility.....		125,000	
Crane.....	125,000		
E. DESIGN AND ENGINEERING SERVICES.....			$2,000,000
Total estimated cost.....			$22,510,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO TITAN II LAUNCH COMPLEX

DESCRIPTION:

This project covers the conversion of an existing Titan I launch complex to a Titan II launch complex. The complex will be used in the launching of Titan II vehicles with Gemini spacecraft as payloads. The proposed modifications, shown in the sketches on the following two pages, are discussed in greater detail as follows:

(a) An extension of the erector tower structure is required to accommodate the modified Titan II launch vehicle which is longer than the Titan I launch vehicle.

(b) Relocation and the addition of work platforms on the erector tower will be required because of the difference in lengths of the Titan II and the Titan I launch vehicles. Work platforms will have to be added to provide access to the Gemini spacecraft.

(c) A higher capacity jib hoist will be required to facilitate the hoisting of the Gemini spacecraft into launch position.

(d) A "white room" work area will be required at the level of the spacecraft. This work area is required to provide a dust free, humidity controlled area where spacecraft checkout and minor repairs can be accomplished.

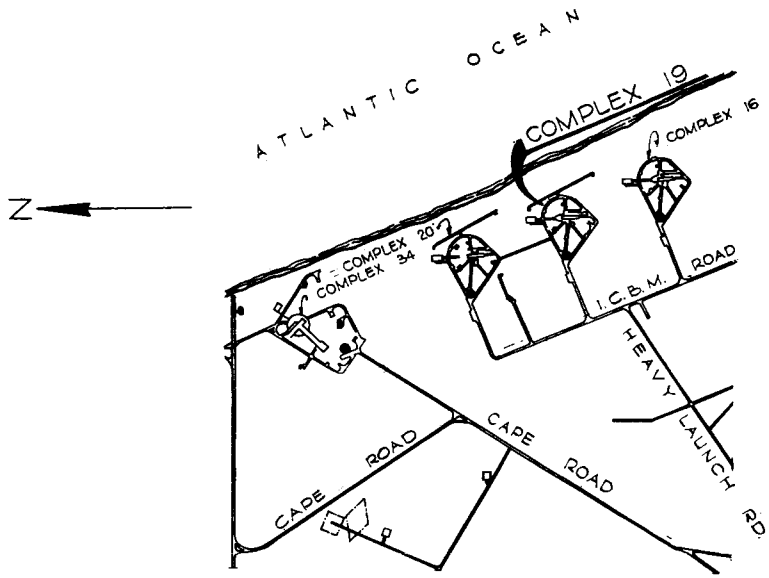
(e) The capacity of the hydraulic actuator system which raises and lowers the erector tower must be increased to accommodate the greater weight and resulting moment of the modified erector tower.

(f) An additional umbilical boom will have to be added to the existing umbilical tower. This boom is required to support the Gemini spacecraft umbilical cable.

(g) The propellant handling and storage systems will require extensive modification and replacement due to the change from cryogenic propellants in the Titan I to hypergolic propellants in the Titan II. This work will include rework of the flume and skimming basin systems.

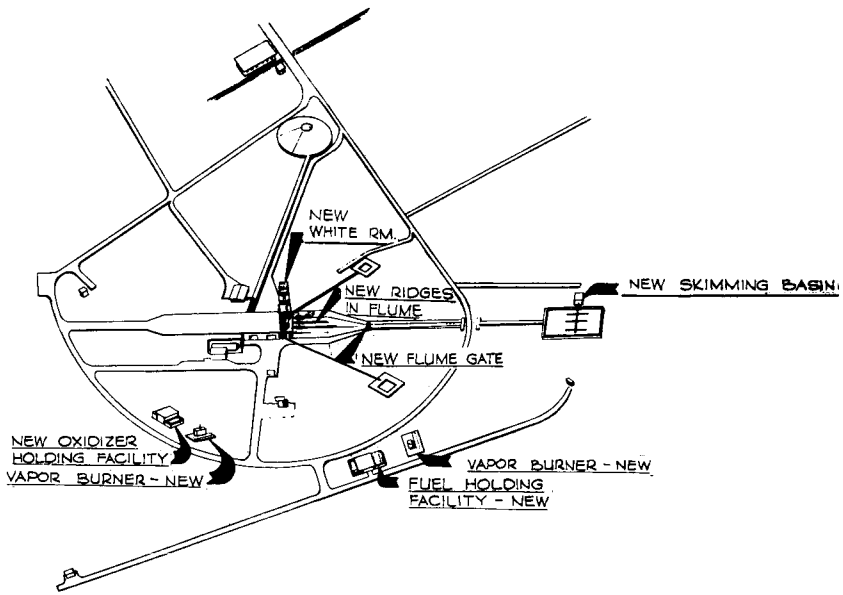
ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

MODIFICATIONS TO TITAN II LAUNCH COMPLEX



SITE PLAN

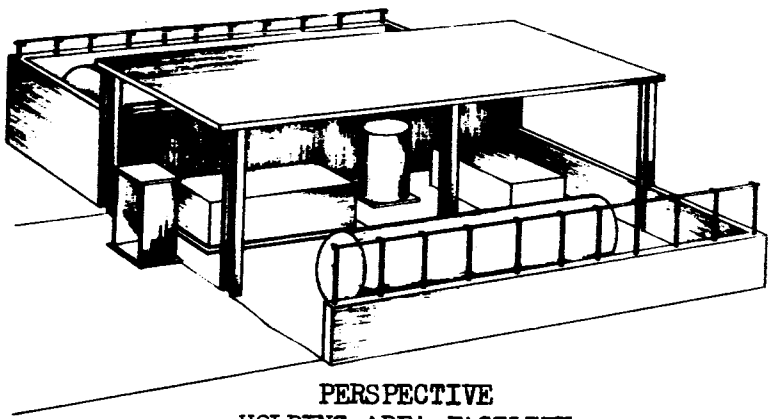
1500 0 1500 3000
SCALE - FEET



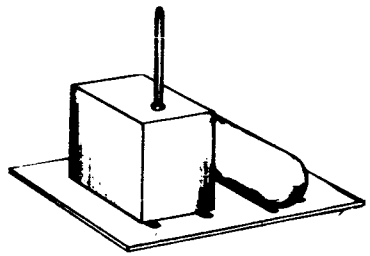
PERSPECTIVE - COMPLEX 19

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

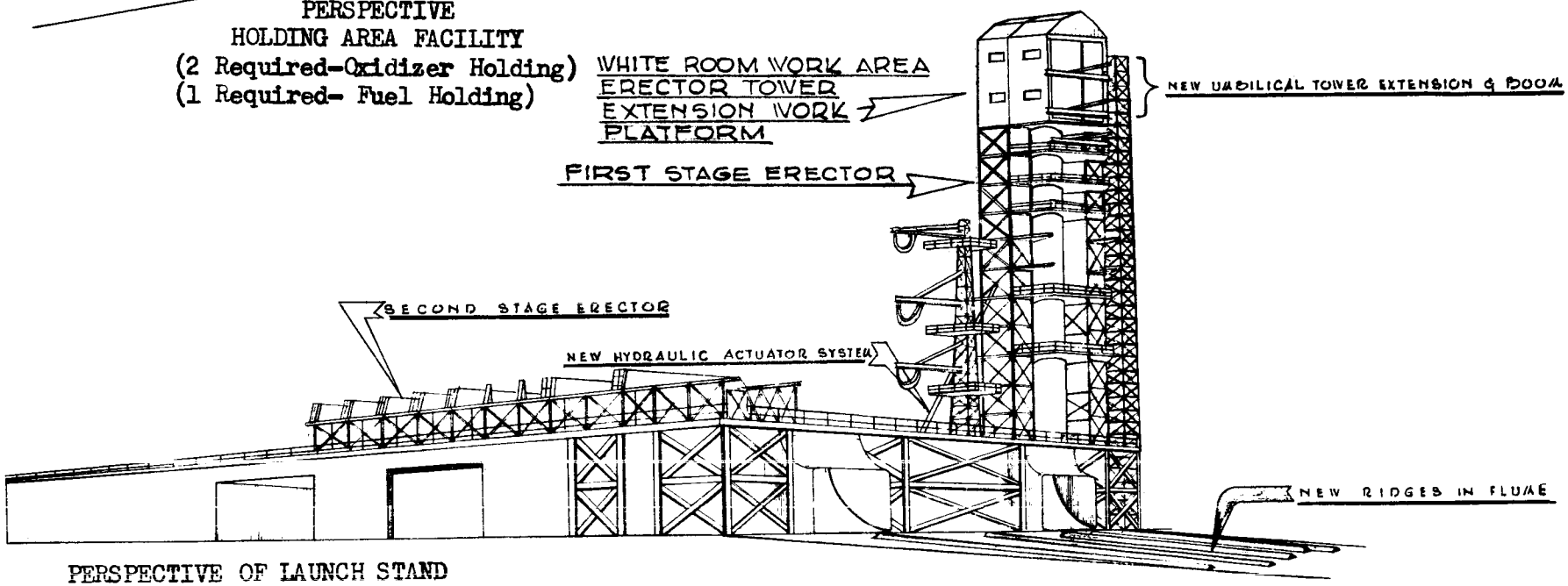
MODIFICATIONS TO TITAN II LAUNCH COMPLEX



PERSPECTIVE
HOLDING AREA FACILITY
(2 Required-Oxidizer Holding)
(1 Required- Fuel Holding)



PERSPECTIVE
VAPOR BURNER FACILITY
(2 Required)



PERSPECTIVE OF LAUNCH STAND

PROPELLANT HANDLING AND STORAGE FACILITIES

(h) Provision for the increased bulk storage of propellants will be required as a result of the increased usage of nitrogen tetroxide and arozene.

JUSTIFICATION:

Project Mercury, the initial step in the long range national program of space exploration, is nearing completion. Project Gemini has been approved as the follow-on project to provide a continuous source of development information. The primary purpose of Project Gemini is to gain experience in long duration and rendezvous missions for use in future projects to extend man's capability in exploring space. Maximum use is being made of vehicle and equipment development which has already been accomplished for previous programs. The Titan II has been selected as the launch vehicle on the basis of its status of development and on its capability of putting the Project Gemini spacecraft into the desired orbit.

At the present time there are no launch complexes available which are capable of accepting the Titan II Gemini spacecraft combination. Titan I launch complexes are available at the Atlantic Missile Range, however, which can be modified to meet the basic launch requirements of the present project. It is estimated that the planning and design of the necessary modifications to a Titan I launch complex will require approximately three to four months. Approximately twelve months will then be required to procure new equipment including several long lead time items, to install this equipment, and to modify the existing structural components of the complex. Upon completion of the modifications, checks of individual components and of the entire complex must be made prior to operational use in order to insure satisfactory and safe performance of all equipment. These checks will require approximately four months after completion of the construction phase.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		---
C.	FACILITIES CONSTRUCTION AND MODIFICATIONS		$2,187,000
	Extension of the erector tower structure	$500,000	
	Relocation and addition of work platforms	350,000	
	High capacity jib hoist	5,000	
	White room work area	245,000	
	Increased capacity for hydraulic actuator	450,000	
	Umbilical boom	141,000	
	Modification and replacement of propellant handling and storage facilities	296,000	
	Increased capacity for bulk storage of propellants	200,000	

D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....	---
E.	DESIGN AND ENGINEERING SERVICES.....	$213,000
	Total estimated cost.....	$2,400,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS - EXISTING AREA

DESCRIPTION:

This project provides for the construction and modifications required to extend the primary utility and road systems to service the new NASA facilities that are to be constructed in the existing industrial area at the Atlantic Missile Range in the fiscal year 1963 program. A location plan of some of the proposed improvements is shown on the next page. The scope of the work includes:

(a) Communications: The underground duct systems and telephone cabling will be extended from existing facilities into the expanded industrial area. Construction will consist of approximately 5,000 linear feet of concrete encased underground ducts with the necessary manholes.

(b) Electrical distribution: A new double circuit 13.2 KV feeder circuit will be installed from the new 69 KV substation to the new NASA facilities in the industrial area. Construction will consist of approximately 6 miles of double-circuit pole line and approximately 5,000 feet of underground cabling in concrete encased ducts. Two 13.2 KV circuit breakers will be provided at the 69 KV primary substation.

(c) Water: The existing potable water system will be extended to the new facilities. Construction will consist of approximately 2,200 linear feet of water mains.

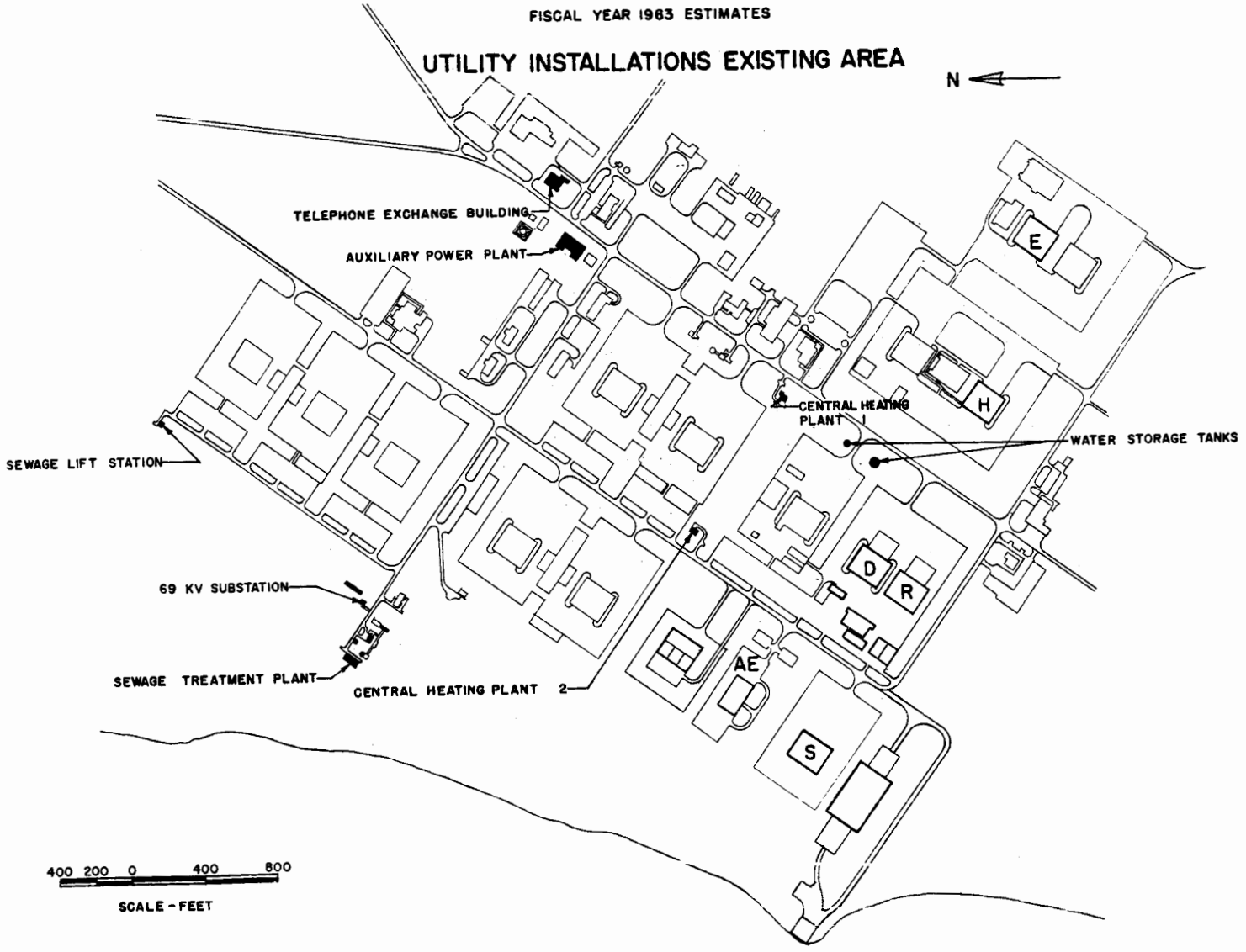
(d) Steam: Steam mains will be installed from the existing steam plants to the new facilities. The boiler capacity will be increased by a small addition to the existing plant. The structure will be a concrete block building (20 by 20 feet) with reinforced concrete foundation and floor slab. The roof will be of the build-up type on roof panels and bar joists.

(e) Sewage: The project includes approximately 2,200 linear feet of sewage line extensions and an addition to the sewage plant.

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS EXISTING AREA



(f) Roads: Approximately 3,000 linear feet of 22 feet wide secondary access roads will be added to serve the new facilities proposed for the industrial area.

JUSTIFICATION:

The proposed modifications and expansions to the existing utility systems are required to support the new facilities to be constructed in the industrial area. The capabilities of the present systems are limited; in some instances the systems are operating beyond their designed capacity. The systems must be extended to meet the planned facilities growth.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$700,000
	Extension of underground ducts and telephone cabling	$93,000	
	Extension of electrical lines and sub-station installation	258,000	
	Extension of water mains	43,000	
	Extension of steam mains including addition to existing plant	189,000	
	Extension of sewer mains including addition to sewage plant	39,000	
	Extension of roads	78,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		---
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		---
E.	DESIGN AND ENGINEERING SERVICES		100,000
	Total estimated cost		$800,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN LAUNCH COMPLEX NO. 39

DESCRIPTION:

Initial funding is requested for the construction of facilities for the Advanced Saturn Launch Complex No. 39. The scope of work in this project, covering approximately forty percent of the cost of the total complex, includes the design and construction of a vertical assembly and checkout building; one launch pad with the associated propellant system; the rail transfer system from the vertical assembly building to the one launch pad; the launcher-transporters; and site preparation, roads, and utility connections. It also includes the procurement of checkout and control equipment, deflectors, firing accessories, instrumentation, and ground support equipment; and the design of the ordnance arming tower.

The facilities for the complex are based on the concept of transporting the Advanced Saturn vehicle from the assembly area to the launch pad by a rail transfer system. The concept as described herein is presently under intensive engineering review and analysis, the results of which could cause changes in any or all of the specific items being proposed for construction in this writeup. The total complex will consist of three major operating areas as follows:

(a) Assembly and checkout area: The vertical assembly building will contain the necessary assembly and checkout facilities, along with supporting shops and engineering areas. The high-bay area will be approximately 665 feet long by 454 feet wide and the low-bay area approximately 560 feet long by 370 feet wide. The upper stage bays will be 175 feet high and the assembly bays 460 feet high, with a maximum hook height of 400 feet. Each assembly unit (1st, 2nd and 3rd stage and spacecraft areas) will accommodate six vehicle stages for preliminary checkout, test, and maintenance. Final assembly and checkout will be accomplished on the launcher-transporter in the high-bay area. A launch control area will be located in the high-bay area to serve the dual purpose of checkout and launch. The concept will prevent undue duplication of launch, checkout, computer, and control equipment. Required laboratory and shop space will be provided in the facility. The interlocking bridge crane system in the building will transfer stages to the assembly area.

Terminal facilities, which are not included in this budget due to their shorter lead time, will be requested in a subsequent budget. They consist of a barge basin, intercoastal waterway connection, and storage facilities. The stages will be transported to this area by barge.

(b) The intermediate (arming) area: Facilities for this area are not included in this budget due to their shorter lead time, and will be requested in a subsequent budget. The intermediate area will contain facilities for arming retro rockets and squibs, facilities for the storage of ordnance supplies, and high pressure gas converter equipment.

(c) Launch area: The launch area will contain facilities and equipment required to monitor final checkout, to load propellants, and to launch the vehicle. The fiscal year 1963 budget includes funds for the construction of only one launch pad with its associated propellant and storage facilities. The support building and ground control station which are also required for the launch pad are not included at this time due to their shorter lead time.

The total facilities eventually to be constructed in this area are as follows:

Three identical launch pads, elevated thirty feet above grade, will be connected to the vertical assembly building by the rail system over which the launcher-transporter can operate. This system will pass through the intermediate area where the vehicle will be armed. Each pad will contain separate propellant storage and transfer facilities for liquid oxygen, liquid hydrogen, RP-1 fuel, and a support building. An automatic ground control station will be adjacent to the pad and contain distribution systems, checkout consoles, motors, recording and metering equipment, and the space vehicle environmental control system necessary for the final checkout, propellant loading, and launching of the vehicle. Prior to the propellant loading, the control of prelaunch operation will be transferred to the launch control center in the vertical assembly building where final preparations and launch will be effected through digital computer links.

The two launcher-transporters will be truss-type structures mounted on rails, and will include selfcontained drive systems. Launch support and holddown arms will support and restrain the vehicle, and will serve as mounts for firing accessories and other equipment. Included with the launcher-transporters will be such firing accessories as cable masts,

propellant loading masts, water quenching masts, and other electrical and pneumatic components. An umbilical tower approximately 360 feet high will also be mounted on each launcher-transporter. The tower will contain an elevator, cables for lights and communications, a pneumatic distribution system, a sprinkler system, camera and service platforms, and the umbilical connections.

Sketches of the Advanced Saturn launch complex are presented on the following four pages.

JUSTIFICATION:

The launch complex requested in this project will provide the necessary capability for launching the Advanced Saturn vehicle. Existing facilities cannot be modified for this purpose. To meet the scheduled flight test program and firing rate of the Advanced Saturn vehicle, it is necessary to request funds in the fiscal year 1963 for only a portion of the total facilities required for complete construction of the complex. Such items as the vertical assembly building, the rail transfer systems, and the launcher-transporters have long lead times and must be started in promptly to meet the operational ready dates. The launch frequency as presently scheduled requires only one pad in the program and funding of the additional proposed two pads will follow in a subsequent year's budget. Support items such as pads support buildings and ground control stations have shorter lead times and can also be requested in a subsequent year's budget.

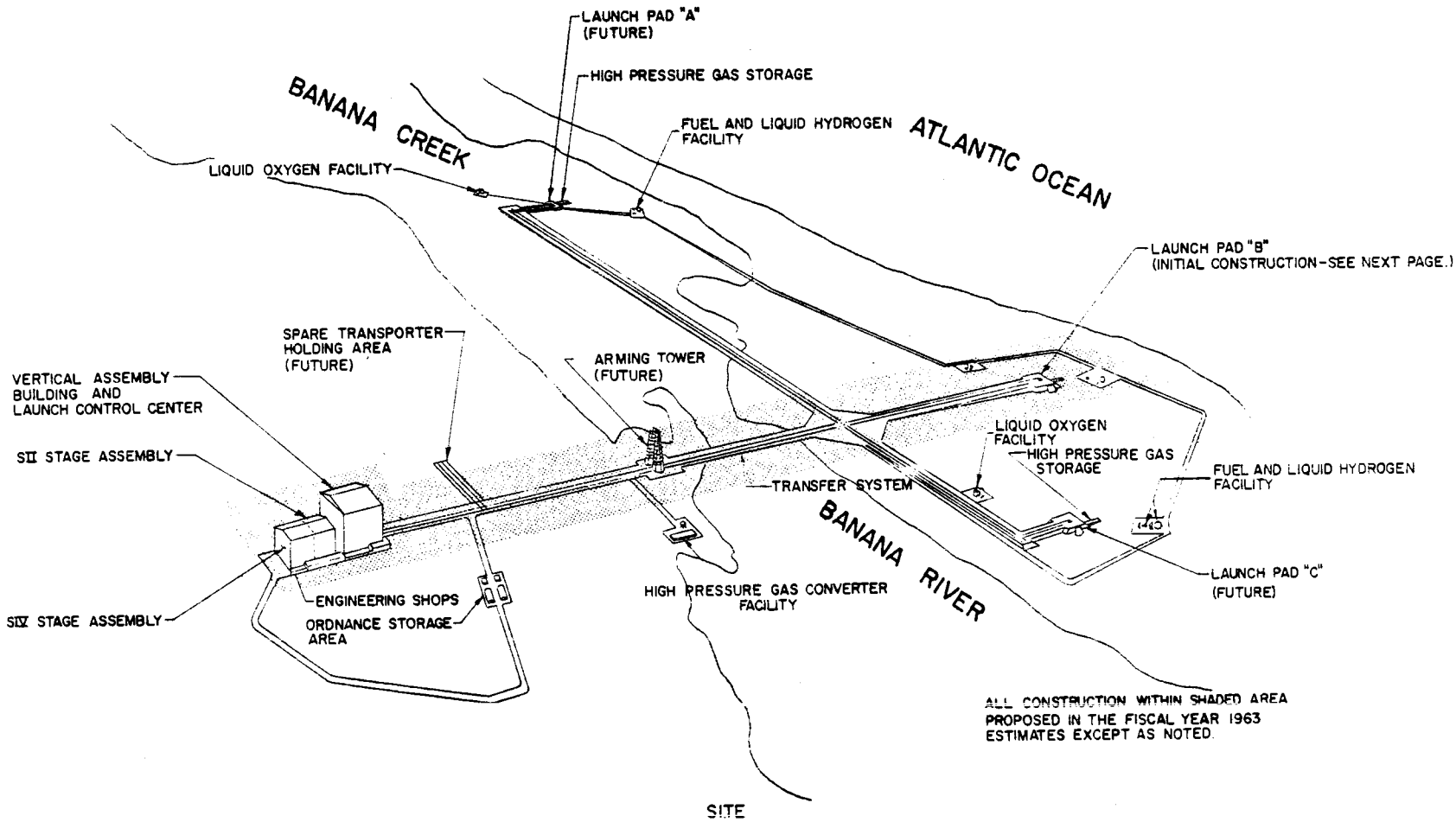
The total facilities of the complex are required for the rendezvous mission of placing a man on the moon in this decade. To meet this objective, three vehicles are needed for each mission; this requires three launch pad complexes for pre-flight testing and launch. Two vehicles would be on launch pads for flight testing and one vehicle would be on a launch pad as a back-up for a possible abort in the rendezvous mission; thus all three launch pads would be utilized simultaneously. Each launch pad will have its own fuel and support facilities as the distances between the launch stands make the construction cost of central facilities prohibitive.

The need for the reduction of on-pad vehicle time to an absolute minimum requires the utmost utilization of these pads. To accomplish this purpose, it is proposed that the complete checkout and assembly of the vehicles will be undertaken in the vertical assembly building.

It is estimated that the funding requested in this project will permit the design, construction, and equipment of approximately forty percent of the total facilities that comprise the three pad launch complex.

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

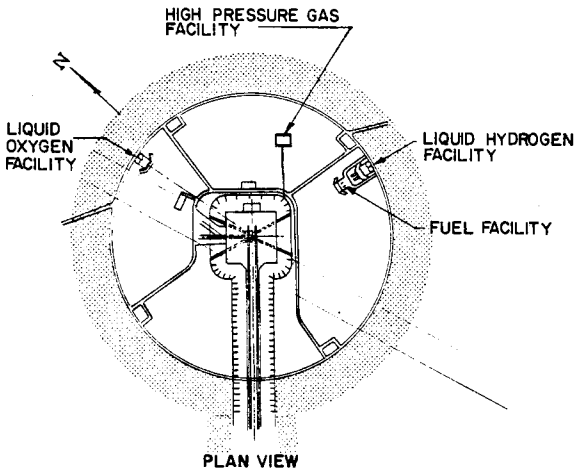
ADVANCED SATURN LAUNCH COMPLEX NO. 39



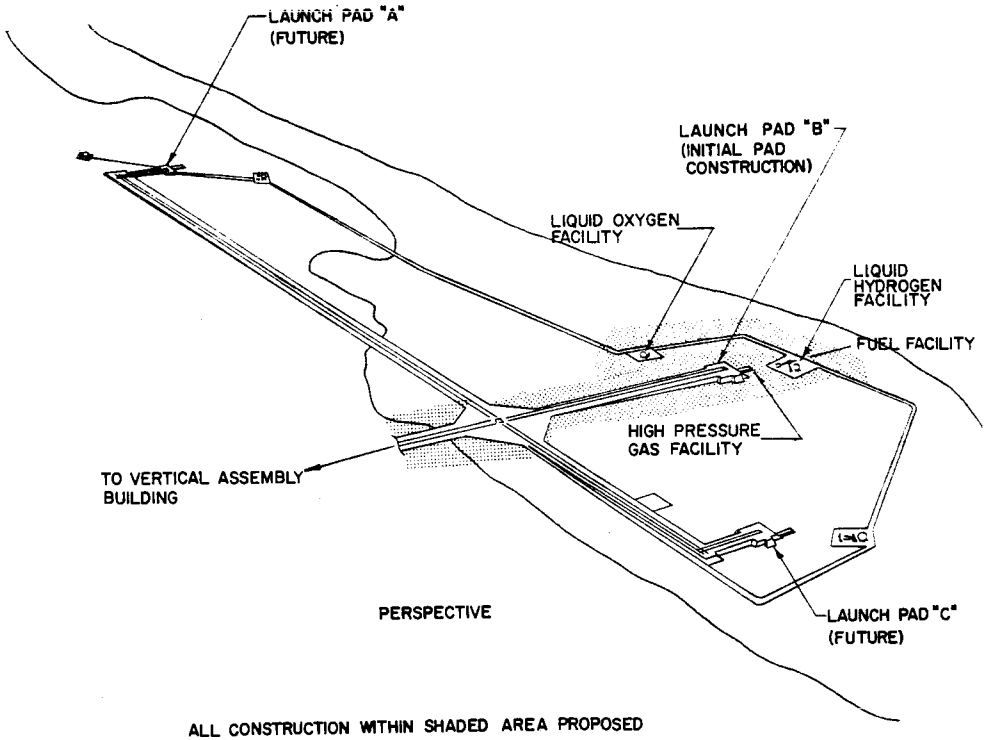
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN LAUNCH COMPLEX NO. 39



PLAN VIEW



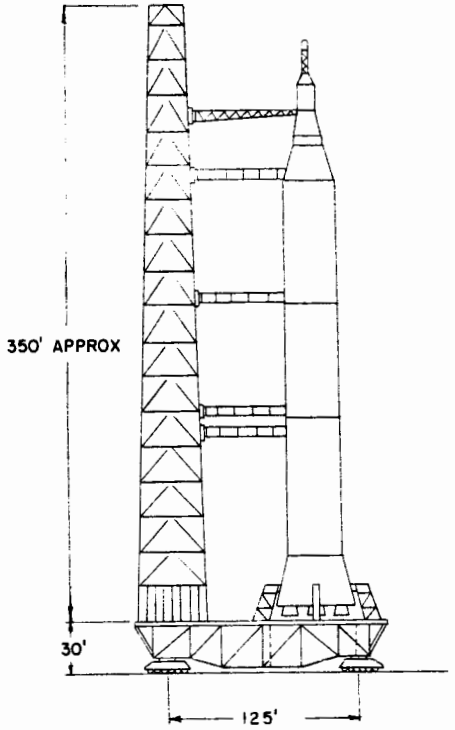
PERSPECTIVE

ALL CONSTRUCTION WITHIN SHADED AREA PROPOSED IN THE FISCAL YEAR 1963 ESTIMATES.

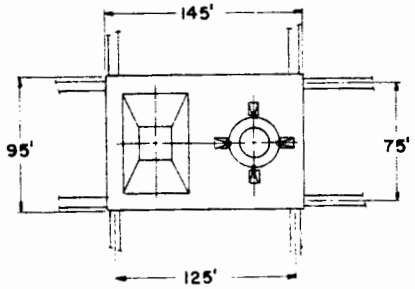
LAUNCH PAD "B"

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

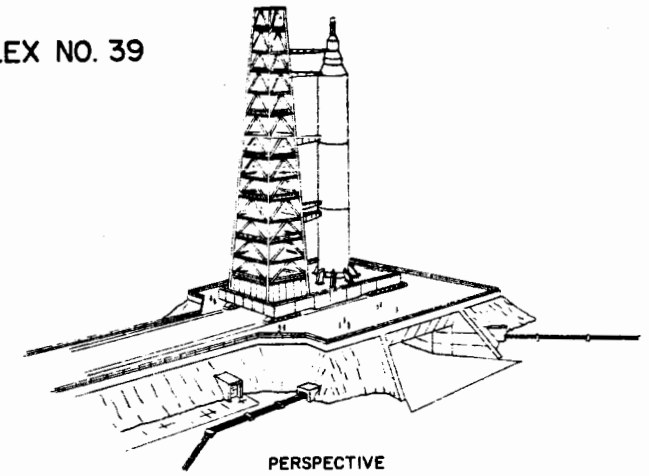
ADVANCED SATURN LAUNCH COMPLEX NO. 39



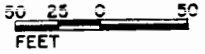
ELEVATION



PLAN



PERSPECTIVE

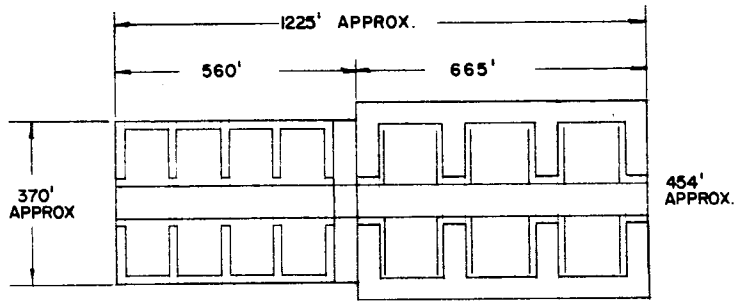


LAUNCHER - TRANSPORTER

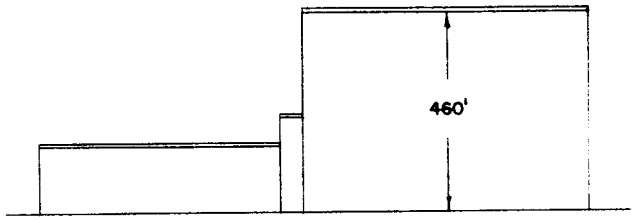
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN LAUNCH COMPLEX NO. 39



PLAN VIEW



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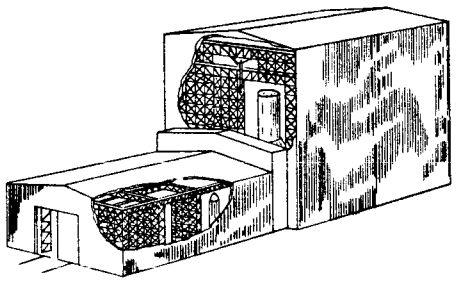


PERSPECTIVE

VERTICAL ASSEMBLY BUILDING

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$4,050,000
	Site preparation and roads	$1,850,000	
	Utility installations and connections	2,200,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		106,870,000
	Vertical assembly and checkout building	92,882,000	
	Low bay area..(370 by 560 feet; 207,200 square feet at $135 per square foot) $27,972,000		
	High bay area..(454 by 665 feet; 301,910 square feet at $215 per square foot) 64,910,000		
	Rail transfer system	8,400,000	
	Launch pad	5,588,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		48,875,000
	Propellant services	23,600,000	
	High pressure system 7,000,000		
	Liquid oxygen system 9,000,000		
	Fuel system 1,600,000		
	Liquid hydrogen system 6,000,000		
	Launcher-transporters (two)	11,100,000	
	Checkout and control equipment	5,400,000	
	Deflectors	775,000	
	Firing accessories	5,000,000	
	Instrumentation	2,000,000	
	General support equipment	1,000,000	
E.	DESIGN AND ENGINEERING SERVICES		16,755,000
	(Additional design funds in the amount of $3,700,000 are proposed to be allocated from fiscal year 1962 funds)		
	Total estimated cost		$176,550,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES

DESCRIPTION:

This project describes the supporting facilities that are required in the New Area of the Atlantic Missile Range to support the Manned Lunar Landing Program. Current siting is tentative and, pending additional study and program development, is subject to change. The scope of work includes:

Mission Support Facilities

Facilities are required to provide space for approximately 1,000 NASA and contractor employees. Two buildings are proposed for construction, as follows:

(a) Contractors' building: This building will provide a gross area of 60,000 square feet within a two story building, for office, laboratory and administrative management facilities for contractor personnel.

(b) Engineering, laboratory, and operations building: A permanent type, air conditioned, two story building will be constructed to contain approximately 65,000 square feet of laboratory and engineering space.

Range Support Facilities

The project includes funding for the initial increment of range instrumentation facilities and equipment. As the program develops, additional facilities and equipment will be required. It is anticipated that approximately $14,000,000 will be required in the fiscal year 1964 program for these purposes. The facilities for this purpose in the 1963 program are described below; the 1963 equipment requirements are listed under "Cost Estimate" and discussed under "Justification".

(a) Cable storage and maintenance facility: This facility will be a permanent single story warehouse type masonry structure, with a total floor area of 30,000 square feet.

(b) Central telemetry facility: This facility will consist of a permanent single story, air conditioned building of approximately 25,000 square feet in the New Area. It will include the construction of a back-up power station

and the necessary antenna foundations.

(c) Communications facilities: The construction of the following permanent type, air conditioned structures is proposed:

(1) A 7,500 square foot addition to the central telephone office in the Existing Area.

(2) A 1,500 square foot addition to the central telephone office at Patrick Air Force Base.

(3) A 15,000 square foot central telephone office in the New Area.

(4) Three repeater buildings with an average of 1,500 square feet each, at various locations in the New Area.

(5) A 6,500 square foot cable terminal building in the New Area.

(d) Nuclear radiation facility: This system will consist of multiple scintillation centers installed in blast-proof shelters in the vicinity of the launch pad, with radioactive sources mounted on the missile. Particle density will be recorded as detected by each counter during the lift-off phase. Post flight reduction of the counter recorded data will provide position information from lift-off to approximately 500 feet altitude. Real-time position, velocity, and acceleration will also be available for presentation.

(e) Central control facility: A 14,500 square foot addition is required to the existing central control building in the Existing Area. Construction will be permanent type and of special design to match the existing building. Interior modifications to the existing building and additional air conditioning are included.

(f) Precision infrared tracking system facilities: Two concrete trailer pads with the necessary utilities will be located near the Advanced Saturn launch sites for the operation of precision infrared tracking trailers.

(g) Surface surveillance radar facilities: Two mobile surveillance radar sites will be constructed. Each mobile site will include a van pad and the necessary utilities.

Location plans and sketches of the facilities included in this project are shown on the following nine pages.

JUSTIFICATION:

The Manned Lunar Landing Program will require the construction of several supporting facilities to house personnel, equipment, and instrumentation. The instrumentation in the Existing Area at the Atlantic Missile Range is not fully capable of supporting launches north of the boundaries of the Existing Area. The project accordingly includes a substantial increase in range support instrumentation and equipment. More detailed justifications follow:

Mission Support Facilities

(a) Contractors' building: The size of the planned program requires close coordination between operational contractor personnel who are engaged in work on Saturn and Nova upper stages and personnel who are engaged in booster work. This facility will provide the proximity necessary for this coordination and the required space to house contractor personnel.

(b) Engineering, laboratory, and operations building: This facility will provide laboratory and engineering space to be used by systems engineering and technical personnel engaged in the test, evaluation, and checkout of parts, components, sub-assemblies, equipment, and materials for booster and upper stages. It will also house project engineers, project coordinating staffs, contract coordinating personnel, supporting personnel, and the equipment related to these functions.

Range Support Facilities

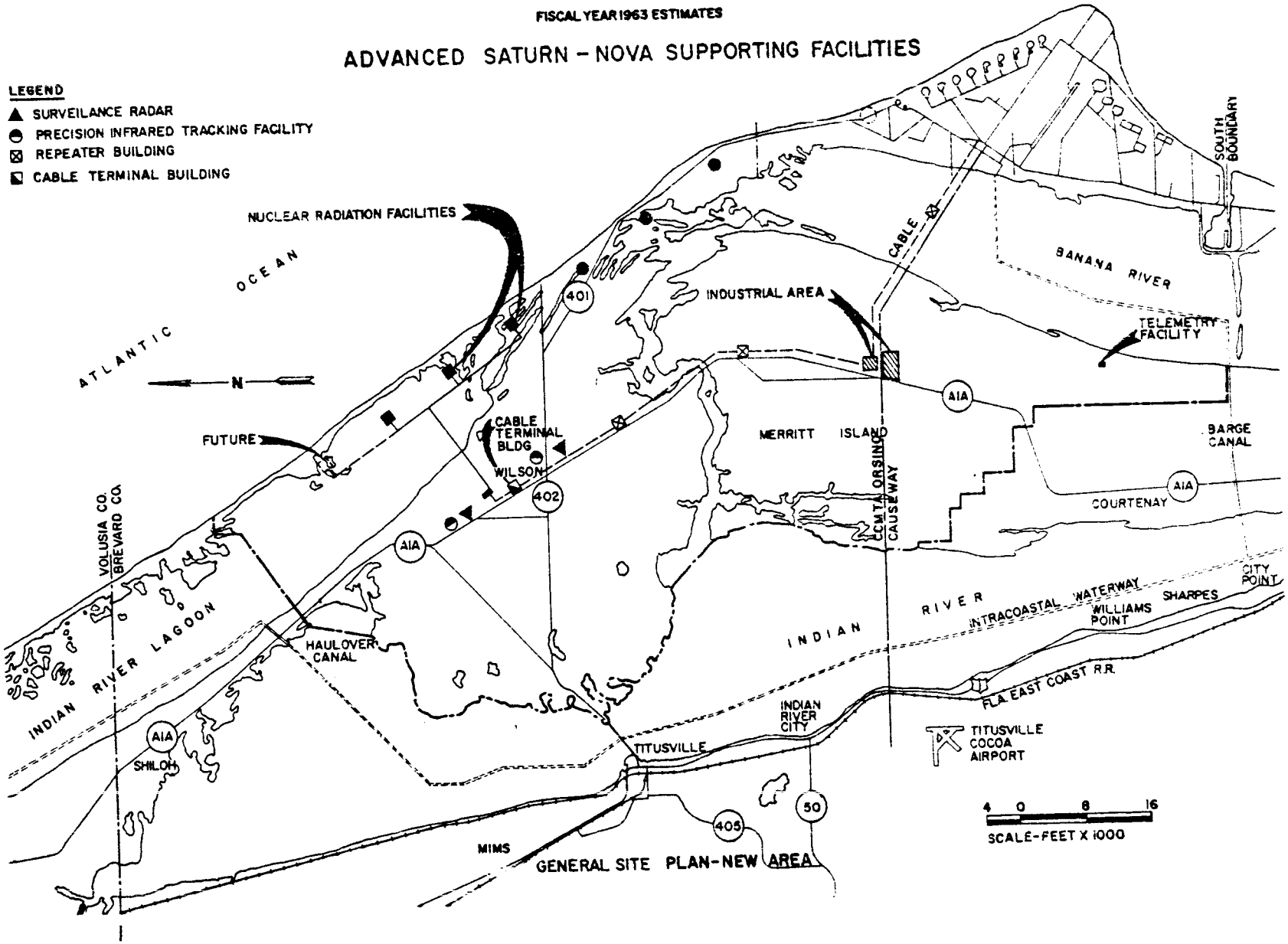
(a) Cable storage and maintenance facility: A secondary center is required for the communications and data distribution cable maintenance and installation operations. The structure will provide limited interior storage for small cable and associated components and equipment. Large open-storage areas will be provided for the outside storage of cable reels. The cable maintenance and installations personnel operating from this facility will maintain all outside cable systems in the New Area.

(b) Central telemetry facility: The existing telemetry facilities at the Atlantic Missile Range must be supplemented by the construction of a central telemetry facility. The facility will support programs in both the

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

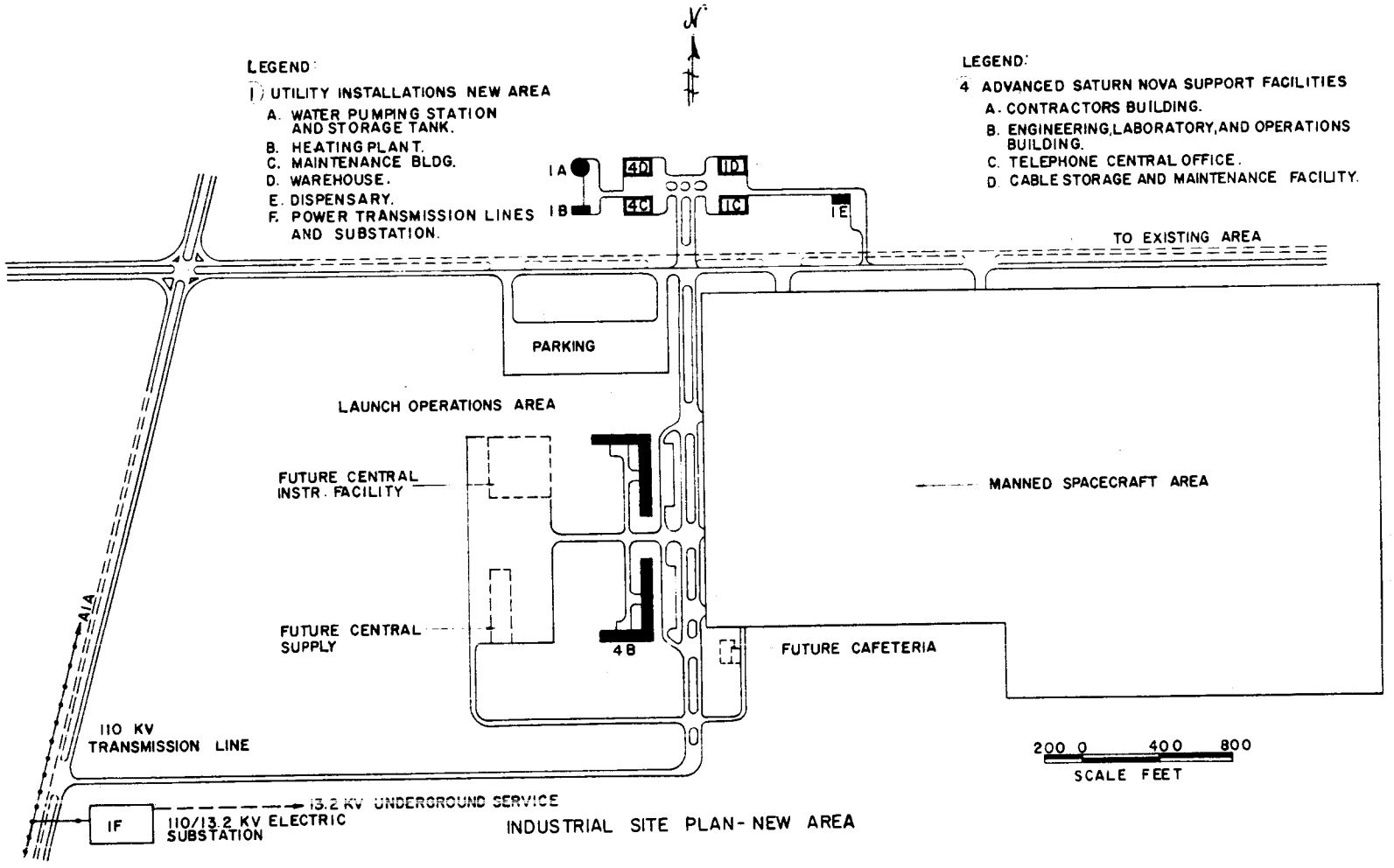
ADVANCED SATURN - NOVA SUPPORTING FACILITIES



ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES

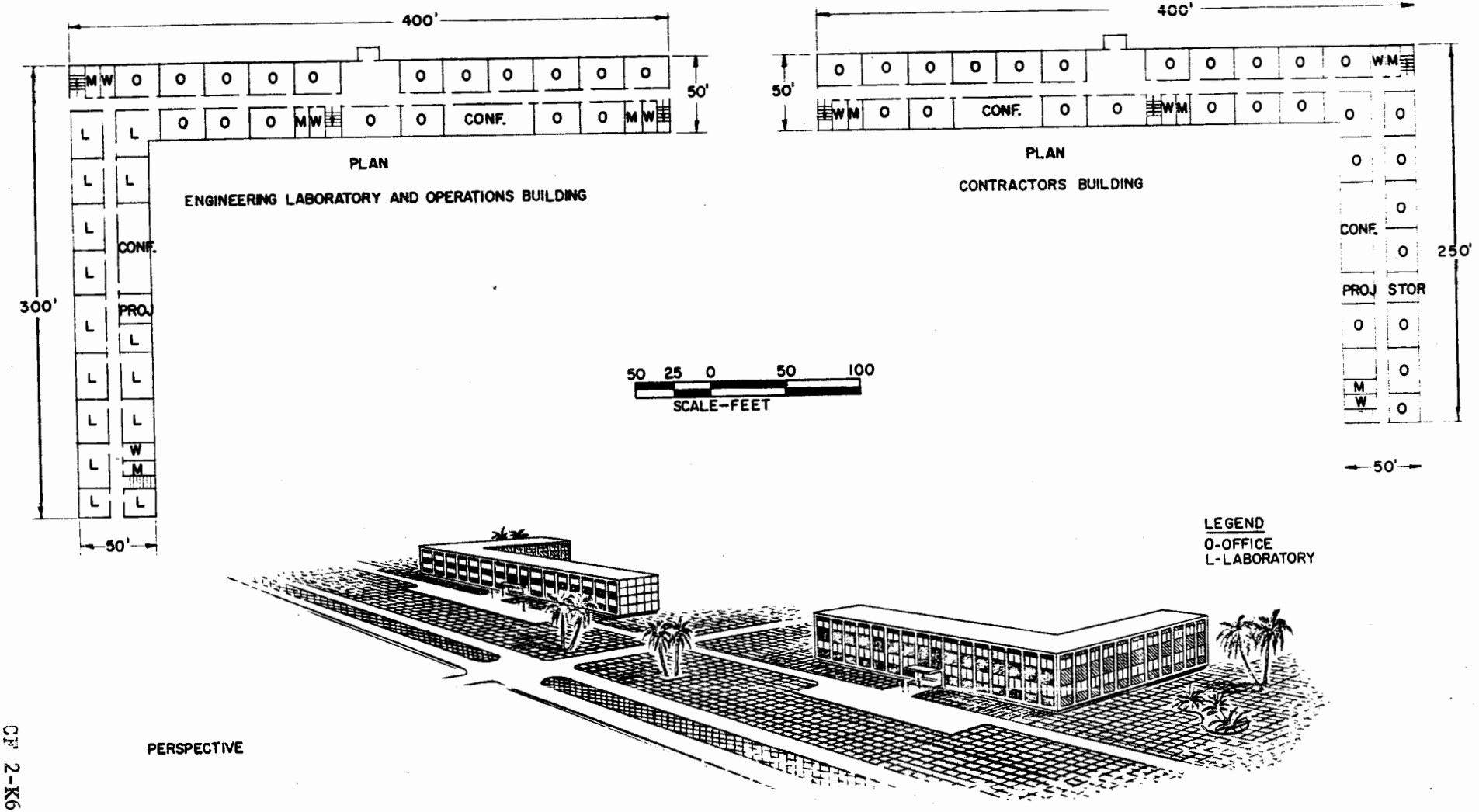


INDUSTRIAL SITE PLAN- NEW AREA

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES



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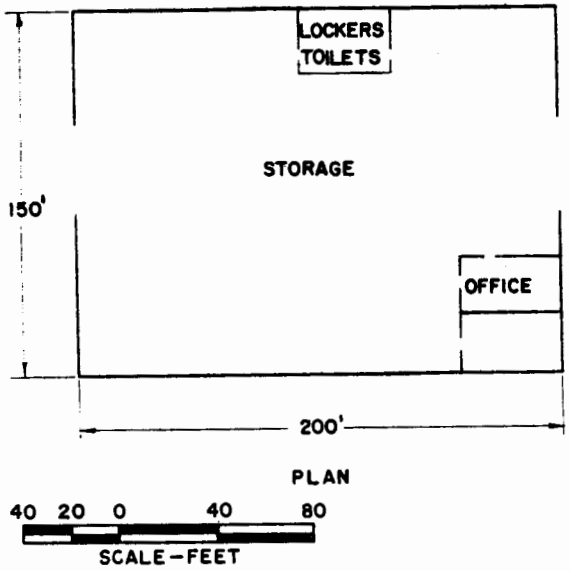
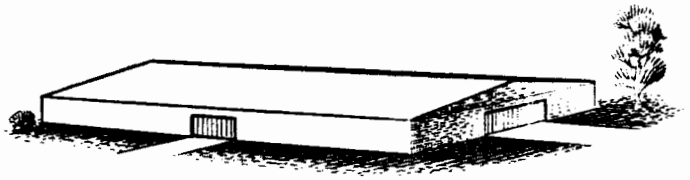
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

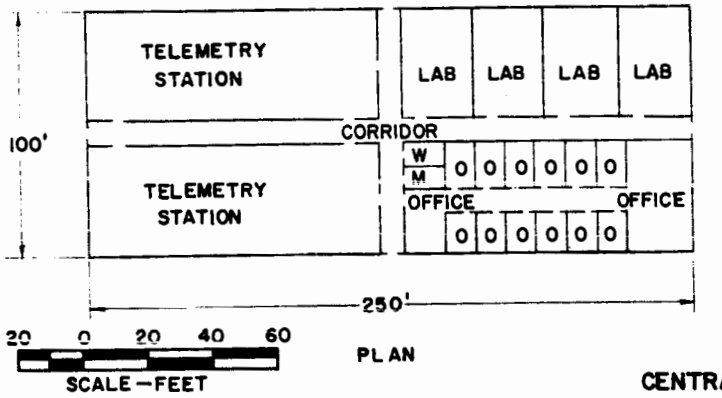
ADVANCED SATURN-NOVA SUPPORTING FACILITIES

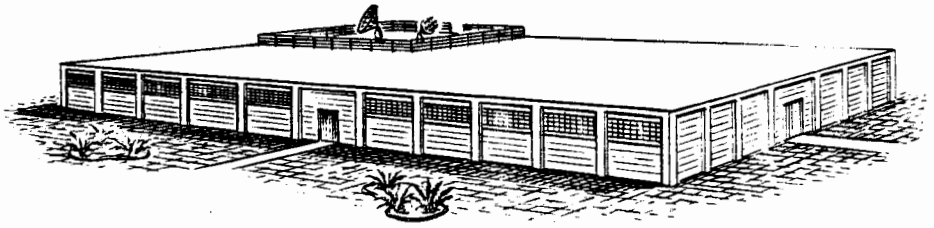




PERSPECTIVE

CABLE STORAGE AND MAINTENANCE FACILITY-NEW AREA





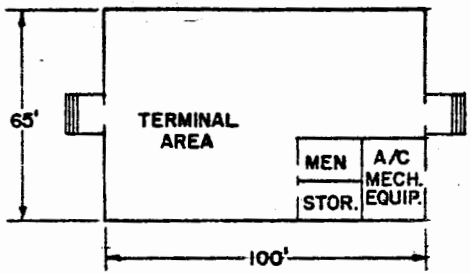
PERSPECTIVE

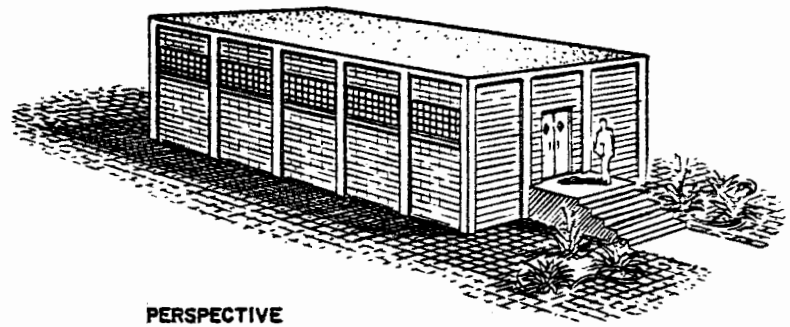
CENTRAL TELEMETRY FACILITY-NEW AREA

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

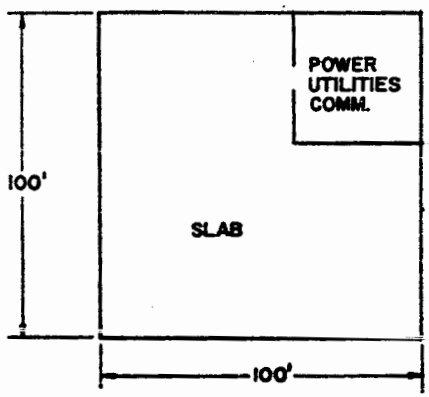
ADVANCED SATURN-NOVA SUPPORTING FACILITIES



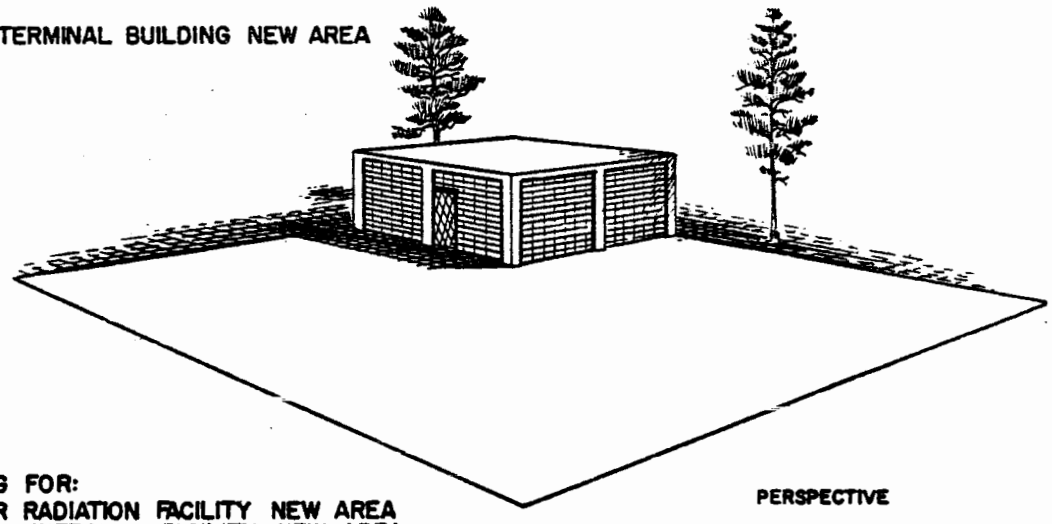


PERSPECTIVE

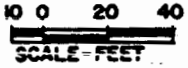
CABLE TERMINAL BUILDING NEW AREA



PLAN



PERSPECTIVE

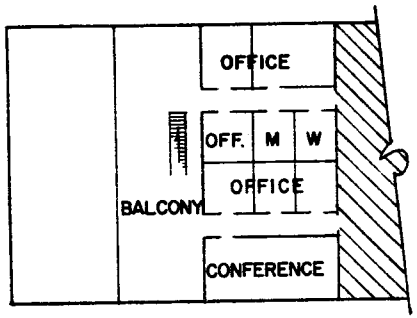


TYPICAL BUILDING FOR:
NUCLEAR RADIATION FACILITY NEW AREA
PRECISION INFRARED FACILITY NEW AREA
SURFACE SURVEILLANCE FACILITY NEW AREA

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES



SECOND FLOOR

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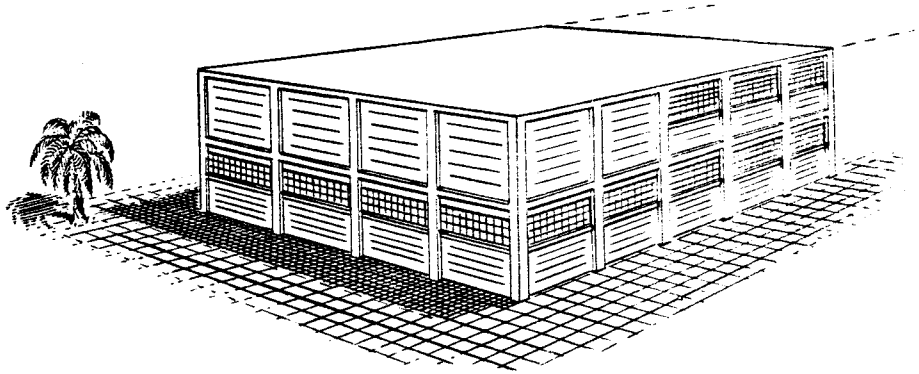
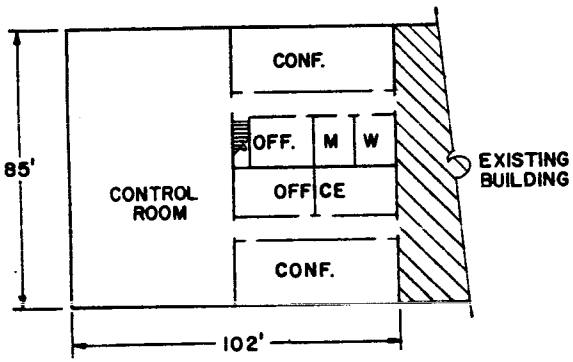
SCALE-FEET



PERSPECTIVE



PLAN

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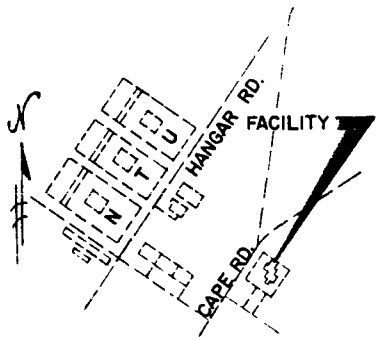


SITE PLAN

0 1000 2000

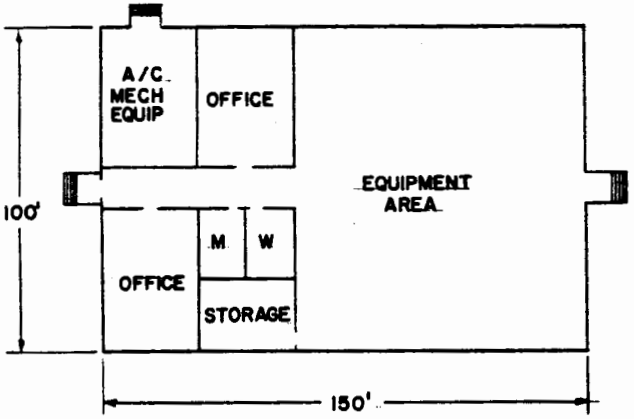
SCALE-FEET

CENTRAL CONTROL BUILDING ADDITION- EXISTING AREA

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES



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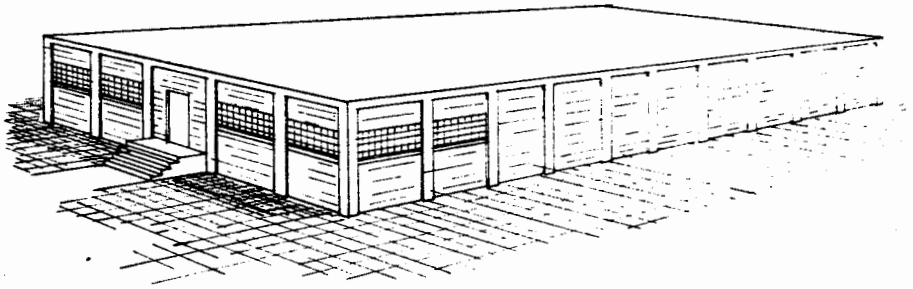
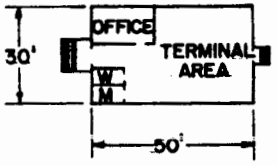


PERSPECTIVE

CENTRAL TELEPHONE OFFICE - NEW AREA



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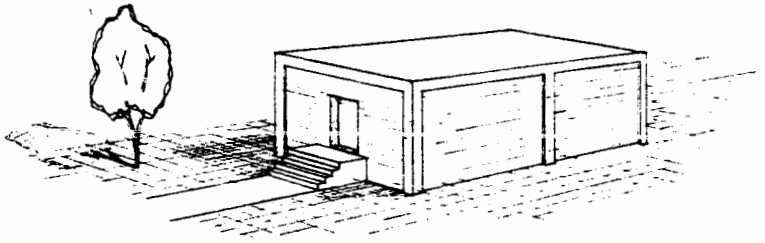


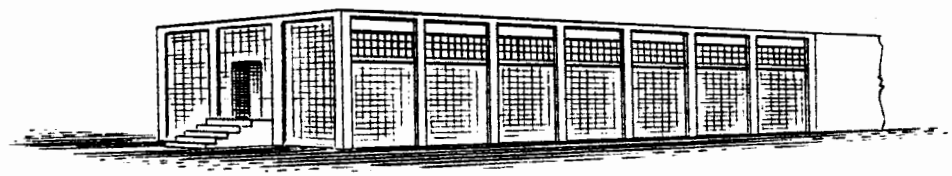
PERSPECTIVE

REPEATER BUILDING - NEW AREA

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES



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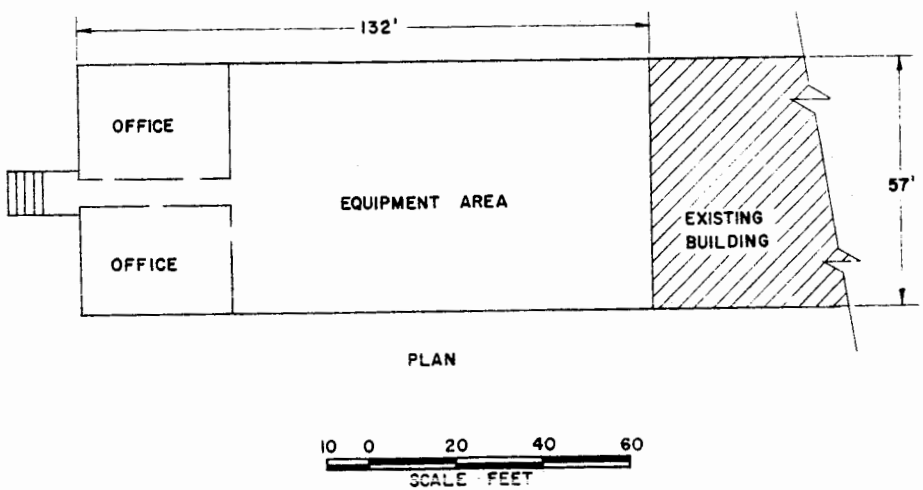

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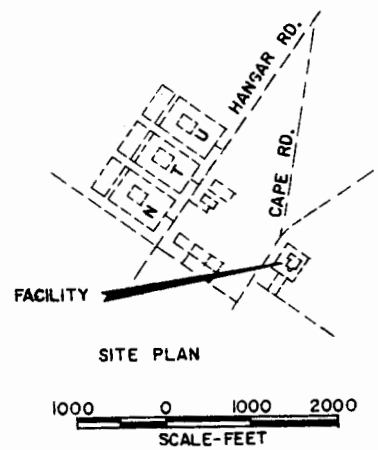


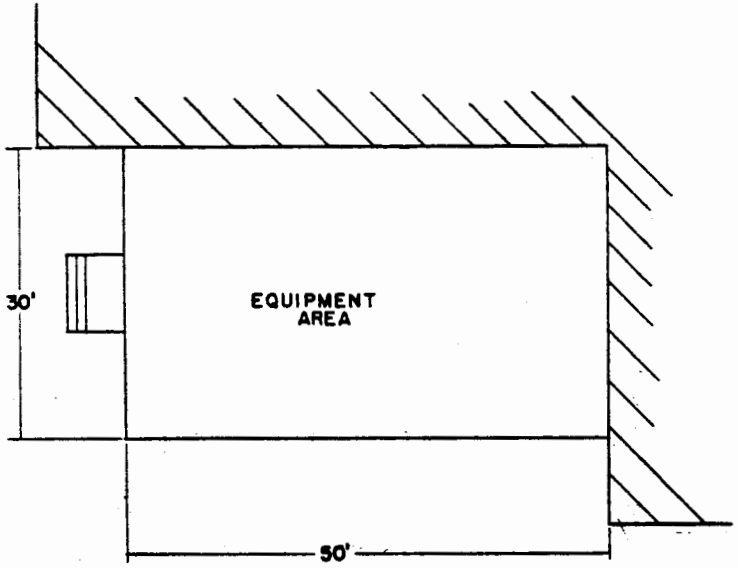
SITE PLAN

CENTRAL TELEPHONE OFFICE ADDITION-EXISTING AREA

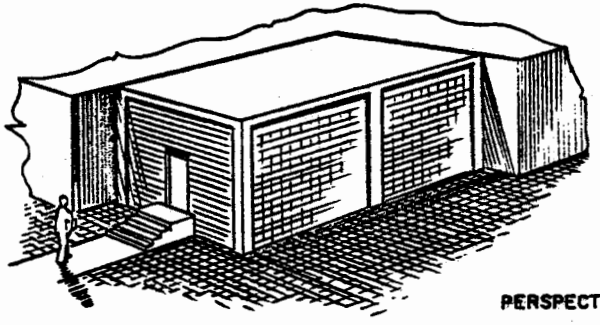
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

ADVANCED SATURN-NOVA SUPPORTING FACILITIES



PLAN



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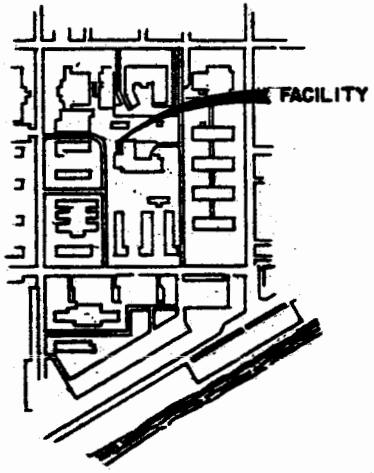


SITE PLAN

CENTRAL TELEPHONE OFFICE ADDITION–PATRICK AIR FORCE BASE

New and the Existing Areas. It will provide the necessary telemetry pre-launch checkout and coverage of vehicles during the initial portion of flight. It will also receive, process, record, or transmit data received from telemetry receiving stations at outlying sites (New Smyrna Beach, Florida, Vero Beach, Florida and Grand Bahama Island). All acquired information will be correlated in this central facility and will be transmitted to user organizations for presentation in real-time at their control centers.

(c) Communications facilities: Several facilities, as outlined in the project description, are necessary to establish a communication and data distribution network to support the Manned Lunar Landing Program.

(d) Nuclear radiation facilities: These facilities are necessary to provide precision data, unhampered by weather, flame, or blast during the early lift-off phase. There are no systems presently in use which will provide real-time data of adequate accuracy during this critical phase. Such a system would add negligible weight and volume to the missile and would not be dependent on missile power. Remote recording of the metric data would preserve such data for analysis following any missile malfunction during lift-off.

(e) Central control facility: The central control building in the Existing Area is the control point for a variety of vital functions including range safety and range readiness. Launches are not permitted unless instrumentation along the flight path is ready for the test and populated areas can be protected against damage. These functions must be expanded to receive data from the New Area instrumentation.

(f) Precision infrared tracking system facilities: Facilities are required to place in operation a precision infrared tracking system that will support Advanced Saturn launches. Instrumentation will be provided to fulfill the requirement for an early launch tracking system capable of providing real-time data to the appropriate control centers. A mobile system using van pads with supporting utilities is contemplated.

(g) Surface surveillance radar facilities: The facilities outlined in (f) above will provide the support required for a mobile surface surveillance radar. The radar will be used for range safety support of Advanced Saturn launches with the mobile unit positioned at one of the van sites

to provide optimum surface surveillance coverage. A fixed position radar is planned for a subsequent budget to further implement this system.

(h) Equipment, instrumentation, and supporting systems: The instrumentation itemized in the Cost Estimate is required due to the limited capability of the existing range instrumentation to handle launches in the New Area north of the existing Cape Canaveral Missile Test Annex pads, and to handle extended missions. The development of new systems such as the precision infrared tracking system and the nuclear radiation ranging system is necessary to meet program requirements and reliability. Large quantities of additional equipment and support systems are required to supplement instrumentation presently available at Atlantic Missile Range and at remote locations. Among these requirements are provisions for the extension of existent telemetry coverage and data distribution both at lift-off and during first phase of flight; extended camera coverage of all types; highly accurate optical, infrared, and various special precision and high resolution tracking systems for trajectory position and velocity surveillance systems; extended central control capabilities; coordination systems with global range network; redundant command control and extended range safety coverage; intercommunications systems; and radiation ranging systems. The instrumentation proposed for funding in this project is required for the initial launch phase.

COST ESTIMATE:

A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$1,574,000
Site preparation	$560,000	
Roads and parking areas	404,000	
Utility connections	610,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		6,986,000
Mission support facilities:		
Contractors' building..(60,000 square feet at $22.00 per square foot)	1,320,000	
Engineering, laboratory, and operations building..(65,000 square feet at $23.00 per square foot)	1,500,000	

Range support facilities:		
Cable storage and maintenance facility..(30,000 square feet at $15.00 per square foot).....	$450,000	
Central telemetry facility..(25,000 square feet at $50.00 per square foot).....	1,250,000	
Nuclear radiation facilities.....	250,000	
Central control building addition.. (14,500 square feet at $38.62 per square foot).....	560,000	
Precision infrared facility.....	30,000	
Surface surveillance radar facility.....	40,000	
Communications facilities..(35,000 square feet at $45.50 per square foot).....	1,586,000	
Central telephone office, New Area (15,000 square feet)		
Central telephone office addition, Existing Area (7,500 square feet)		
Cable Terminal Building, New Area (6,500 square feet)		
Repeater building, New Area (4,500 square feet)		
Central telephone office addition, Patrick Air Force Base (1,500 square feet)		
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$28,661,000
Central telemetry equipment.....	6,248,000	
Telemetry control data terminal equipment.....	1,445,000	
Inside and outside cable system (1,200 miles).....	10,597,000	
Intercommunication equipment.....	336,000	
Precision early launch rate equipment.....	4,929,000	
Nuclear radiation ranging system.....	724,000	
Central control equipment.....	2,120,000	
Precision infrared triangulation system....	1,591,000	
Universal timing terminal unit.....	44,000	
Data handling equipment for range rate station.....	243,000	
Surface surveillance radar.....	144,000	
Office equipment and furniture.....	240,000	
E. DESIGN AND ENGINEERING SERVICES.....		1,900,000
Total estimated cost.....		$39,121,000

(F 2-K15

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

APOLLO STATIC TEST FACILITY

DESCRIPTION:

This project involves the construction of two test stands and related structures, and the installation of the necessary equipment, instrumentation, and support systems. A steam ejector will be provided to simulate the space vacuum environment in which the spacecraft rocket engines must be able to ignite. The facility will be located east of launch pad No. 5 so that use may be made of the existing blockhouse of launch complex Nos. 5 and 6. Studies have indicated that this location is the most practicable and economical. A sketch of the proposed facility is shown on the following page.

JUSTIFICATION:

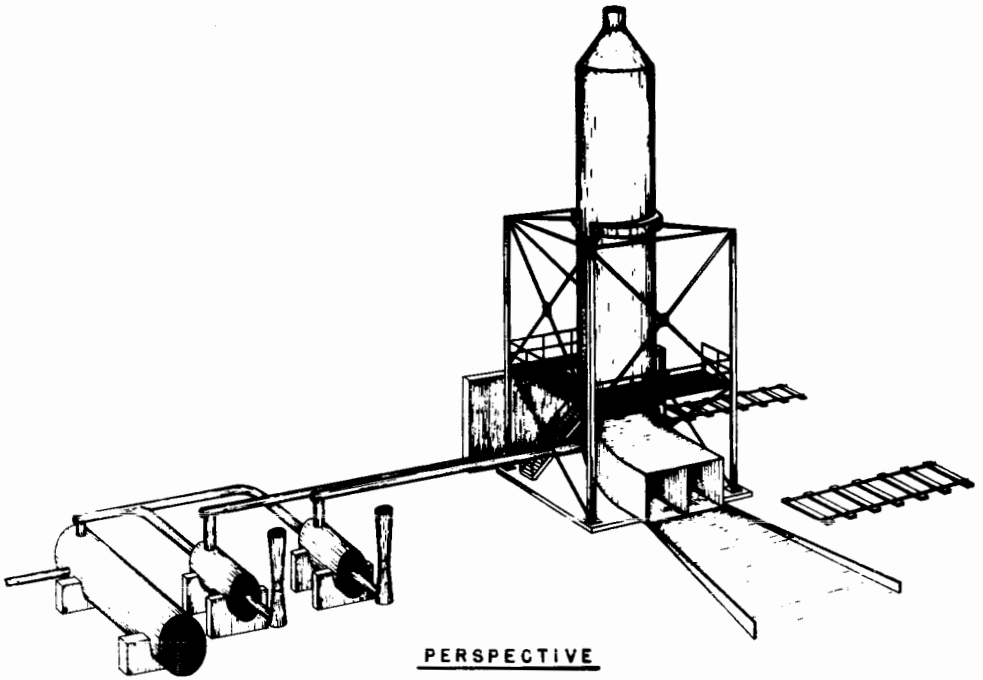
Two stands are required for static tests of the Apollo spacecraft. One test stand will be used for static firing and proof testing cryogenic lunar hypergolic engines of the Apollo service module. Both of the modules will be tested simultaneously. Static testing on the earth of the lunar landing and take-off stages of Apollo spacecraft under simulated lunar conditions is a vital part of the overall systems testing programs. The safety of the astronauts and the fulfillment of the assigned missions cannot be predicated until confidence factors have been developed by these tests. There are no existing facilities available to perform this type of testing.

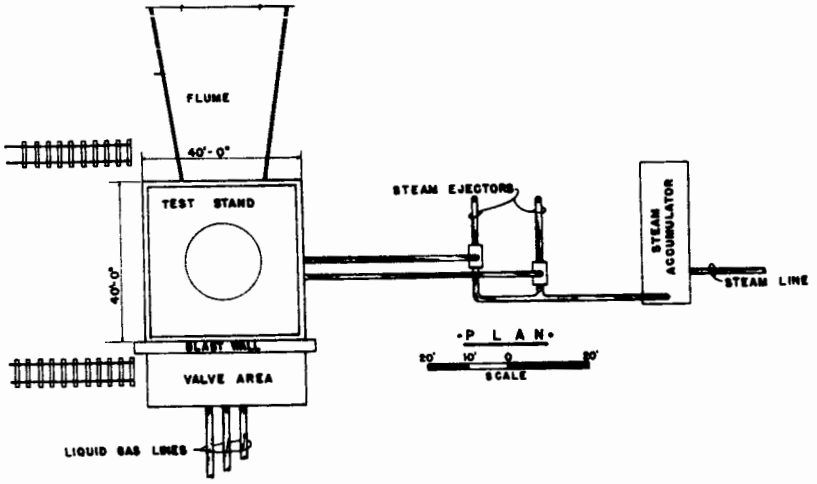
COST ESTIMATE:

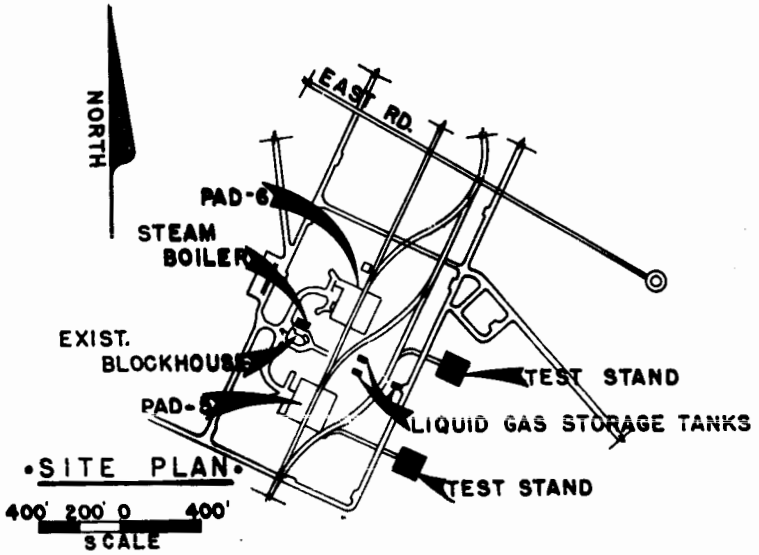
A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$354,000
Site preparation	$13,000	
Roads and parking areas	64,000	
Utility connections	90,000	
Railroad switches	57,000	
Railroad track	130,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		445,000
Lunar module test stand	230,000	
Service module test stand	130,000	
Pump house facility	35,000	
Boiler facilities	50,000	

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

APOLLO STATIC TEST FACILITY







D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$3,605,000
	Lunar module stand fire protection system....	$150,000	
	Lunar module stand electrical system.....	920,000	
	Service module stand fire protection system..	150,000	
	Service module stand electrical system.....	641,000	
	Vacuum system.....	136,000	
	Propellant system.....	513,000	
	Instrumentation.....	845,000	
	Cabling.....	250,000	
E.	DESIGN AND ENGINEERING SERVICES.....		596,000
	Total estimated cost.....		$5,000,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

NOVA LAUNCH COMPLEX

DESCRIPTION:

This project requests the funds necessary to initiate the design and construction of a complex for the assembly, checkout, and launch of very heavy vehicles of the NOVA class. The fiscal year 1963 portion of the project includes the construction of one vertical assembly and lanuch building, the sub pad work for two (2) launch pads, and the site preparation and utilities installations. The latter would include such items as canals, roads, and water and power services in the complex area. The design of long lead time items, such as the launcher-transporter, propellant systems, and control and checkout systems, is also included in this project. It is estimated that the fiscal year 1963 request covers approximately 35 percent of the total cost of the complex. The complex will be divided into two (2) general areas, as follows:

(a) Launch control area: This area will include the launch control center, high pressure gas conversion facilities, and upper stage inspection and modification facilities. Space will also be provided for the receipt and temporary storage of spacecraft. The supporting facilities such as roads, causeways, bridges, and utilities within the area are also included.

(b) Vertical assembly and launch area: Three (3) launch pads will be constructed, each containing a vertical assembly and launch building, and propellant storage and transfer facilities. The vehicle will be assembled, checked out, and launched from the vertical assembly and launch structure which will be of fixed design. The structure as presently envisioned will be approximately 470 feet high and 300 feet long and will be designed to withstand launch pressures as well as hurricane loadings. Remote controlled vertical louvers and a split opening roof are contemplated to allow full opening and pressure relief during launch.

The transporter for the first stage will serve as a launcher and will be integral with the booster from initial assembly to launch. The transporter-launcher unit will move through a system of canals to the vertical assembly and launch building. After the transporter is positioned, the locks will close and the water will be pumped out. The transporter will

then be firmly founded and used as a launch platform. Following launch, the water will be pumped back into the lock and the transporter floated away for reconditioning and the acceptance of another first stage booster. The launcher-transporter concept is unique and special design and construction techniques will be required.

The remaining stages for the completed NOVA vehicle will be brought to the launch area by water or road and will be assembled in the vertical assembly and launch building. The assembled vehicle will be checked out and control transferred to the control center for launch. The checkout and launch systems will be linked through computers.

Sketches of the proposed complex are shown on the following two pages.

JUSTIFICATION:

The NOVA vehicle is being designed for a thrust of 12,000,000 pounds. The vehicle will be used for launching very heavy payloads to direct landing on the moon without the need for rendezvous. The three pad complex described above will launch eight NOVA type vehicles per year. Each launch pad will have the capability to permit assembly, pre-flight check-out, launch, and pad refurbishing for only four vehicles per year. This requires two launch pads to meet the scheduled eight launches per year. However, one additional pad is required for back-up in the event of an explosion or when major delays in launching from the other pads occur.

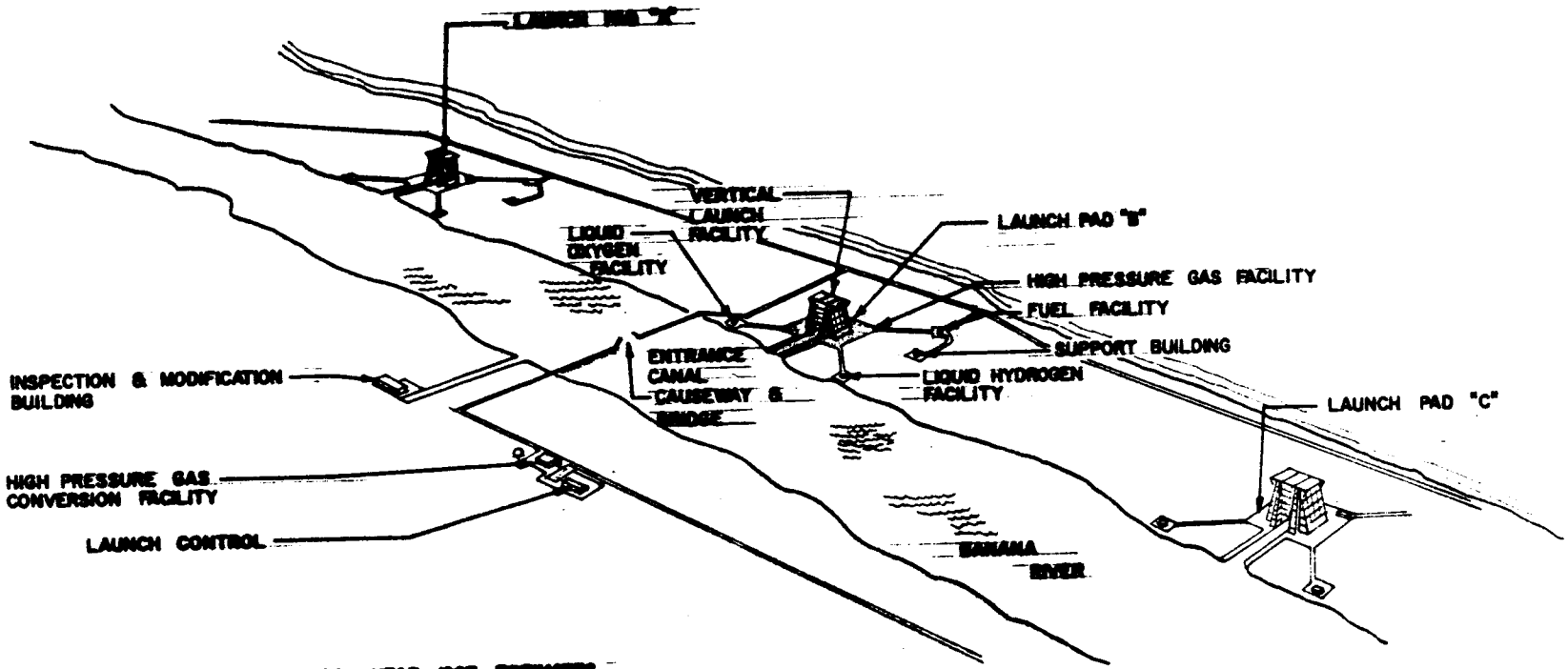
COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$5,770,000
	Site preparation, grading, and filling	$2,100,000	
	New roads	1,700,000	
	Electric lines	1,000,000	
	Water lines, potable and industrial	970,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		60,630,000
	Vertical assembly building..(141,000 square feet at $430 per square foot)	60,630,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		---
E.	DESIGN AND ENGINEERING SERVICES		13,100,000
	Total estimated cost		$79,500,000

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

NOVA LAUNCH COMPLEX



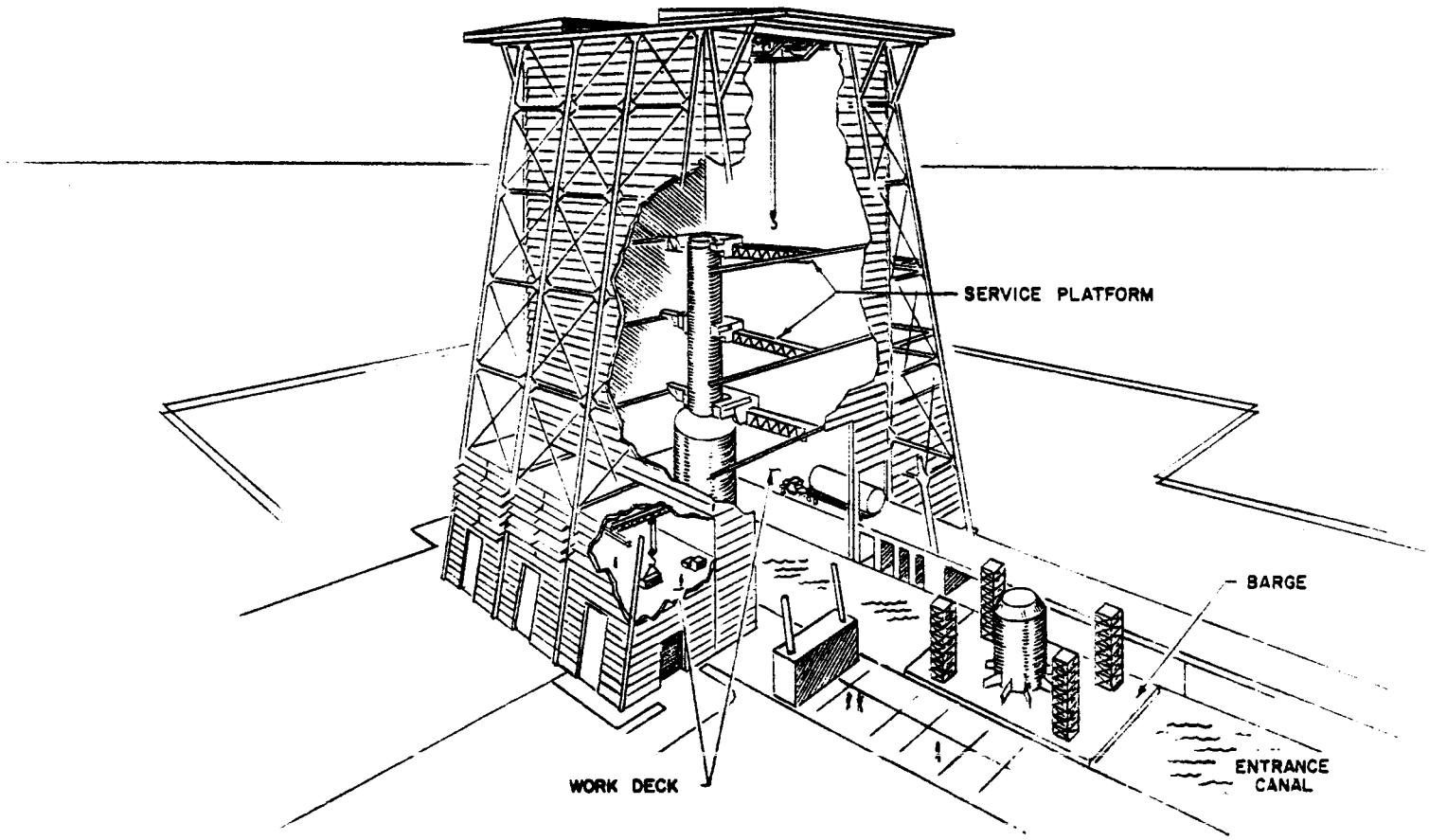
NOTE: HEAVY AREA INDICATES FISCAL YEAR 1963 ESTIMATES.
LIGHT AREA INDICATES FUTURE CONSTRUCTION

SITE PLAN

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

NOVA LAUNCH COMPLEX



VERTICAL ASSEMBLY AND LAUNCH BUILDING

CF 2-M4

ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS - NEW AREA

DESCRIPTION:

This project covers the extension of range utilities and the construction of range support facilities in the New Area of the Atlantic Missile Range in support of the Manned Lunar Landing Program. The scope of work includes:

(a) Canal dredging: The dredging of approximately 18 miles of 100 foot wide canal to a depth of 12 feet will be required to service launching sites.

(b) Primary and access roads and bridges: This item consists of access and interior roads and bridges as follows:

Exterior of the site: Approximately 5.0 miles of existing Route A1A from Haulover Canal Bridge north to the Volusia County line will be reconstructed and widened. A new two lane bridge will be built over the Haulover Canal. The road will be 24 feet wide with six foot wide shoulders on either side.

It is proposed to rebuild 1.3 miles of Route A1A south of Gate 2 (south boundary) to provide a 24 foot wide roadway with six foot wide shoulders on either side. A new bridge over a drainage canal is included in this work.

A new four lane causeway will be constructed across Indian River from U. S. Highway #1 on the mainland to the new area boundary. A bridge across the Intercoastal Waterway and a traffic interchange at U. S. Highway #1 will also be required.

On the site: This item includes approximately 29 miles of new and rehabilitated road net within the New Area including 4.0 miles of new four lane road, 6.0 miles of new two lane road, a causeway and bridge at Banana River connecting the New Area with present facilities in the Existing Area, and approximately 19.0 miles of rehabilitated roadway throughout the New Area.

(c) Power transmission lines and substations: It will be necessary to construct 22 miles of 110 KV overhead power transmission

lines, two 110 KV to 13.2 KV substations, and 20 miles of 13.2 KV overhead distribution lines.

(d) Water mains: The project includes the installation of 14.5 miles of 20 to 24 inch water mains and connections.

(e) Range support - utilities:

Heating plant and distribution system: This system will consist of two miles of steam lines, two miles of steam return lines, and a 1500 horse power boiler plant.

Water storage and distribution system: The installation of 2.2 miles of water lines, a 500,000 gallon storage tank, and a pumping station will be required.

Electric power distribution system: Approximately 2.0 miles of 13.2 KV overhead distribution lines, a substation, and switching gear will be installed.

(f) Range support - roads and parking areas:

Road network: Roads within the support area consisting of approximately 28,400 square yards of paving will be required to support the new facilities.

Parking areas: Parking areas are also required to support the new facilities; approximately 58,000 square yards of paving will be laid.

(g) Security facilities: This item includes 15.0 miles of security fences, lights, and four (4) pass and identification buildings, one on each access road to the New Area.

(h) Range support - facilities:

Maintenance building: This structure, consisting of 15,000 square feet gross area, will house the first increment of the range plant maintenance functions.

Warehouse: This building will contain 20,000 square feet of storage area for range support supplies, parts, and equipment. Additional storage facilities will be required in subsequent fiscal years as the program progresses.

Dispensary: A central dispensary will provide medical support for personnel in the immediate area and will support all other first aid stations in the New Area. The building will contain 4,600 square feet of floor area.

Location plans of the utilities to be installed and sketches of the facilities to be constructed under this project are shown on the following five pages.

JUSTIFICATION:

After the decision was made to acquire the new land area at the Atlantic Missile Range for the launching of the flight vehicles for the Manned Lunar Landing Program, a study was made to determine the types and quantities of utilities required to support the launch flight facilities being requested in the fiscal year 1963 budget. This study revealed that the existing access roads, bridges, and canals were inadequate to support the scheduled flight launches. In coordination with the State of Florida and the Air Force, an access roads study was undertaken which indicated that the access projects requested herein will be required to move the quantities of traffic that will be entering the newly acquired area.

The primary utility systems proposed are the minimum required at this time to support the launch pads being requested in the 1963 program for the NOVA and the Advance Saturn Programs. When additional pads are requested in subsequent programs, additional utilities to support these pads will be programmed concurrently.

The proposed extension of range utilities and the proposed construction of range support facilities and utilities are scheduled in accordance with launch site support requirements for the Manned Lunar Landing Program. Timely construction completion of these facilities in proper sequential order is essential to meeting the projected launch schedule.

COST ESTIMATE:

A. LAND ACQUISITION..... ---

B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS..... $17,363,000

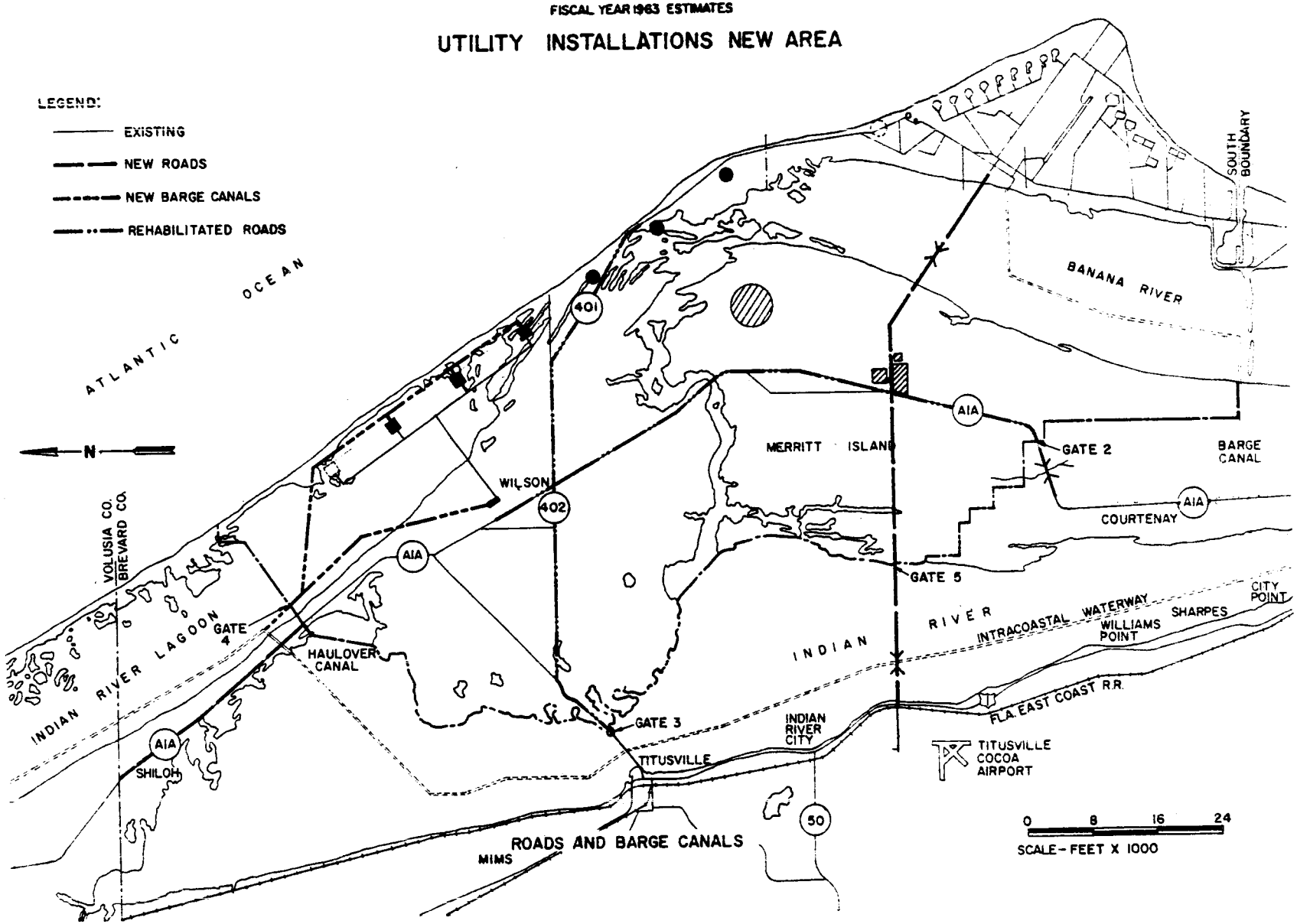
Canal dredging..... $2,650,000
Primary and access roads and bridges..... 7,260,000

Exterior of the site..... $3,953,000

5.0 miles of road from Haulover Bridge to Volusia County line..... $350,000

ATLANTIC MISSILE RANGE
FISCAL YEAR 1963 ESTIMATES

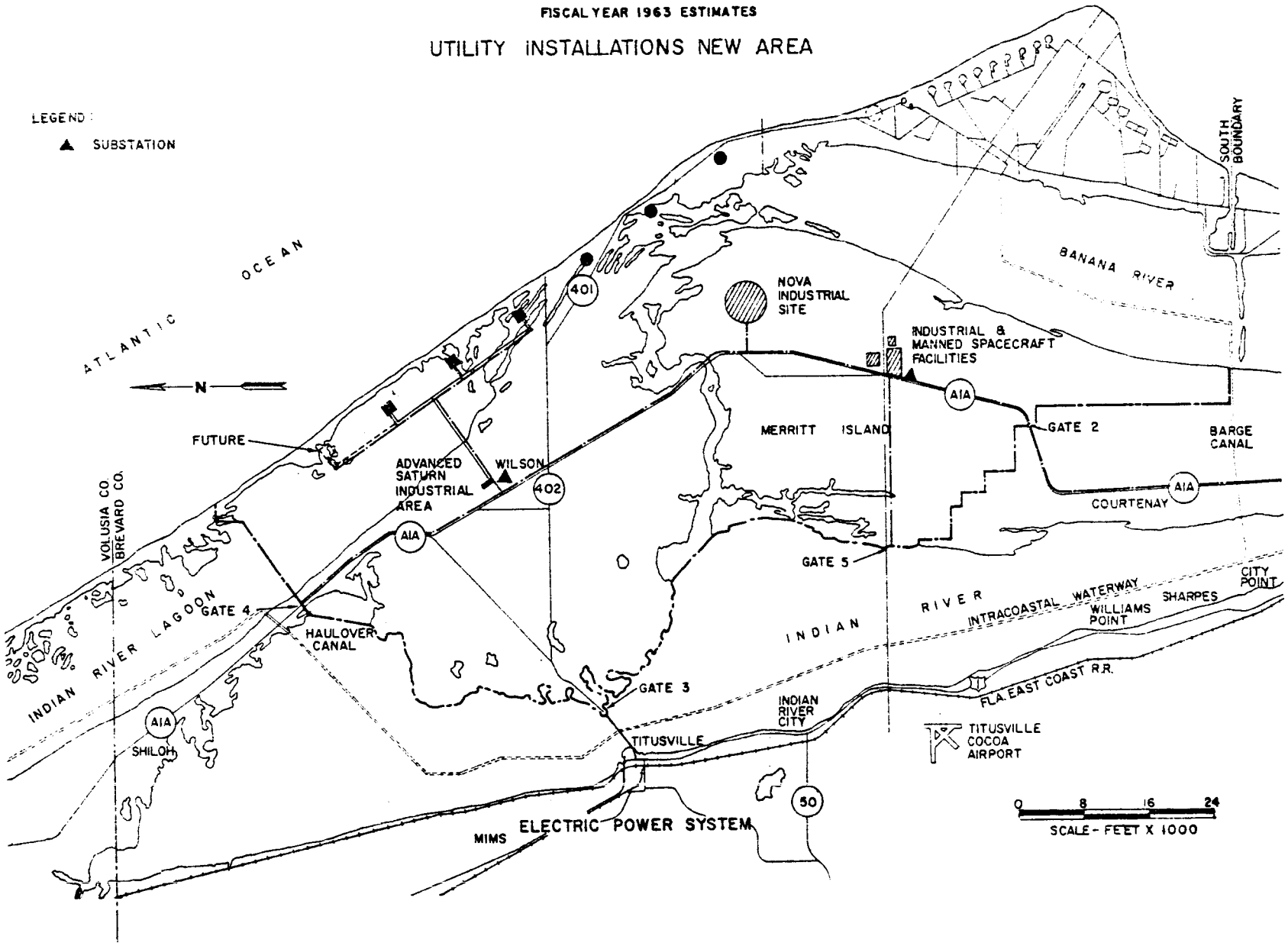
UTILITY INSTALLATIONS NEW AREA



ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

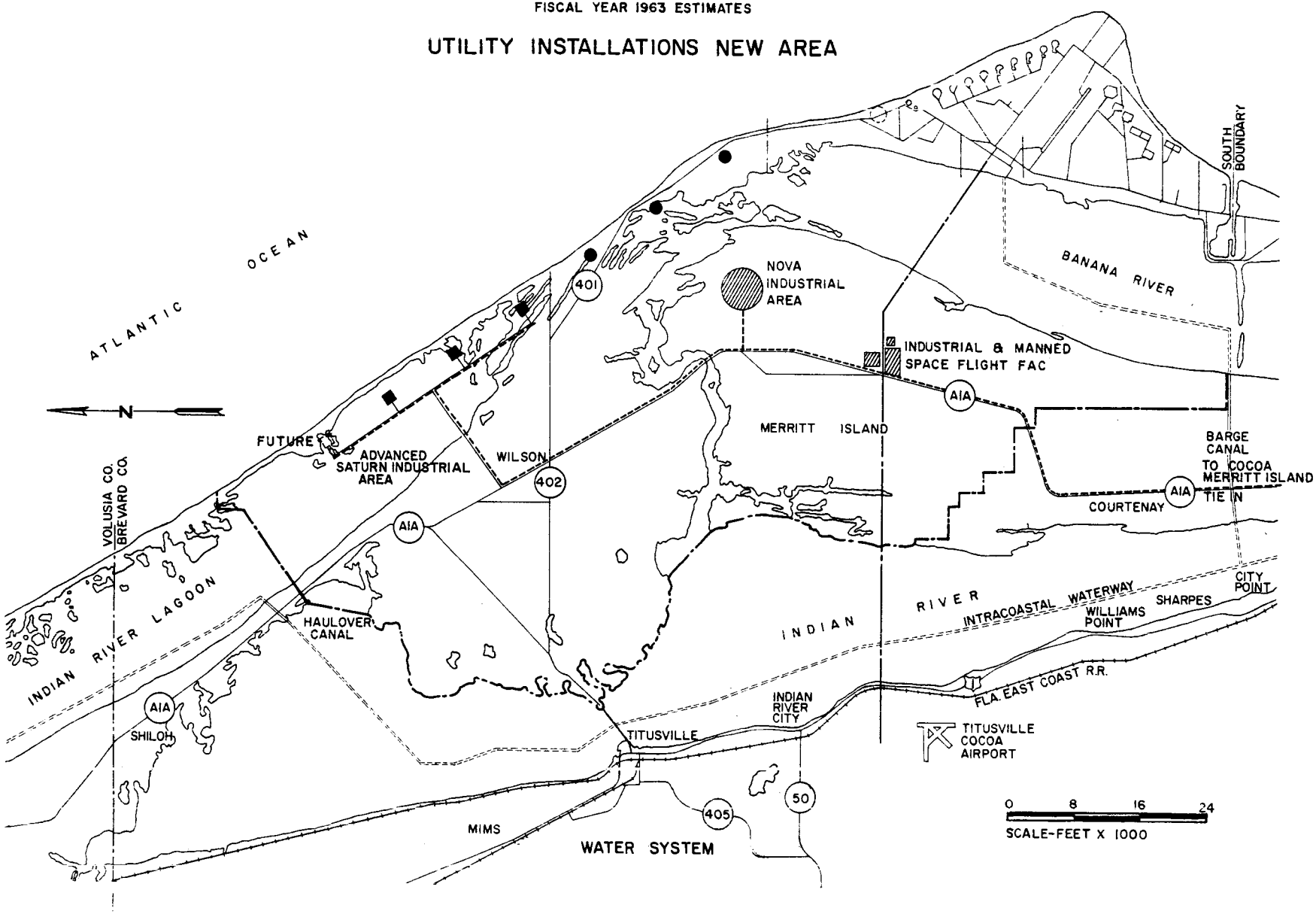
UTILITY INSTALLATIONS NEW AREA



ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

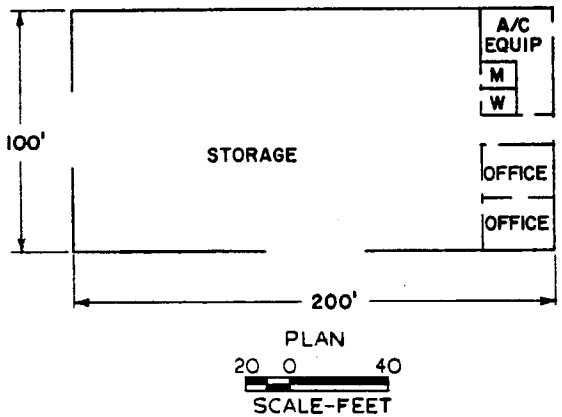
UTILITY INSTALLATIONS NEW AREA

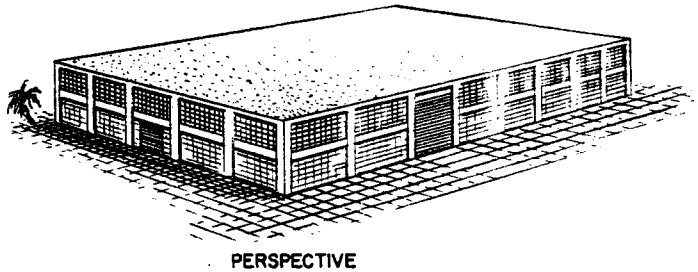


ATLANTIC MISSILE RANGE

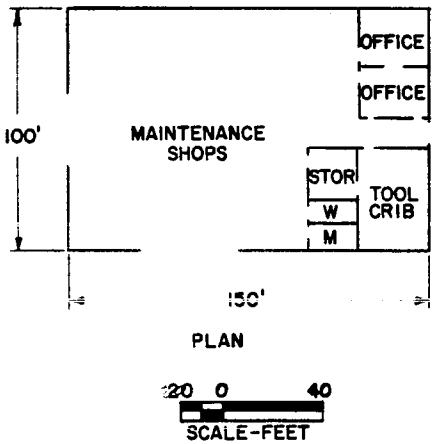
FISCAL YEAR 1963 ESTIMATES

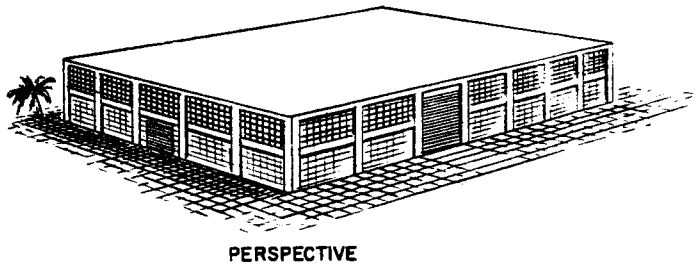
UTILITY INSTALLATIONS NEW AREA





WAREHOUSE



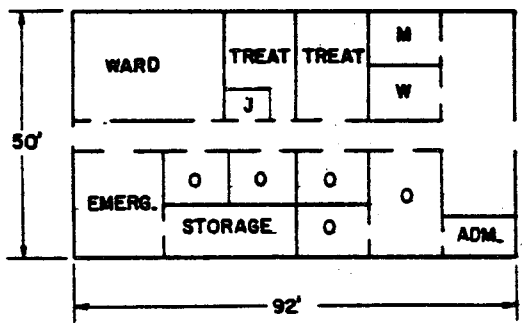


MAINTENANCE BUILDING

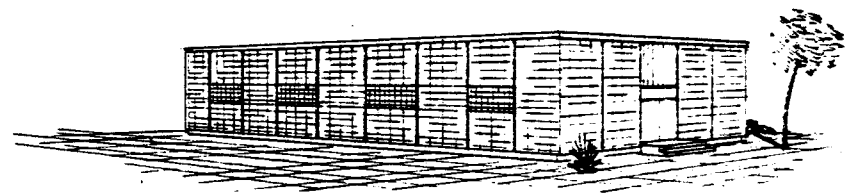
ATLANTIC MISSILE RANGE

FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS NEW AREA

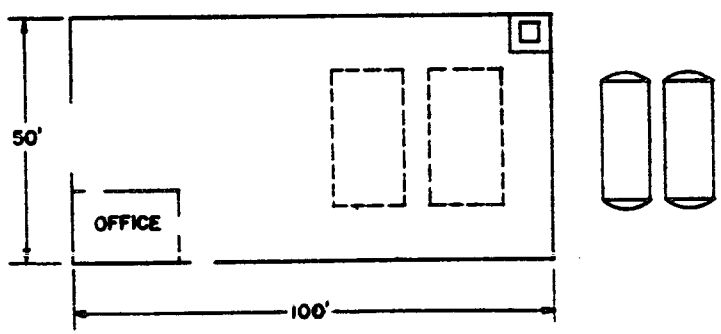


PLAN



PERSPECTIVE

DISPENSARY



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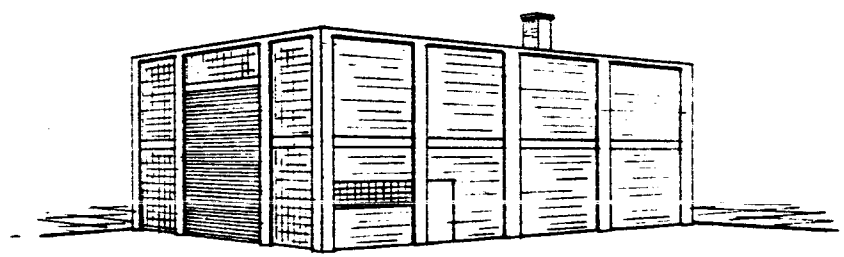


PERSPECTIVE

10 0 10 20 30

SCALE-FEET

HEATING PLANT

Bridge over Haul-over Canal.....	$578,000		
1.3 miles of road.	65,000		
Bridge.....	50,000		
Causeway road to U. S. Highway #1.....	1,240,000		
Bridge.....	1,270,000		
Interchange at U. S. Highway #1.....	400,000		
On the site.....		$3,307,000	
4 miles of 4 lane road.....	800,000		
6 miles of 2 lane road, including causeway and bridge.....	1,870,000		
19.0 miles of rehabilitated road.....	637,000		
Power transmission lines and substation...			$2,340,000
Power transmission lines.....		1,300,000	
2 Substations.....		1,040,000	
Water mains.....			1,990,000
Range support - utilities.....			1,390,000
Heating distribution system..		760,000	
Water distribution system....		270,000	
Electrical power distribution system.....		360,000	
Range support - roads and parking areas...			740,000
Road network.....		260,000	
Parking areas.....		480,000	
Security forces.....			498,000
Lighting.....			495,000

C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		$1,200,000
Pass and identification buildings; four each (600 square feet at $30 per square foot).....	$72,000	
Water storage tank.....	130,000	
Heating plant (5000 square feet at $40 per square foot).....	200,000	
Maintenance building (15,000 square feet at $24.00 per square foot).....	360,000	
Warehouse (20,000 square feet at $15.00 per square foot).....	300,000	
Dispensary (4,600 square feet at $30.00 per square foot).....	138,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		572,000
Maintenance, warehouse, and dispensary equipment.....	22,000	
Boilers, pumps and accessories.....	550,000	
E. DESIGN AND ENGINEERING SERVICES.....		2,865,000
Total estimated cost.....		$22,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

FACILITY PLANNING AND DESIGN

DESCRIPTION:

The funds requested under this project are required for advanced facility planning and design on projects for which construction funds may be requested in subsequent budgets.

JUSTIFICATION:

Long-range plans in several program areas must anticipate the need for the construction of facilities beyond the budget year for which estimates are being submitted. A considerable saving in time and an increase in the accuracy of construction cost estimates is possible with the availability of an advanced facility planning and design fund which can be used to initiate the design of high-priority facilities prior to the enactment of project authorization and the appropriation of funds. Without this project, the only method by which such advanced design work can be initiated is through the use of the Administrator's emergency authorizations provided in the authorization act. The provision of the separate and identifiable advanced planning and design fund proposed by this project allows the emergency authorizations to be conserved for projects requiring the prompt initiation of construction, and permits advanced planning and design to be funded without the necessity of reprogramming funds provided for other projects.

COST ESTIMATE:

Total estimated cost..... $10,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

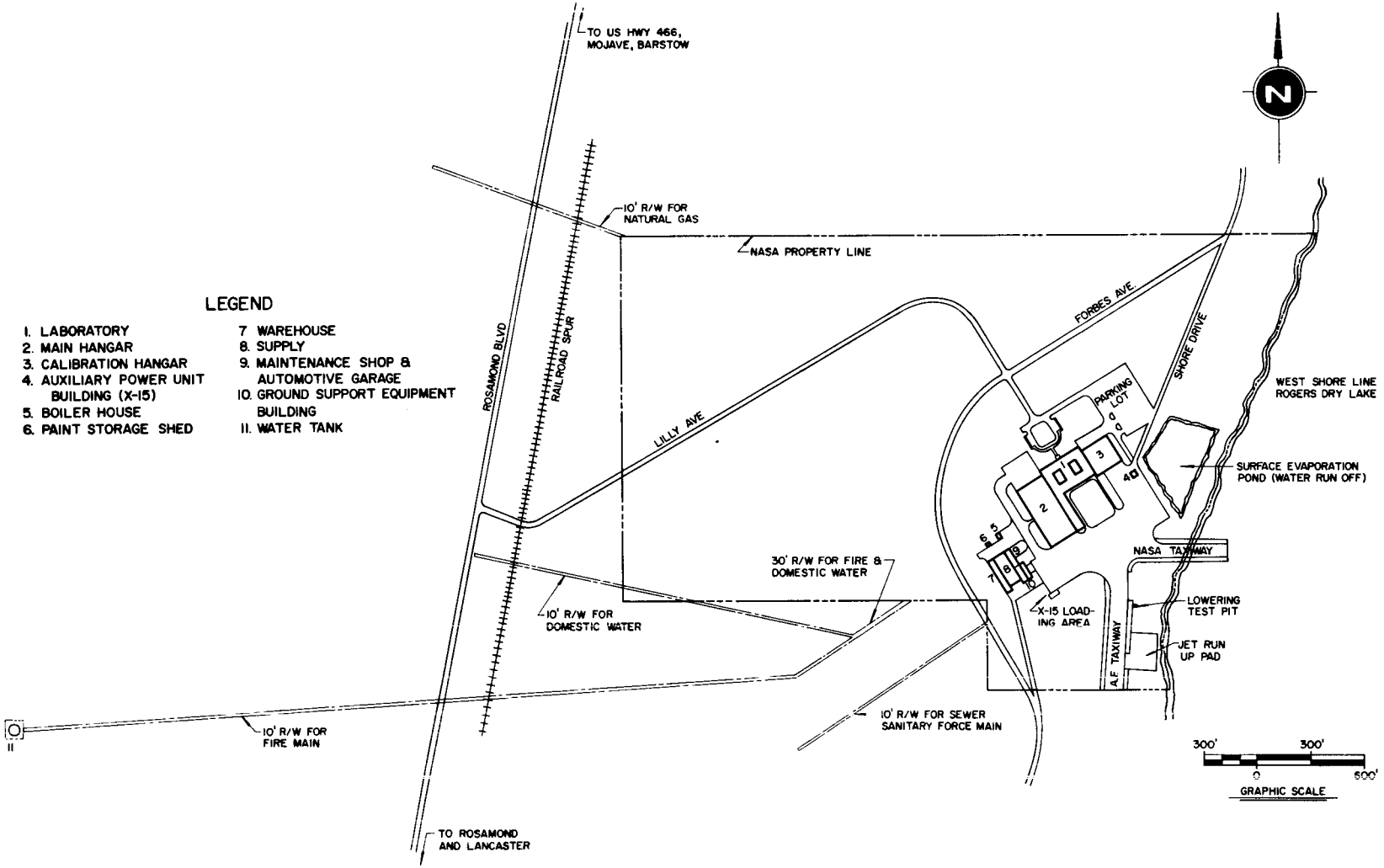
FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES - 1963 PROGRAM

FLIGHT RESEARCH CENTER

Page No.		
CF4-A2	Location plan	
CF4-A3	Building additions.....	$1,332,000
CF4-B1	Visual flight simulator.....	475,000
	Total.....	$1,807,000

FLIGHT RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES
LOCATION PLAN



FLIGHT RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

BUILDING ADDITIONS

DESCRIPTION:

Building additions to the main Flight Research Center building are proposed as indicated in the sketch on the following page. The additions total to approximately 42,000 square feet of space which will provide a net usable area of slightly over 31,000 square feet. About 21,000 square feet of the additional space will be used for shop and laboratory activities, and about 10,000 square feet for office space and other supporting activities.

JUSTIFICATION:

The increasing workload at this station, particularly in connection with the X-15, the Dyna-Soar, and the supersonic transport programs, is creating a requirement for additional shop and laboratory space. At present, the machine, sheet metal, and welding shops occupy 8,750 square feet of the calibration hanger. It is proposed to move these shops into the new technical services wing. The vacated area in the calibration hanger will be used to house simulators, altitude test chambers, and test tables for use in the development and testing of aircraft instrumentation and control systems.

Additional office space is urgently needed to alleviate existing crowded conditions (an average of only 65 square feet per person) and to provide working space for additional personnel to be added during the fiscal year 1963.

The additional shop area indicated in the drawing will permit necessary additions to the photographic laboratory, the radio room, data processing units, and the aircraft component shops and laboratories, other than the heavy-duty type of fabrication and repair shops.

COST ESTIMATE:

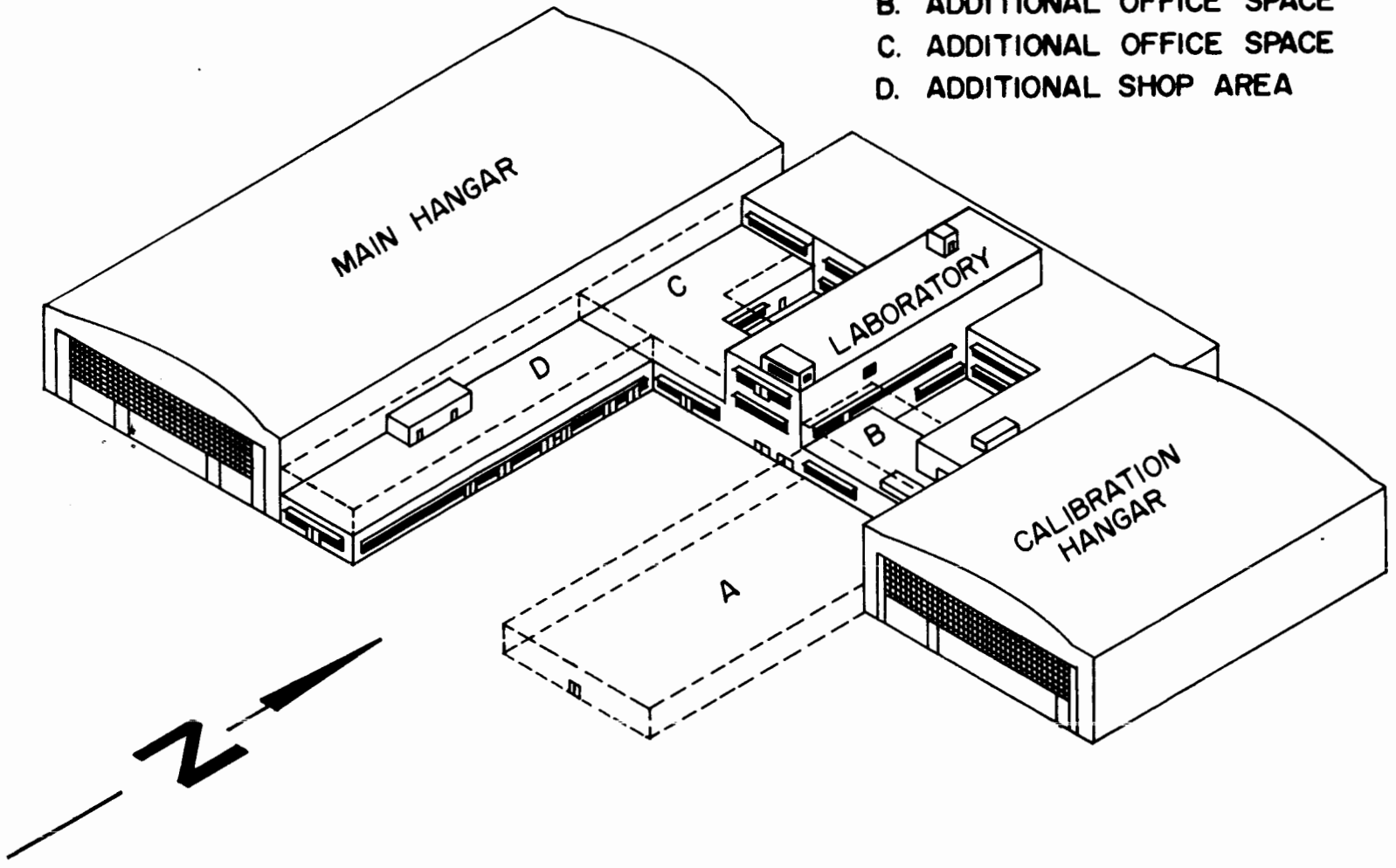
A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$51,000
Utility connections	$35,000	
Paving	16,000	

FLIGHT RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

BUILDING ADDITIONS

LEGEND

A. NEW TECHNICAL SERVICES WING
B. ADDITIONAL OFFICE SPACE
C. ADDITIONAL OFFICE SPACE
D. ADDITIONAL SHOP AREA



C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		$1,201,000
	Building...(41,705 square feet at $28.80 per square foot).....	$1,201,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		---
E.	DESIGN AND ENGINEERING SERVICES.....		80,000
	Total estimated cost.....		$1,332,000

FLIGHT RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

VISUAL FLIGHT SIMULATOR

DESCRIPTION:

A flight simulator is required with the capability of providing a projection of the outside view, controlled in response to the pilot's control movements and the performance of the simulated vehicle, to the pilot in a cockpit mockup. The facility will include:

(a) A projection system capable of a bright, controllable, wide-angle presentation of earth and sky.

(b) The cockpit, indicator, controls and other facilities required to provide flexibility and easy interchangeability of the pilot's display, field of vision, and control system.

(c) Required electronic equipment to modify the present general-purpose simulator to permit solving the problems involved in long duration high performance missions.

JUSTIFICATION:

The success of a flight research program is critically dependent upon the provision of proper and adequate simulator equipment. The basic use of flight simulation equipment at the Flight Research Center is for support of flight activity. Simulators have been found to be indispensable in the areas of flight guidance and planning, data reduction and analysis, pilot training, development of research procedures, and prediction of flight characteristics.

The Flight Research Center, at present, has two static simulators: an X-15 simulator and a general-purpose simulator. These two pieces of equipment are limited to simulation with instrument cockpits, that is, blind flying. This limitation to instrument presentation is unacceptable, in many flight programs to be investigated in the future. Examples of such programs are recovery and landing research, navigation and energy-management problems, and complete mission simulation. All of these programs will rely heavily on the visual stimulus of the outside environment, and, for adequate simulation, this outside environment must be provided. The proposed equipment will provide this visual-environment capability for the present static simulators, and will thus permit investigation of a wider range of flight problems.

COST ESTIMATE:

A.	LAND ACQUISITION.....		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$15,000
	Utility connections.....	$15,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		30,000
	Hangar modification.....	20,000	
	Projection dome.....	10,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		350,000
	Projection system.....	150,000	
	Cockpit.....	50,000	
	Electronic controls and simulation equipment.....	150,000	
E.	DESIGN AND ENGINEERING SERVICES.....		80,000
	Total estimated cost.....		$475,000

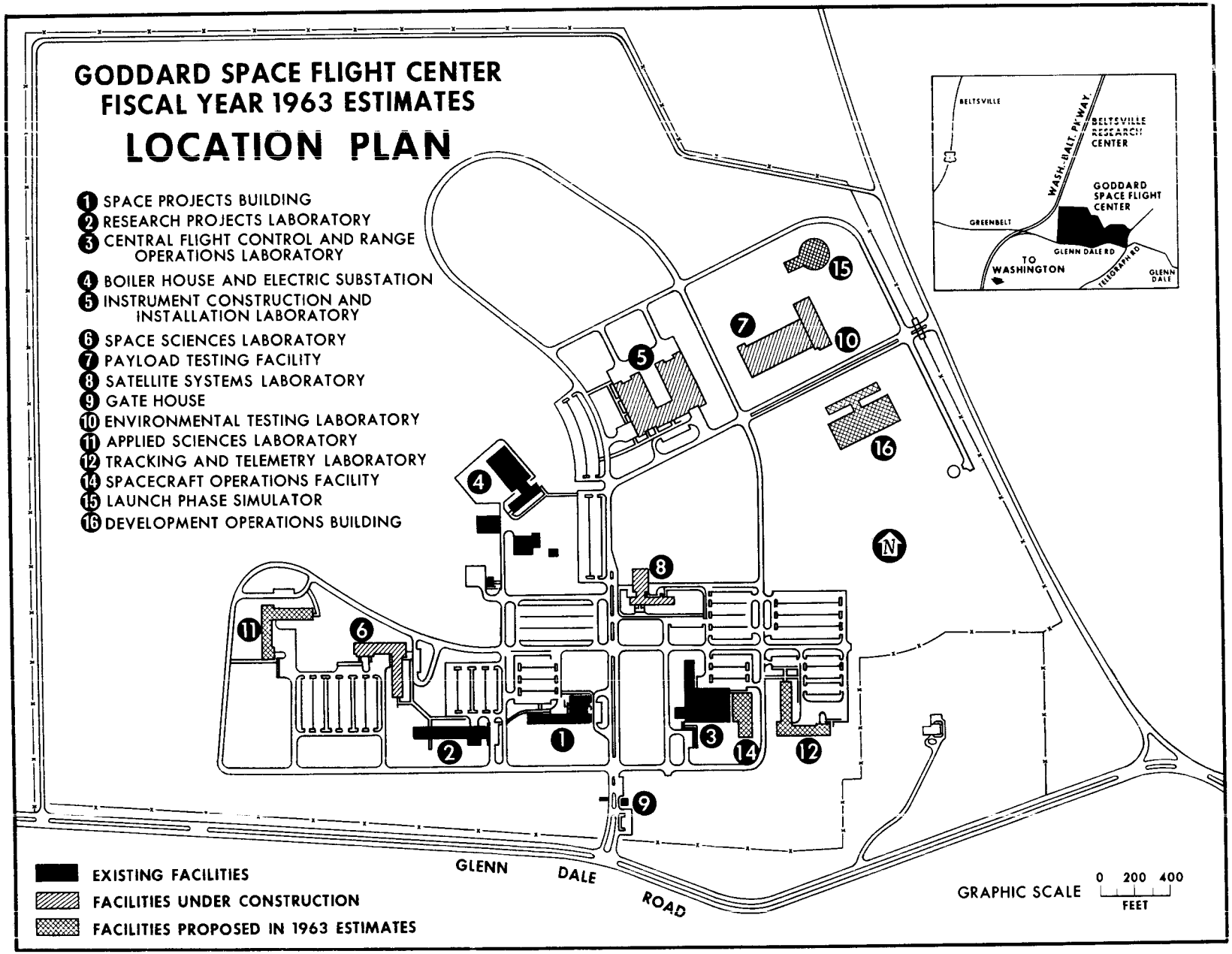
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES - 1963 PROGRAM

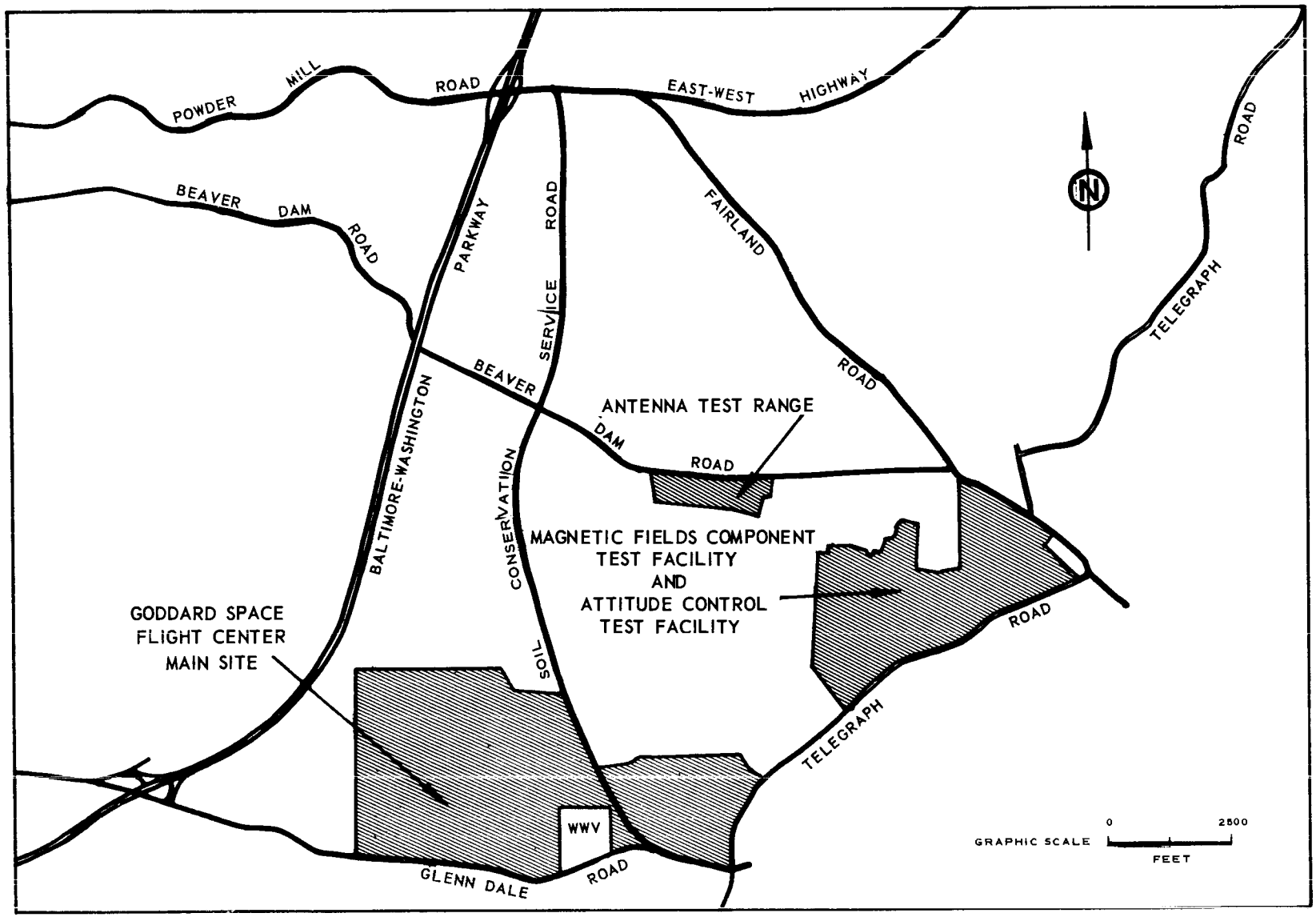
GODDARD SPACE FLIGHT CENTER

Page No.		
CF5-A2	Location plan	
CF5-A3	Applied sciences laboratory.....	$3,175,000
CF5-B1	Attitude control test facility.....	915,000
CF5-C1	Conversion of dynamic test chamber.....	3,250,000
CF5-D1	Development operations building.....	1,850,000
CF5-E1	Launch phase simulator.....	3,915,000
CF5-F1	Spacecraft operations facility.....	7,500,000
CF5-G1	Tracking and telemetry laboratory.....	3,175,000
	Total.....	$23,780,000


GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES
LOCATION PLAN
1 SPACE PROJECTS BUILDING
2 RESEARCH PROJECTS LABORATORY
3 CENTRAL FLIGHT CONTROL AND RANGE OPERATIONS LABORATORY
4 BOILER HOUSE AND ELECTRIC SUBSTATION
5 INSTRUMENT CONSTRUCTION AND INSTALLATION LABORATORY
6 SPACE SCIENCES LABORATORY
7 PAYLOAD TESTING FACILITY
8 SATELLITE SYSTEMS LABORATORY
9 GATE HOUSE
10 ENVIRONMENTAL TESTING LABORATORY
11 APPLIED SCIENCES LABORATORY
12 TRACKING AND TELEMETRY LABORATORY
14 SPACECRAFT OPERATIONS FACILITY
15 LAUNCH PHASE SIMULATOR
16 DEVELOPMENT OPERATIONS BUILDING
BELTSVILLE
WASH.-BALT. PY'WAY
BELTSVILLE RESEARCH CENTER
GODDARD SPACE FLIGHT CENTER
GREENBELT
GLENN DALE RD
TO WASHINGTON
TELEGRAPH RD
GLENN DALE
N
GLENN DALE ROAD
EXISTING FACILITIES
FACILITIES UNDER CONSTRUCTION
FACILITIES PROPOSED IN 1963 ESTIMATES
GRAPHIC SCALE
0 200 400
FEET

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN - REMOTE SITE AREAS



GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

APPLIED SCIENCES LABORATORY

DESCRIPTION:

It is proposed to construct a laboratory consisting of approximately 100,000 square feet of floor area in a ground floor, two additional floors, and headhouse space. The building will have a monolithic concrete frame and floor slabs with face brick masonry exterior walls. Antenna test rooms provided in the headhouse and roof slabs will be designed to accommodate antenna loads. Interior partitions will be of concrete block and movable metal. Offices, laboratory work space, and parking areas will be provided for about 350 people. The building essentially will be a duplicate of the space sciences laboratory with revisions and alterations required for the new site orientation. It will contain the necessary electrical, air-conditioning, and ventilation systems for research and development of satellite payloads. Existing utility systems will be extended to the building and the central power plant steam generating and chilled water capacity will be expanded as required. Drawings of the proposed laboratory are shown on the following page.

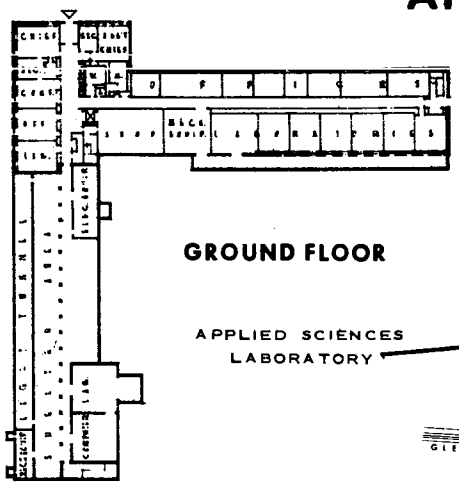
JUSTIFICATION:

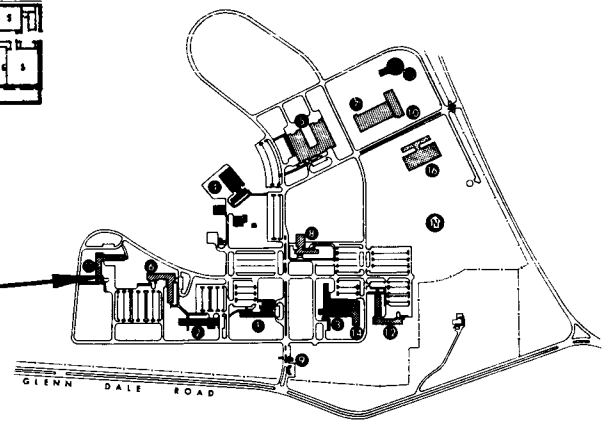
This building will house the additional scientific personnel required for research and development of instrumentation for spacecraft and sounding rockets. Studies will be made on infra-red radiation, cosmic rays, meteorites, solar physics, x-ray radiation, magnetic fields, and other geophysical phenomena. The functions of this laboratory will also include the development of vehicle-borne computers and the improvement of ground-based computers used to derive detailed orbital or flight path constants of space vehicles. Special equipment to be housed in the laboratory will include particle accelerators, leak detectors, mass spectrometer, vacuum and thermal testing tanks, balancing equipment, and gyro and hydraulic test stands.

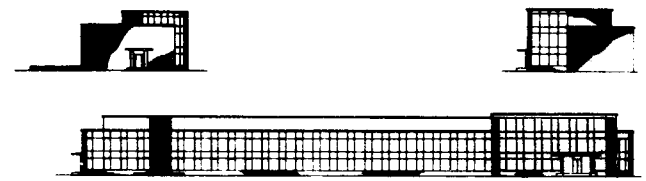
The first and second floors will provide laboratories for studies in the areas mentioned and offices for the research personnel. The basement will provide space for building heat, ventilating, and electrical equipment, some equipment storage, additional laboratory and office space, and a small electronic instrumentation shop.

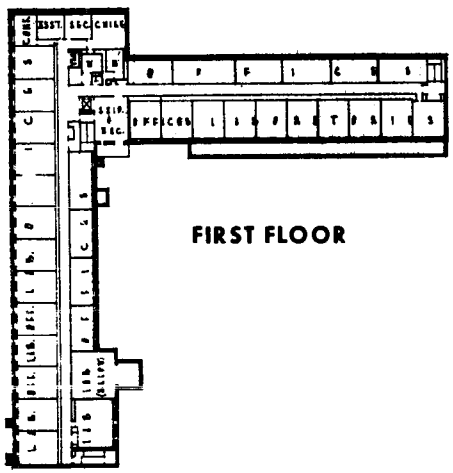
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

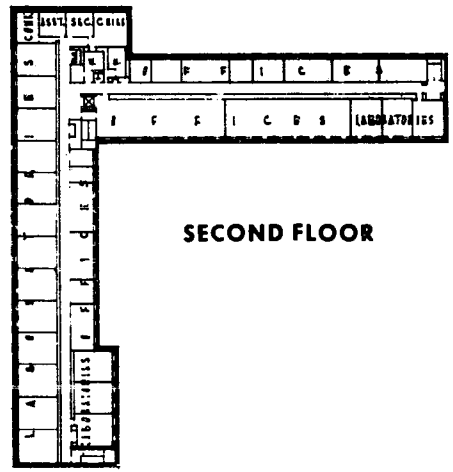
APPLIED SCIENCES LABORATORY

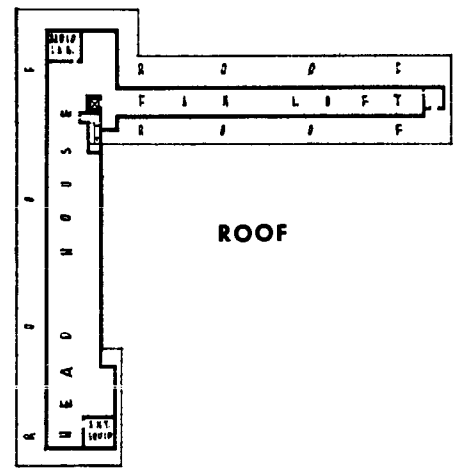












GRAPHIC SCALE 0 100 FEET

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$275,000
	Water lines	$45,000	
	Steam lines	30,000	
	Sanitary and storm sewers	30,000	
	Electric power and communications systems	70,000	
	Roads and parking areas	100,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		2,600,000
	Building -- (100,000 square feet at $25.00 per square foot)	2,500,000	
	Addition to power plant	100,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		300,000
	Special electrical system for laboratory use	200,000	
	Special air-conditioning for high heat loss electrical equipment	100,000	
E.	DESIGN AND ENGINEERING SERVICES		---
	(Advanced design funds in the amount of $75,000 allocated from fiscal year 1962 funds)		
	Total estimated cost		$3,175,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

ATTITUDE CONTROL TEST FACILITY

DESCRIPTION:

This facility will provide the Goddard Center with a functional attitude control laboratory comprising two buildings, four enclosed concrete pads, access roads, and utilities for testing complete spacecraft up to the size of the orbiting astronomical observatory. Location diagrams and sketches of the facility are shown on the following two pages. The coil building will be of frame construction, 60 by 60 by 60 feet on a concrete foundation with all materials selected for nonmagnetic properties. It will be located 1,400 feet west of the magnetic instruments test laboratory of the magnetic fields component test facility at the center of a 900 foot radius nonmagnetic area acquired on permit from the Department of Agriculture. The one-story controls building will be of nonmagnetic construction 30 by 60 feet, with a full basement, and will be located between the coil building of the attitude control test facility and the magnetic instruments test laboratory of the magnetic fields component test facility.

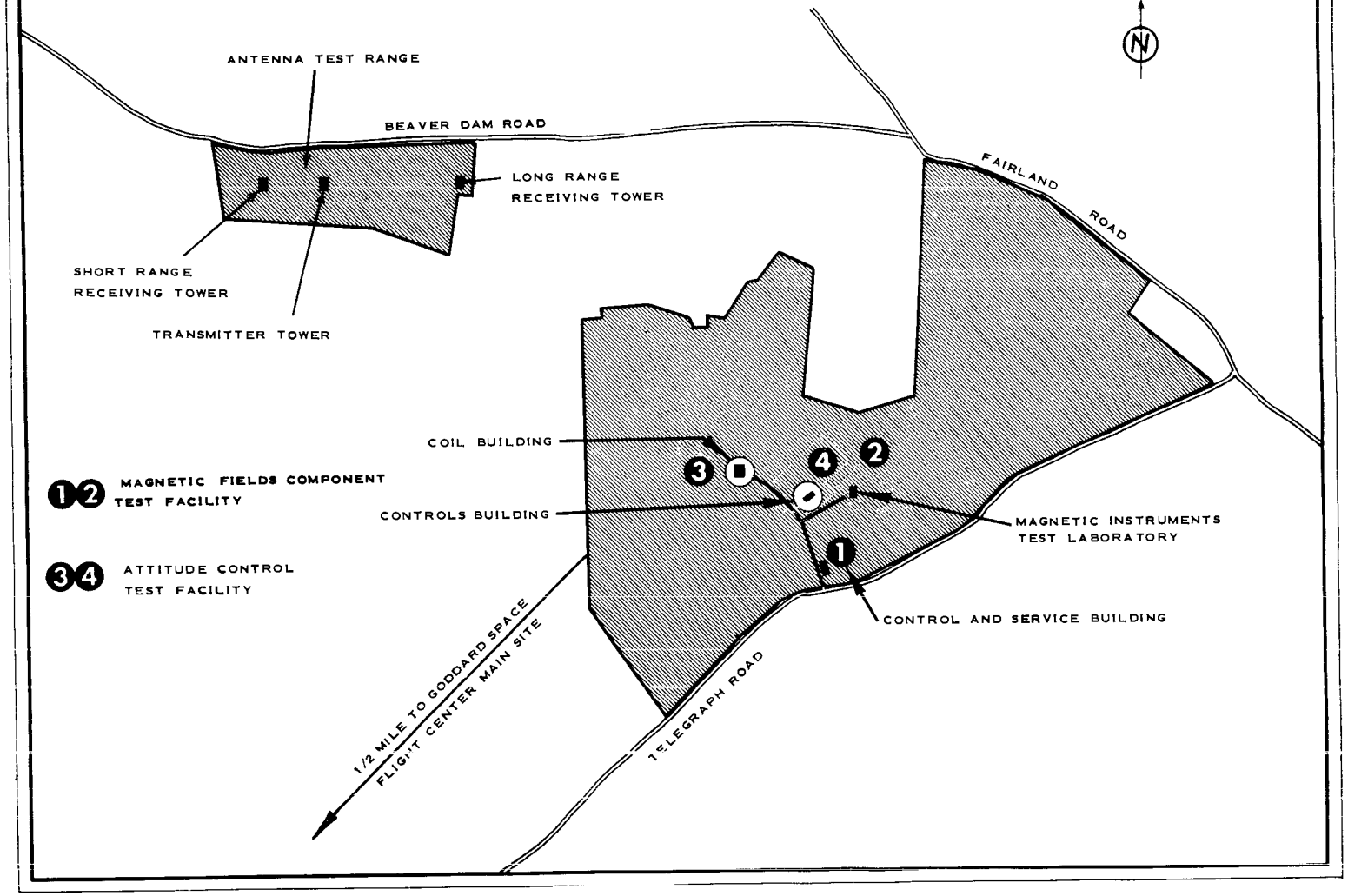
The enclosed pads will be within the nonmagnetic area remote from all other buildings and will house reference standard magnetometers placed on 10 foot square, nonmagnetic, concrete pads with 8 foot high wooden frame sheds over them. All-weather roads will be provided to connect the controls building and the coil building with the magnetic fields component test facility. Access to the pads will be by secondary roads.

Electric power will be furnished from the substation in the control and service building of the magnetic fields component test facility. A stationary compressor plant will be installed in the building to furnish compressed air for shaft power in the coil building of the attitude control test facility. Research equipment in the coil building will include a spherical coil system 40 feet in diameter. A pneumatic overhead hoist will be provided for spacecraft handling. Pneumatically energized shaft power will be available to drive positioning fixtures for changing spacecraft orientation and for moving instruments used to survey field contours surrounding the spacecraft.

Test operations will be conducted in the controls building which will provide adequate space for experimenters equipment in addition to facility control. Control console, current regulators, monitoring

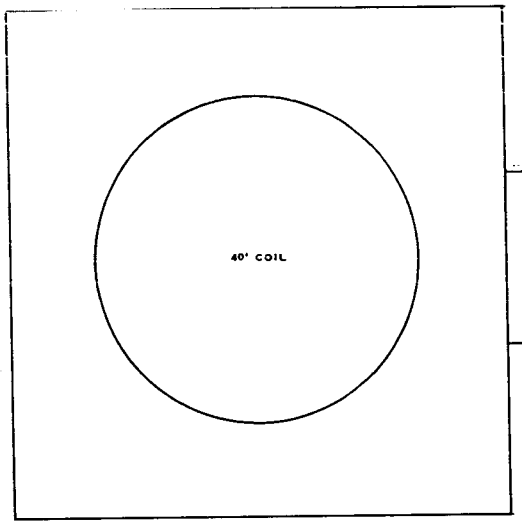
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

ATTITUDE CONTROL TEST FACILITY

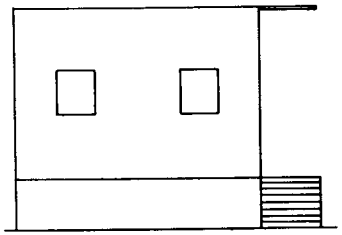


GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

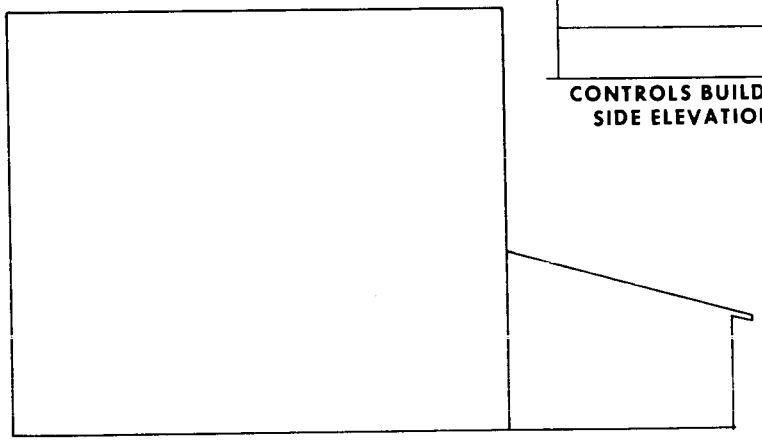
ATTITUDE CONTROL TEST FACILITY



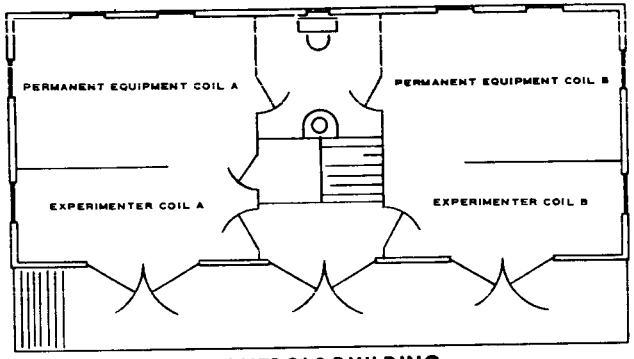
COIL BUILDING
PLAN VIEW



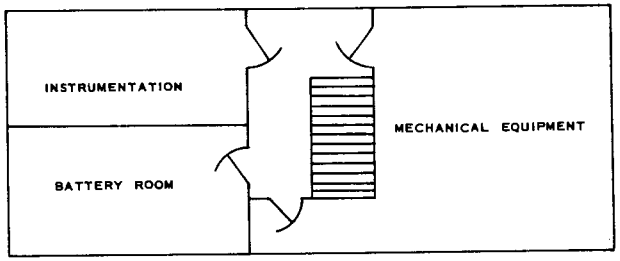
CONTROLS BUILDING
SIDE ELEVATION



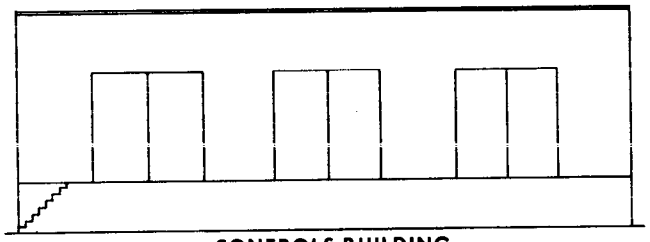
COIL BUILDING
SIDE ELEVATION



CONTROLS BUILDING
FIRST FLOOR PLAN VIEW



CONTROLS BUILDING
BASEMENT PLAN VIEW



CONTROLS BUILDING
FRONT ELEVATION

GRAPHIC SCALE 0 10 20 FEET

indicators, and associated electronic equipment will be housed in the controls building. Primary power will be obtained from batteries and battery chargers located in the control and service building of the magnetic fields components test facility.

JUSTIFICATION:

Techniques for attitude control and space navigation which are either deliberately or unavoidably influenced by magnetic effects must be developed and refined. The proposed facility is required for the evaluation of the attitude control characteristics of scientific spacecraft. Meteorological satellites; geophysical, solar, and astronomical observatories; space probes; and other programs will benefit from the following capabilities to be provided by this facility:

(a) Measurement of the magnetic signature of large, flight configuration spacecraft. This feature will be unique in the proposed facility with regard to the size of payload that can be mapped and to the precision of measurements that can be made.

(b) Calibration of instruments over all ranges of interest when mounted in flight orientation within the influence of spacecraft induced fields.

(c) Electrical rotation of the field about a stationary spacecraft to permit evaluation of magnetic spin damping torques without the use of a large vacuum vessel and special air bearings.

(d) Electrical spin simulation to permit measurement and correction of the magnetic moment which causes precession and mutation of spin stabilized spacecraft and guidance devices.

COST ESTIMATE:

A.	LAND ACQUISITION.....		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$154,000
	Water lines.....	$48,000	
	Electric power and communications systems.....	25,000	
	Gas lines.....	9,000	
	Pneumatic system lines.....	33,000	
	Roads and parking areas.....	21,000	
	Fence repairs and additions.....	3,000	
	Grading and clearing.....	15,000	

C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		$320,000
Coil building...(3,600 square feet at $44.00 per square foot).....	$160,000	
Nonmagnetic crane.....	20,000	
Controls building...(3,600 square feet at $33.00 per square foot)....	120,000	
Enclosed pads.....	20,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		381,000
40 Foot spherical coil.....	156,000	
Payload and instrument positioner....	35,000	
Magnetometers and reference standards	60,000	
Control system and power supply.....	130,000	
E. DESIGN AND ENGINEERING SERVICES.....		60,000
Coil design.....	15,000	
Control system and power supply design.....	15,000	
Architectural and engineering services.....	30,000	
Total estimated cost.....		$915,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

CONVERSION OF DYNAMIC TEST CHAMBER

DESCRIPTION:

This project proposes the conversion of the Dynamic Test Chamber to a Space Simulator. In order to effect the conversion, it will be necessary to clean the chamber and add a solar simulator to the removable head. Liquid nitrogen cooled curtain walls will be installed within the vessel to provide a dark space heat sink temperature less than $100^{\circ}K$ when the solar simulator is in use and to provide programmed wall temperatures between -65° and $+100^{\circ}C$ when the solar simulator is not in use. The vacuum system will be extended by the addition of twenty-five diffusion pumps with baffles, and will increase the present vacuum from 1 mm Hg to 1×10^{-8} mm Hg. Additional stages of mechanical pumping will be added to existing pumps. Approximately fifty helium panels will be installed to complete the vacuum system. The existing substation will be modified to provide 1000 kilowatts of additional power.

JUSTIFICATION:

The space environment facility approved for construction during the fiscal year 1962 is comprised of two stainless steel vacuum vessels 35 feet in diameter and 60 feet high that are duplicates in mechanical design. The primary difference between the chambers is that one chamber, the space environment simulator, contains a solar simulator in the top and nitrogen-cooled curtain walls and is capable of producing a vacuum of 1×10^{-8} mm Hg; the dynamic test chamber does not contain these additional features and produces a vacuum of only 0.1 mm Hg.

The space environment simulator is used in spacecraft testing which involves the effects of solar radiation and the coldness of outer space in combination with the vacuum environment. The dynamic test chamber is used for tests in which air resistance is of importance such as dynamic balancing, spin-up tests, solar paddle erection, and vibration tests. This chamber will continue to have this capability after its conversion to a space environment simulator.

The workload generated by the orbiting astronomical and geophysical observatory programs will overload the present solar simulator to the extent that one simulator will no longer be sufficient to carry the entire workload. It is estimated that the two solar simulators will be in use in excess of 40 percent of the time available on a 24 hour a day operating schedule.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$ 120,000
	Expanded electric and cooling tower water services	$120,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		---
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		3,130,000
	Vacuum system	750,000	
	Solar optics and lamps	715,000	
	Solar power supplies, starters, and wiring	360,000	
	Penetrations and plenum	125,000	
	Cryogenic pumping system	250,000	
	Heat transfer system	650,000	
	Instrumentation	280,000	
E.	DESIGN AND ENGINEERING SERVICES		---
	Total estimated cost		$3,250,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

DEVELOPMENT OPERATIONS BUILDING

DESCRIPTION:

This building will be of steel frame and masonry construction, air-conditioned and humidity controlled, and will provide approximately 70,000 square feet of floor area on one floor. It will provide work space and parking area for 100 people. In addition, it will provide space for a magnetic tape library, an instrument loan and repair facility, and a clean area for a satellite holding facility. It will also include an area for shipping and receiving functions. Sketches of the building are shown on the following page.

JUSTIFICATION:

This building will provide space for a magnetic tape library, an instrument loan and repair facility, a satellite holding facility, and an area for shipping and receiving functions.

Magnetic tape, both blank tape and that on which data has been recorded, requires storage in a temperature-humidity controlled area to avoid damage. This tape is presently stored in work space and hallways, and runs the constant risk of damage.

At present, there is no central location for instrument loan and repair. This situation is likely to lead to duplication in the procurement of instruments and in the fragmentation of the Center's instrument repair capability.

A spacecraft and spacecraft component holding facility is required for the storage of spacecraft awaiting test either prior to launch, for follow-up shots, or while awaiting tests in various stages of manufacture prior to acceptance. Storage space is also required for various spacecraft components awaiting integration into spacecraft. A clean room condition is required in this area both for the normal storage of these units and because of the periodic inspections which must be made to assure launch ready capability of the components and the spacecraft.

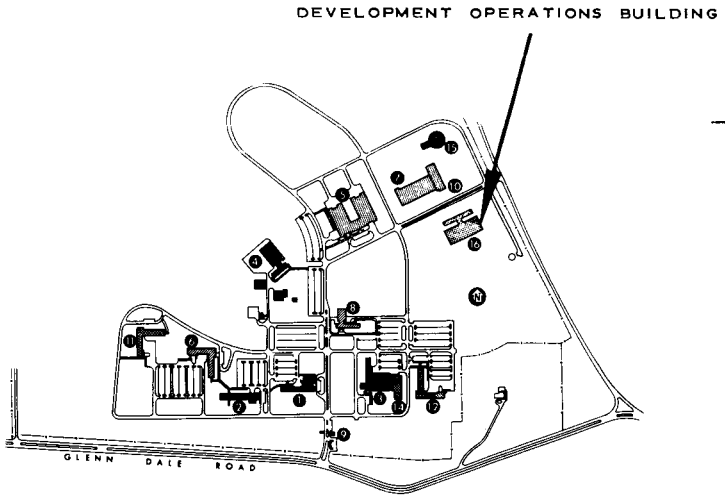
Shipping and receiving space is urgently required to provide service for both local and world-wide logistic support requirements. The present facilities at the Goddard Center are at the saturation point. The proposed building being located within the Center complex will avoid the waste of manpower and transportation equipment utilized in traveling to rented space currently utilized for the storage, shipping, and receiving functions.

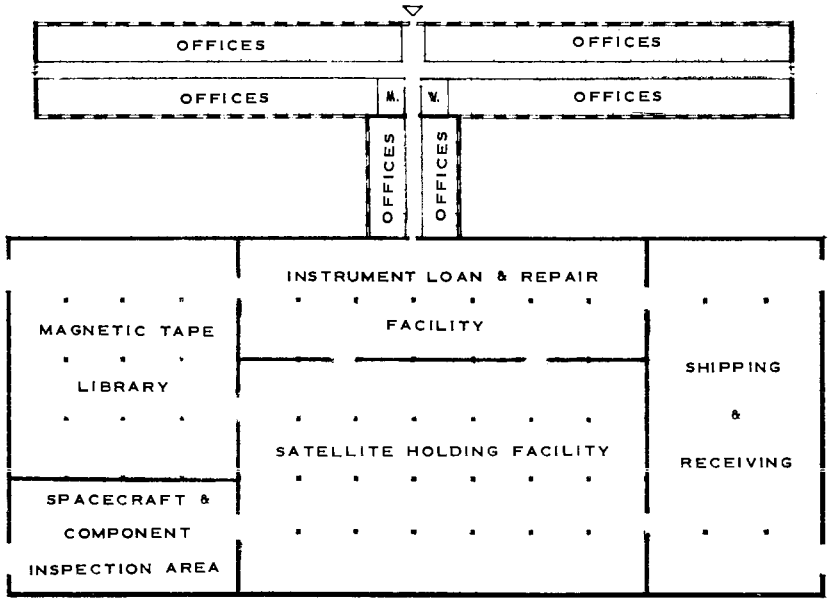
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

DEVELOPMENT OPERATIONS BUILDING

EAST ELEVATION

NORTH ELEVATION





FLOOR PLAN

GRAPHIC SCALE 0 100 FEET

COST ESTIMATE:

A.	LAND ACQUISITION.....		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$250,000
	Water lines.....	$25,000	
	Steam lines.....	15,000	
	Sanitary and storm sewers.....	20,000	
	Electric power and communications systems	50,000	
	Additional equipment for central power plant.....	40,000	
	Roads and parking areas.....	95,000	
	Grading, clearing, and seeding.....	5,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		1,475,000
	Building:		
	15,000 square feet of office space at $25.00 per square foot.....	375,000	
	55,000 square feet of open work and storage space at $20.00 per square foot.....	1,100,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		---
E.	DESIGN AND ENGINEERING SERVICES.....		125,000
	Total estimated cost.....		$1,850,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

LAUNCH PHASE SIMULATOR

DESCRIPTION:

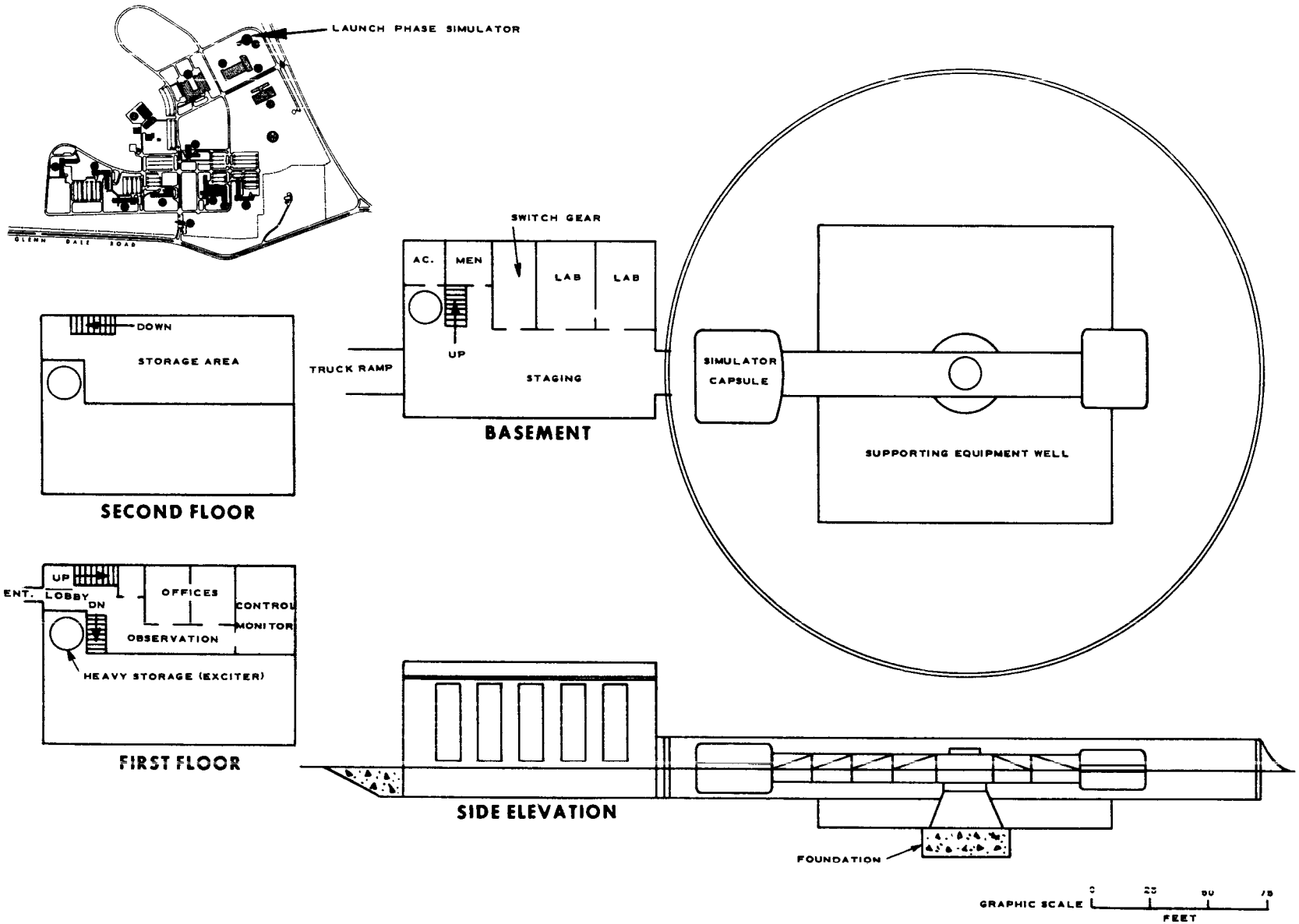
This project provides for the construction of a combined environment facility to be employed in the test and qualification of scientific unmanned spacecraft. The facility will be capable of subjecting spacecraft of the Centaur class and smaller to realistic simulation of the significant temperature and acceleration-spin-vacuum.

The facility will comprise a test capsule mounted on a 65-foot radius rotating arm, a prime mover system, related environmental systems and support equipment, and an operations building. Spacecraft will be mounted within the test capsule and subjected to steady state acceleration loads resulting from centrifugal action as the arm rotates. The length of the arm is dictated by the size of spacecraft to be tested in the facility and by the maximum acceleration gradient produced along the thrust axis of the spacecraft under test that is consistent with realistic testing. It will be possible to test specimens 10 feet in diameter and 15 feet in length with an acceleration gradient of 20 percent. The facility will furnish 30 g's acceleration for spacecraft weighing up to 8000 pounds and 50 g's for spacecraft of 1000 pounds and less. Vibratory excitation will be imposed simultaneously with steady state acceleration by means of an electronically controlled vibration shaker system with the vibration shaker located near the outboard end of the capsule at the spacecraft mounting interface. A spin table, that can be employed interchangeably with the vibration shaker, will be included for testing small spin stabilized spacecraft. The test capsule will serve the dual purpose of a vacuum vessel and a streamlined aerodynamic shroud. Its design will eliminate transverse wind loads on the specimen and minimize the power required to overcome aerodynamic drag. A vacuum of 10^{-2} mm Hg will be achieved within the test capsule for combined environment tests and to eliminate mechanical effects of the atmosphere on spacecraft under spin test. High performance mechanical vacuum pumps will be employed for evacuation. The test capsule will be designed to accommodate interior mounting of radiant heating and cooling elements for use when test programs require simulation of the temperature environment encountered during launch. The temperature extremes will be from -65°C to 100°C with provisions for localized heating to higher temperatures.

Operation of the facility will be conducted in an operations building located adjacent to the simulator area. This building will provide a useable area of approximately 10,000 square feet for supporting services, spacecraft staging, test control, and monitory activities. Equipment requiring direct tie-in with the simulator will be located in an enclosure surrounding the hub of the simulator. The simulator will be

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

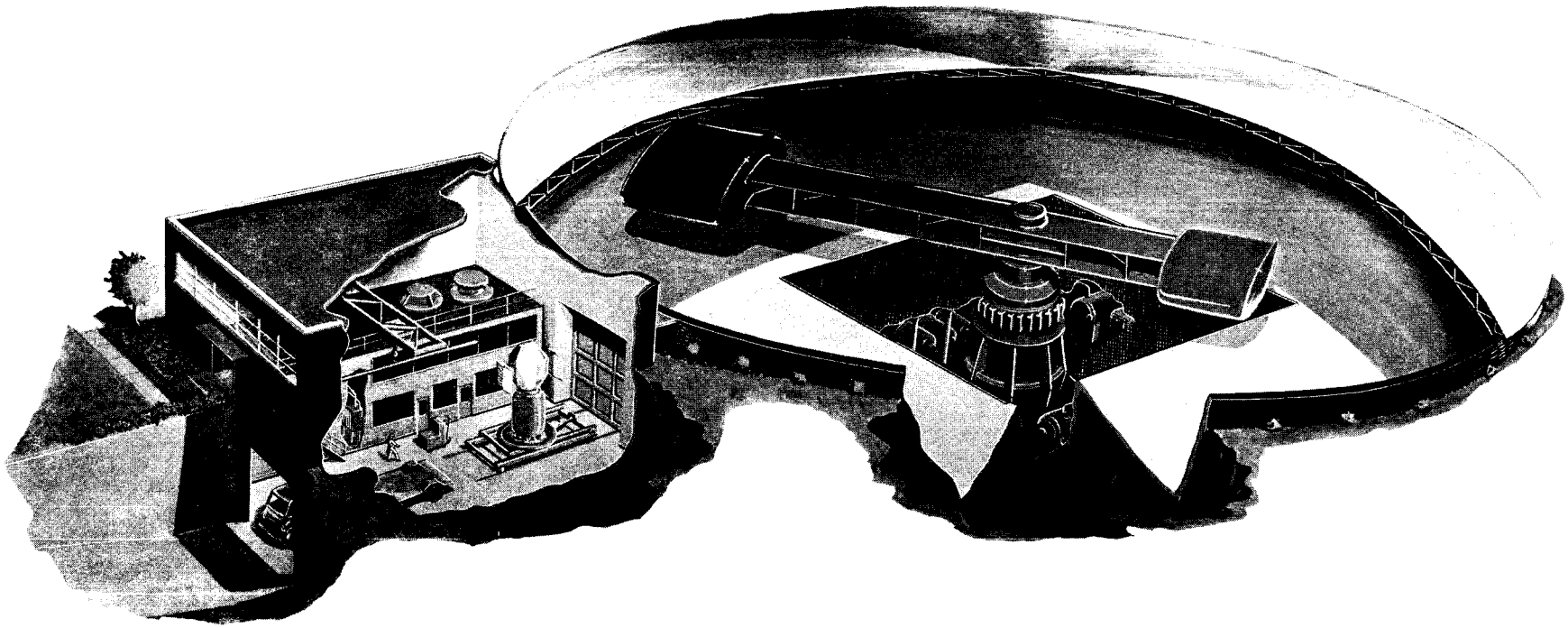
LAUNCH PHASE SIMULATOR



CF 5-E2

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

LAUNCH PHASE SIMULATOR



set in a concrete pit whose side walls will provide safety protection. The facility will be designed for all weather operation. Data acquisition will be coordinated with the automatic data processing system of the Goddard Center. Drawings and sketches of the launch phase simulator are shown on the preceding two pages.

JUSTIFICATION:

The ever-increasing complexity, size, and missions of scientific spacecraft dictates the need for a test facility that will permit the straightforward and accurate determination of all significant failure inducing effects actually encountered during the launch phase of space flight. The facility is needed to secure the highest possible level of confidence in spacecraft launch integrity for the NASA missions scheduled during the period 1964-1970 and beyond, such as the geophysical, meteorological, and communication satellites and space observatories.

Scientific satellites and space probes encounter severe exposure to failure inducing stresses during launch. During this period they are subjected to the effects of simultaneously imposed acceleration, vibration, pressure change, and temperature change. The stress patterns produced throughout spacecraft during launch are so complex that prediction of system performance under these conditions is not amenable to a theoretical approach. Developmental tests of system prototypes and proof tests of actual spacecraft intended for flight are therefore required.

Current laboratory techniques for testing the ability of spacecraft to survive launch employ single environment simulation equipment. Such equipment cannot impose the additive stresses and interactive environmental effects actually encountered during launch. Examples of these effects are as follows:

(a) A spacecraft structural member, such as a pressure vessel, may successfully survive consecutive exposure to acceleration, vibration, vacuum, and temperature yet fail due to stress additions occurring when these same environments are imposed simultaneously.

(b) Most vibration failures are associated with resonance phenomena. However, system resonant frequencies can be significantly modified by superimposed steady-state acceleration.

(c) The simultaneous application of steady-state acceleration and reduced pressure such as encountered during upper stage propulsion can cause corona or other electrical malfunction due to small displacements of conductors or relay contacts. This phenomenon may not be disclosed during single environment tests.

(d) Steady-state acceleration can preload vibration isolators so as to diminish their effectiveness and can displace isolated elements to the extent of causing violent impact.

These effects can be partially counteracted by the overdesign of the spacecraft and by overtesting. However, they do remain as elements that can negate an entire mission; they may also result in an excess of structural mass with an attendant sacrifice in capacity to carry functional scientific experiments.

With the coming generations of large and complex scientific spacecraft, the problem of resolving these effects becomes so great that verification can best be conducted by ground-based realistic simulation of the combined launch environments. The proposed facility will fulfill this requirement. Although single environmental test equipment will continue to be vitally important to diagnostic development efforts, the launch phase simulator will be capable of revealing effects not attainable in any other way.

COST ESTIMATE:

A. LAND ACQUISITION		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$250,000
City water lines	$10,000	
Chilled water lines	15,000	
Steam and condensate return lines	15,000	
Sanitary and storm sewer lines	10,000	
Electric power and communications systems	125,000	
Roads	60,000	
Clearing and grading	15,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS		900,000
Operations building...(10,000 square feet at $20.00 per square foot)	200,000	
Simulator enclosure...(32,000 square feet at $20.00 per square foot)	640,000	
Special foundations	60,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		2,695,000
Prime mover (package unit)	1,395,000	
Arm and counterbalance	290,000	
Operations controls	230,000	
Data handling equipment	100,000	
Vibrating table	330,000	

Spin table.....	$70,000	
Vacuum pumps.....	100,000	
Aerodynamic capsule.....	130,000	
Temperature conditioning.....	50,000	
E. DESIGN AND ENGINEERING SERVICES.....		$70,000
(An additional $85,000 has been allocated from fiscal year 1962 funds)		
Total estimated cost.....		$3,915,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

SPACECRAFT OPERATIONS FACILITY

DESCRIPTION:

A spacecraft operations facility is proposed for construction as an addition to the central flight control and range operations laboratory. The new facility will consist of approximately 70,000 square feet of floor area in a basement and two floors. The building will be of concrete and steel frame with face brick masonry exterior walls similar to the existing building and will be designed to accommodate heavy antenna loads in the roof. Office, work space, and parking area will be provided for approximately 150 people. The building will provide space for critically needed data reduction, control center, computation, and communications equipment which is included in the project. Because of the special demands of this type equipment, around-the-clock, all-season air conditioning will be provided. In addition, special electric power and mechanical services will be provided for the data handling equipment and related laboratory area. A drawing of the proposed facility is shown on the following page.

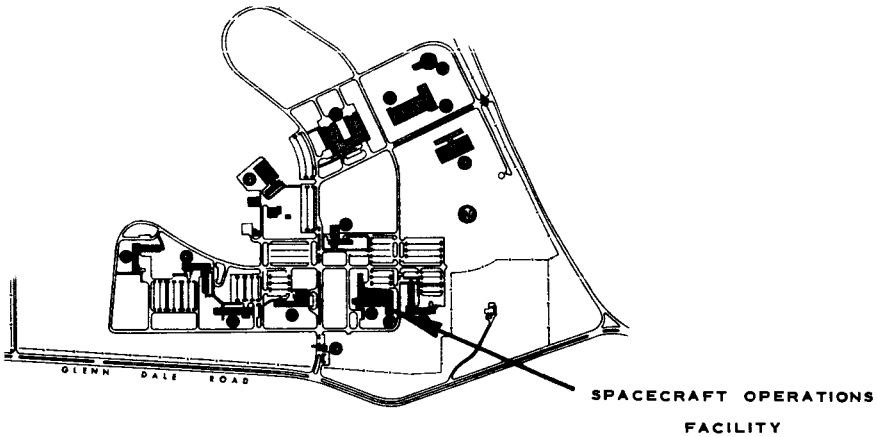
JUSTIFICATION:

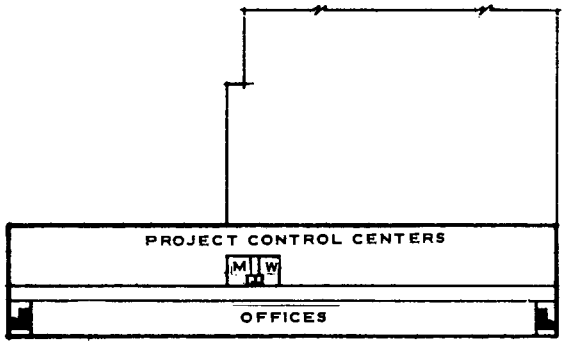
NASA's expanding requirements in the tracking and data acquisition areas make necessary the procurement of additional data reduction, computation, and communications equipment. As itemized in the cost estimate at the end of this project write-up, $5,000,000 of the total project cost of $7,500,000 is required for equipment procurement. The existing facilities at the Goddard Center are currently overcrowded; hall areas are being used for tape and equipment storage; the lack of space for installing additional equipment is causing data reduction activities to fall behind real time; and additional space must be provided in time to permit the installation of equipment required for the support of advanced flight missions. A more detailed discussion follows of the major equipment and instrumentation items included in this project.

A large scale digital data processor is required to accept the output of the digitizing systems and to perform editing, orbit merging, and data reduction functions. Heretofore, these functions have either been done by hand or not at all. The newer satellites will be using advanced telemetry systems which are adaptable to automatic data processing. They will produce tremendous quantities of data which can only be reduced through the use of the large scale digital data processor. The small scale digital data processor will augment the existing capability and is required to handle the expected increase in volume of data to be processed.

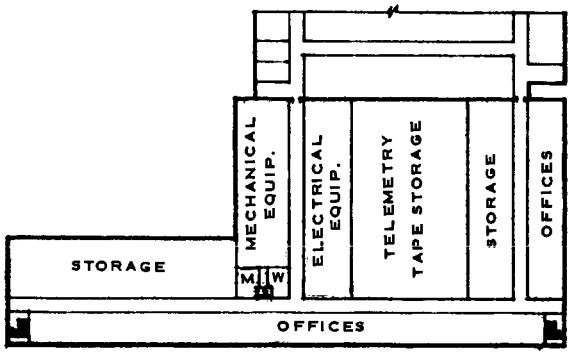
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

SPACECRAFT OPERATIONS FACILITY

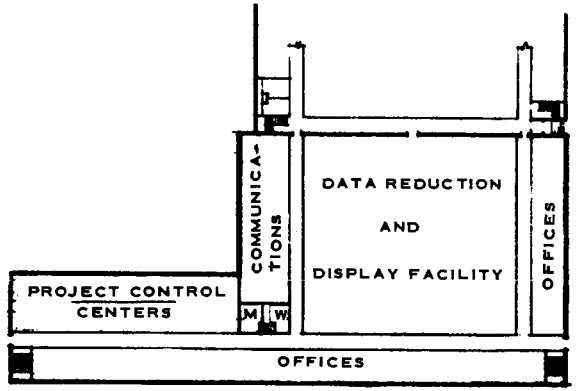




SECOND FLOOR

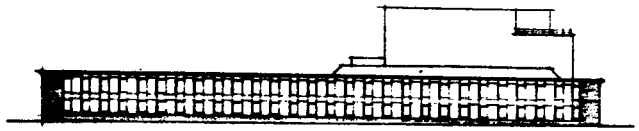


BASEMENT



FIRST FLOOR

GRAPHIC SCALE 0 100 FEET



EAST ELEVATION

CF 5-F2

The tape evaluation equipment will be added to the existing facilities to permit rapid and current evaluation of the analog tapes received from the world wide data acquisition networks. The analog to digital conversion equipment will be used for establishing the capability for real time data processing. Research and development in this area has shown that this mode of operation can produce large savings in time and manpower. This equipment is essential to the programs involving the use of orbiting solar and geophysical observatories.

The printers, plotters and electronic accounting machine equipment will be used as input/output peripheral equipment for both the large and small scale digital data processors. They are required as a means of rapid presentation of reduced data to the experimentors and will augment the present capability.

The purpose of the advanced control center is to provide suitable facilities for monitoring the activities, and controlling the operation, of all spacecraft and all ground instrumentation facilities for which Goddard Space Flight Center has responsibility.

Wall displays in the central control area will consist mainly of graphical and tabular information. Graphic information will be generated by means of plotting projection equipment driven in real-time by a digital computer. This type of system is suitable for display of launch trajectory and orbit ground trace. Tabular information such as network and spacecraft schedules, must be capable of flexible and rapid selection and updating. Projection TV equipment will be driven by a drum memory storage fed by a digital computer. Other displays in the central area will show network and spacecraft status; countdown and Greenwich mean time; and other data of general interest. A closed circuit TV system, with monitors located in the central control room, the project control rooms, and at remote locations, will be used to provide information such as countdown status, operational summaries, and data messages. A flexible information distribution system, employing voice and closed-circuit TV, will link the central control room, project rooms, equipment and computating rooms, and the communications center.

The type of data displayed in the project control rooms and the control facilities made available there, will vary considerably from project to project. Some of the information displayed in these rooms will be processed locally, but data requiring a large computer, or data which is selected from the more general display in the central area, will be generated in a central computing facility and remoted via buffers as required.

The major computational workload is handled by the use of rental equipment. However, certain specific items of equipment are required for full computational effort in a proprietary manner incompatible to the use of rental equipment. A high speed Printer for off-line production of specialized data, world map print-outs, orbit determination, and theoretical work will be used for specific tracking and data requirements wherein considerable development modifications of input-output methods are involved. The use of coordinate, x-y and rectilinear plotting equipment for visual data production will also be used in this same area of endeavor.

Preliminary requirements for the expanded communications center indicate the need for audio and video magnetic tape recorders, a communications supervisory control console, and a microwave terminal. Two video magnetic tape recorders will be needed for recording television pictures from future Nimbus satellites and for transmitting and receiving television pictures from communications satellites. Future requirements will involve the Apollo and other manned spacecraft projects.

Three multi-channeled audio magnetic tape recorders will be provided to make recordings of the voice channels used in the worldwide tracking networks. A supervisory control panel will be required to facilitate network control, present network status, and activate trouble alarms. Future communications systems will employ wide band data channels. Due to the wide bandwidths involved, this data can only be brought into the Goddard Center by microwave equipment. The Nimbus Project will be one of the first to require these bandwidths.

COST ESTIMATES:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$400,000
Water lines.....	$25,000	
Steam lines.....	15,000	
Sanitary and storm sewers.....	10,000	
Communications and electrical power systems.....	80,000	
Parking area.....	60,000	
Road alterations.....	10,000	
Addition to emergency power system...	50,000	
Addition to central power plant.....	150,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		1,950,000
Building...(70,000 square feet at $28.00 per square foot).....	1,950,000	

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$5,000,000
Data reduction equipment:		
Large scale digital data processor....	$1,500,000	
Small scale digital data processor....	600,000	
Tape evaluation equipment.....	200,000	
Analog to digital conversion equipment	500,000	
Printers, plotters, and electronic accounting machine equipment.....	200,000	
Control centers:		
Display projection equipment.....	600,000	
Buffer equipment.....	250,000	
Information distribution system.....	455,000	
Digital and static display equipment	107,000	
Consoles, lighting control, screens, cables, checkout, and repair equipment.....	100,000	
Computation equipment:		
High speed printer.....	50,000	
Plotter.....	50,000	
Communications equipment:		
Video tape recorders.....	150,000	
Magnetic tape recorders, voice.....	90,000	
Communications control board.....	20,000	
Microwave terminal equipment.....	128,000	
E. DESIGN AND ENGINEERING SERVICES.....		150,000
Total estimated cost.....		$7,500,000

GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1963 ESTIMATES

TRACKING AND TELEMETRY LABORATORY

DESCRIPTION:

This project covers the construction of a laboratory consisting of approximately 100,000 square feet of floor area in ground floor, two additional floors, and headhouse space. The building will have a monolithic concrete frame and floor slabs with face brick masonry exterior walls. Antenna test rooms provided in the headhouse and roof slabs will be designed to accommodate antenna loads. Interior partitions will be of concrete block and movable metal. Offices, laboratory work space, and parking areas will be provided for about 350 people. The building essentially will be a duplicate of the space sciences laboratory with revisions and alterations required for the new site orientation. It will contain the necessary electrical, air-conditioning, and ventilation systems for research and development of electronic and optical tracking and telemetry equipment. Existing utility systems will be extended to the building and the central power plant steam generating and chilled water capacity will be expanded as required. Drawings of the proposed laboratory are shown on the following page.

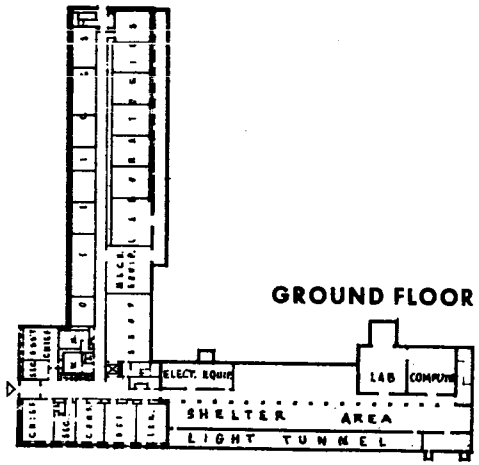
JUSTIFICATION:

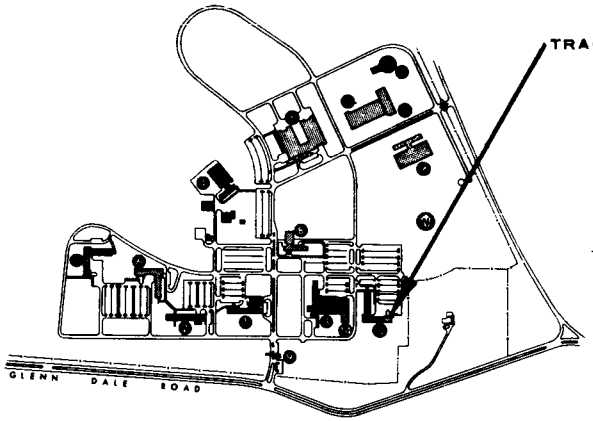
This building will house the additional scientific personnel required for research and development of ground support instrumentation for tracking and data acquisition systems. Studies will be made on optimum transmission, modulation and detection systems, low-noise preamplification systems, cryogenics for high capacity data reduction systems, spacecraft ground control systems, ultra sensitive antenna systems, optimum feed and multiple feed antenna systems, antenna drive systems, timing systems and VLF propagation studies. The functions of this laboratory will serve to develop and improve new and existing tracking and data acquisitions ground support systems.

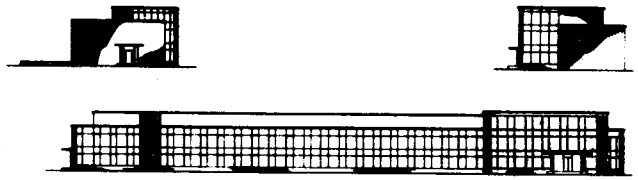
The first and second floors will provide laboratories for studies in the areas mentioned and offices for the research personnel. The basement will provide space for building heating, ventilating, and electrical equipment; some equipment storage; additional laboratory and office space; and a small electronic instrumentation shop.

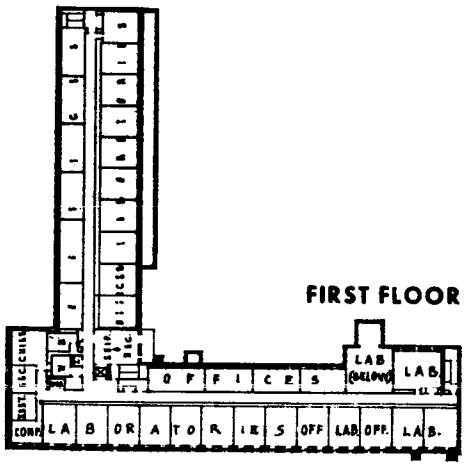
GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1963 ESTIMATES

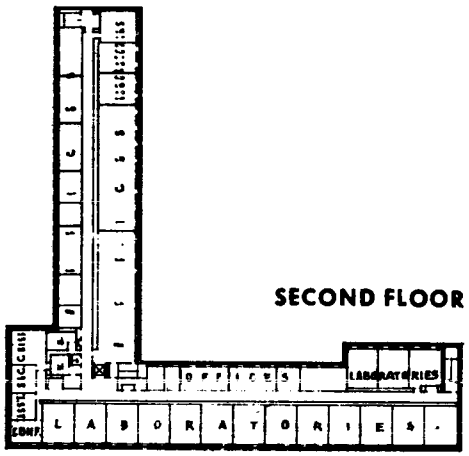
TRACKING AND TELEMETRY LABORATORY

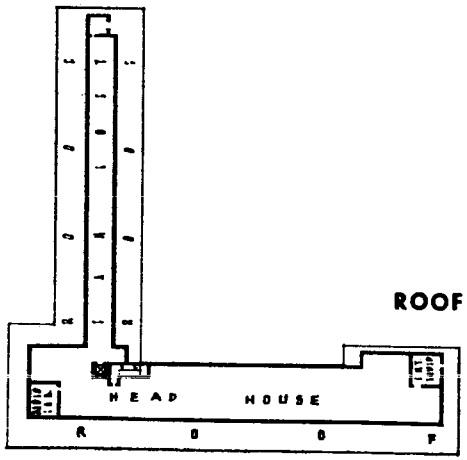












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COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$275,000
	Water lines	$45,000	
	Steam lines	30,000	
	Sanitary and storm sewers	30,000	
	Electric power and communications systems	70,000	
	Roads and parking areas	100,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		2,600,000
	Building -- (100,000 square feet at $25.00 per square foot)	2,500,000	
	Addition to power plant	100,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		300,000
	Special electrical system for laboratory use	200,000	
	Special air-conditioning for high heat loss electrical equipment	100,000	
E.	DESIGN AND ENGINEERING SERVICES		---
	(Advanced design funds in the amount of $75,000 allocated from fiscal year 1962 funds)		
	Total estimated cost		$3,175,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES - 1963 PROGRAM

JET PROPULSION LABORATORY

Page No.		
CF6-A2	Location plan	
CF6-A3	Addition to fabrication services building.....	$605,000
CF6-B1	Data operations and command facility.....	2,420,000
CF6-C1	Engineering mechanics building.....	3,045,000
CF6-D1	Additions to materials research laboratories....	610,000
CF6-E1	Telecommunications laboratory.....	2,860,000
CF6-F1	Utility installations.....	820,000
	Total.....	$10,360,000

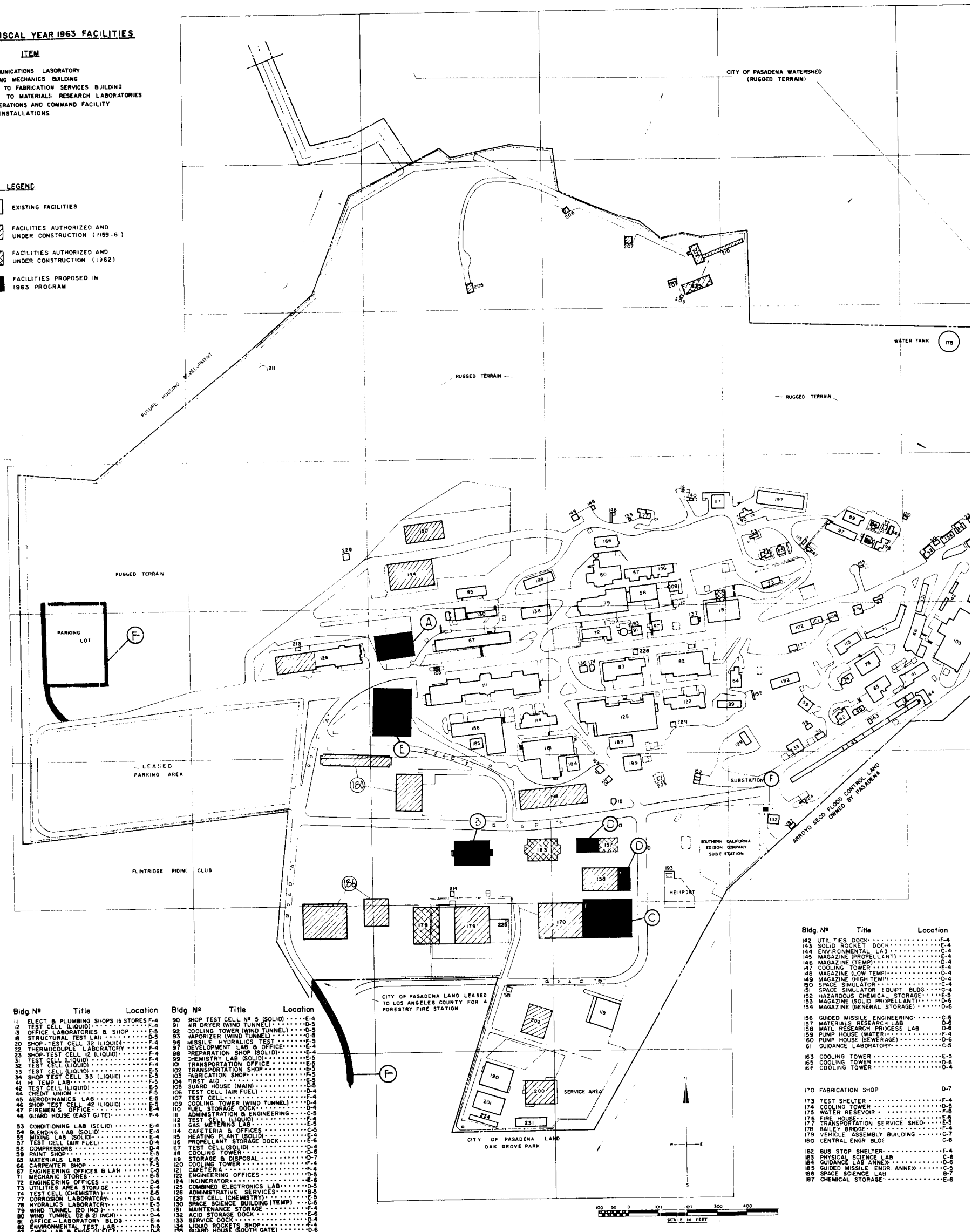
JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES
LOCATION PLAN

PROPOSED FISCAL YEAR 1963 FACILITIES

LEGEND NO.	ITEM
A	TELECOMMUNICATIONS LABORATORY
B	ENGINEERING MECHANICS BUILDING
C	ADDITION TO FABRICATION SERVICES BUILDING
D	ADDITIONS TO MATERIALS RESEARCH LABORATORIES
E	DATA OPERATIONS AND COMMAND FACILITY
F	UTILITY INSTALLATIONS

SYMBOL LEGEND

- EXISTING FACILITIES
- FACILITIES AUTHORIZED AND UNDER CONSTRUCTION (1959-61)
- FACILITIES AUTHORIZED AND UNDER CONSTRUCTION (1962)
- FACILITIES PROPOSED IN 1963 PROGRAM



Bldg. Nº	Title	Location
11	ELECT. & PLUMBING SHOPS & STORES	F-4
12	TEST CELL (LIQUID)	F-4
13	OFFICE LABORATORIES & SHOP	E-5
18	STRUCTURAL TEST LAB	D-5
20	SHOP-TEST CELL 32 (LIQUID)	F-4
22	THERMOCOUPLE LABORATORY	F-4
23	SHOP-TEST CELL 12 (LIQUID)	F-4
31	TEST CELL (LIQUID)	F-4
32	TEST CELL (LIQUID)	F-4
33	TEST CELL (LIQUID)	E-5
34	SHOP TEST CELL 33 (LIQUID)	E-5
41	HI TEMP LAB	F-5
42	TEST CELL (LIQUID)	E-5
44	CREDIT UNION	F-5
45	AERODYNAMICS LAB	E-5
46	SHOP TEST CELL 42 (LIQUID)	E-5
47	FIREMEN'S OFFICE	E-4
48	GUARD HOUSE (EAST GATE)	F-4
53	CONDITIONING LAB (SOLID)	E-4
54	BLENDING LAB (SOLID)	E-4
55	MIXING LAB (SOLID)	E-4
57	TEST CELL (AIR FUEL)	D-4
58	COMPRESSORS	D-4
59	PAINT SHOP	E-5
65	MATERIALS LAB	E-5
66	CARPENTER SHOP	E-5
67	ENGINEERING OFFICES & LAB	C-5
71	MECHANIC STORES	E-5
72	ENGINEERING OFFICES	D-6
73	UTILITIES AREA STORAGE	E-4
74	TEST CELL (CHEMISTRY)	E-5
77	CORROSION LABORATORY	D-4
78	HYDRALICS LABORATORY	E-5
79	WIND TUNNEL (20 INCH)	D-4
80	WIND TUNNEL (12 & 21 INCH)	D-4
81	OFFICE-LABORATORY BLDG.	E-4
82	ENVIRONMENTAL TEST LAB	D-5
83	CHEM LAB & ENGR. OFFICE	D-5
84	TEST CELL & SOLID CHEMISTRY	E-5
85	WIND TUNNEL ENGINEERING	C-4
86	OXIDIZER GRINDING (SOLID)	E-4
87	OVENS (SOLID)	E-4
88	MIXING LAB (SOLID)	E-4
89	PROCESSING LAB (SOLID)	E-4

Bldg. Nº	Title	Location
90	SHOP TEST CELL Nº 5 (SOLID)	E-4
91	AIR DRYER (WIND TUNNEL)	D-5
92	COOLING TOWER (WIND TUNNEL)	D-5
93	VAPORIZER (WIND TUNNEL)	D-5
96	MISSILE HYDRALICS TEST	E-5
97	DEVELOPMENT LAB & OFFICE	E-4
98	PREPARATION SHOP (SOLID)	E-4
99	CHEMISTRY LAB (SOLID)	E-5
101	TRANSPORTATION OFFICE	E-5
102	TRANSPORTATION SHOP	E-5
103	FABRICATION SHOP	F-5
104	FIRST AID	E-5
105	GUARD HOUSE (MAIN)	C-5
106	TEST CELL (AIR FUEL)	D-4
107	TEST CELL	F-4
109	COOLING TOWER (WIND TUNNEL)	D-4
110	FUEL STORAGE DOCK	D-4
111	ADMINISTRATION & ENGINEERING	C-5
112	TEST CELL (LIQUID)	F-4
113	GAS METERING LAB	E-5
114	CAFETERIA & OFFICES	C-5
115	HEATING PLANT (SOLID)	E-4
116	PROPELLANT STORAGE DOCK	E-6
117	TEST CELL (SOLID)	D-4
118	COOLING TOWER	D-6
119	STORAGE & DISPOSAL	D-7
120	COOLING TOWER	F-4
121	CAFETERIA	F-4
122	ENGINEERING OFFICES	D-5
124	INCINERATOR	E-6
125	COMBINED ELECTRONICS LAB	D-5
126	ADMINISTRATIVE SERVICES	B-5
129	TEST CELL (CHEMISTRY)	E-5
130	SPACE SCIENCE BUILDING (TEMP)	C-5
131	MAINTENANCE STORAGE	F-4
132	ACID STORAGE DOCK	E-6
133	SERVICE DOCK	D-4
134	LIQUID ROCKETS SHOP	F-4
135	GUARD HOUSE (SOUTH GATE)	D-6
136	COOLING TOWER	D-6
137	COOLING TOWER	D-5
138	ENGINEERING OFFICES	C-5
140	MAGAZINE X TEMP	D-4
141	MAGAZINE X TEMP	D-4

Bldg. Nº	Title	Location
142	UTILITIES DOCK	F-4
143	SOLID ROCKET DOCK	E-4
144	ENVIRONMENTAL LAB	C-4
145	MAGAZINE (PROPELLANT)	E-4
146	MAGAZINE (TEMP)	D-4
147	COOLING TOWER	E-4
148	MAGAZINE (LOW TEMP)	D-4
149	MAGAZINE (HIGH TEMP)	D-4
150	SPACE SIMULATOR	C-4
151	SPACE SIMULATOR EQUIPT BLDG	C-4
152	HAZARDOUS CHEMICAL STORAGE	E-5
153	MAGAZINE (SOLID PROPELLANT)	D-6
154	MAGAZINE (GENERAL STORAGE)	D-6
156	GUIDED MISSILE ENGINEERING	C-5
157	MATERIALS RESEARCH LAB	D-6
158	MATL. RESEARCH PROCESS LAB	D-6
159	PUMP HOUSE (WATER)	F-4
160	PUMP HOUSE (SEWERAGE)	D-6
161	GUIDANCE LABORATORY	C-5
163	COOLING TOWER	E-5
165	COOLING TOWER	D-6
166	COOLING TOWER	D-4
170	FABRICATION SHOP	D-7
173	TEST SHELTER	F-4
174	COOLING TOWER	D-5
175	WATER RESEVOIR	F-5
176	FIRE HOUSE	E-5
177	TRANSPORTATION SERVICE SHED	E-5
178	BAILEY BRIDGE	F-4
179	VEHICLE ASSEMBLY BUILDING	C-7
180	CENTRAL ENGR. BLDG.	C-6
182	BUS STOP SHELTER	F-4
183	PHYSICAL SCIENCE LAB	C-6
184	GUIDANCE LAB ANNEX	D-6
185	GUIDED MISSILE ENGR. ANNEX	C-5
186	SPACE SCIENCE LAB	B-7
187	CHEMICAL STORAGE	E-6

JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES
LOCATION PLAN

EAR 1963 FACILITIES

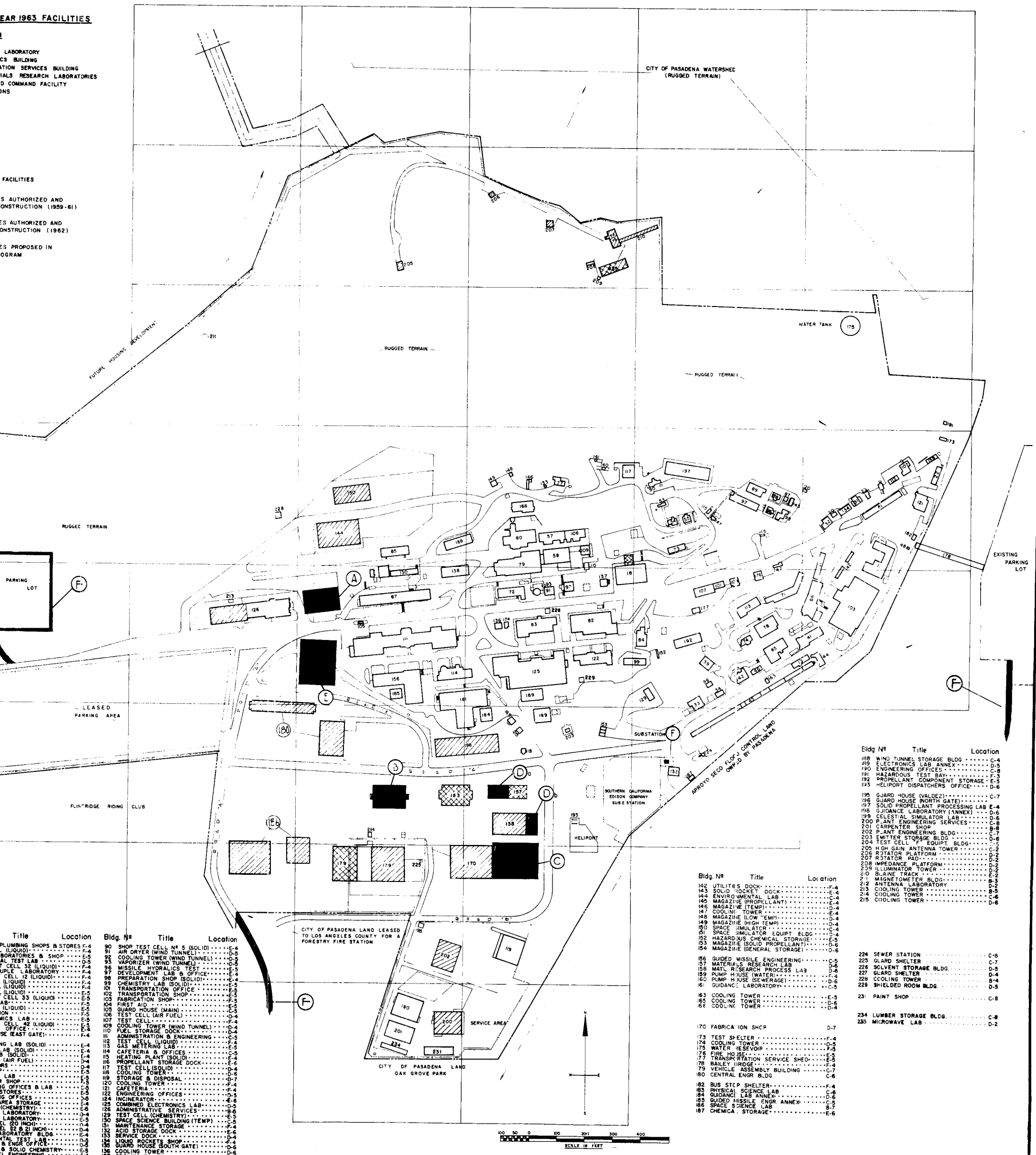
LABORATORY
CS BUILDING
ATION SERVICES BUILDING
IALS RESEARCH LABORATORIES
D COMMAND FACILITY
ONS

FACILITIES

S AUTHORIZED AND
ONSTRUCTION (1959-61)

ES AUTHORIZED AND
ONSTRUCTION (1962)

ES PROPOSED IN
OGRAM



Bldg. Nº	Title	Location
	PLUMBING SHOPS & STORES	F-4
	L (LIQUID)	F-4
	BORATORIES & SHOP	E-5
	AL TEST LAB	D-5
	T CELL 32 (LIQUID)	F-4
	UPLE LABORATORY	F-4
	CELL 12 (LIQUID)	F-4
	(LIQUID)	F-4
	(LIQUID)	F-4
	(LIQUID)	E-5
	CELL 33 (LIQUID)	E-5
	AB	F-5
	(LIQUID)	E-5
	ION	F-5
	MICS LAB	E-5
	CELL 42 (LIQUID)	E-5
	OFFICE	E-4
	SE (EAST GATE)	F-4
	NG LAB (SOLID)	E-4
	LAB (SOLID)	E-4
	B (SOLID)	E-4
	(AIR FUEL)	D-4
	RS	D-4
		E-5
	LAB	E-5
	SHOP	F-5
	NG OFFICES & LAB	C-5
	STORES	E-5
	NG OFFICES	D-5
	AREA STORAGE	E-4
	(CHEMISTRY)	E-5
	LABORATORY	D-4
	LABORATORY	E-5
	EL (20 INCH)	D-4
	EL (12 & 21 INCH)	D-4
	ABORATORY BLDG.	E-4
	NTAL TEST LAB	D-5
	& ENGR OFFICE	D-5
	& SOLID CHEMISTRY	E-5
	EL ENGINEERING	C-4
	RINDING (SOLID)	E-4
	ID)	E-4
	(SOLID)	E-4
	G LAB (SOLID)	E-4

Bldg. Nº	Title	Location
90	SHOP TEST CELL Nº 5 (SOLID)	E-4
91	AIR DRYER (WIND TUNNEL)	D-5
92	COOLING TOWER (WIND TUNNEL)	D-5
93	VAPORIZER (WIND TUNNEL)	D-5
96	MISSILE HYDRALICS TEST	E-5
97	DEVELOPMENT LAB & OFFICE	E-4
98	PREPARATION SHOP (SOLID)	E-4
99	CHEMISTRY LAB (SOLID)	E-5
101	TRANSPORTATION OFFICE	E-5
102	TRANSPORTATION SHOP	E-5
103	FABRICATION SHOP	F-5
104	FIRST AID	E-5
105	GUARD HOUSE (MAIN)	C-5
106	TEST CELL (AIR FUEL)	D-4
107	TEST CELL	F-4
109	COOLING TOWER (WIND TUNNEL)	D-4
110	FUEL STORAGE DOCK	D-4
111	ADMINISTRATION & ENGINEERING	C-5
112	TEST CELL (LIQUID)	F-4
113	GAS METERING LAB	E-5
114	CAFETERIA & OFFICES	C-5
115	HEATING PLANT (SOLID)	E-4
116	PROPELLANT STORAGE DOCK	E-6
117	TEST CELL (SOLID)	D-4
118	COOLING TOWER	D-6
119	STORAGE & DISPOSAL	D-7
120	COOLING TOWER	F-4
121	CAFETERIA	F-4
122	ENGINEERING OFFICES	D-5
124	INCINERATOR	E-6
125	COMBINED ELECTRONICS LAB	D-5
126	ADMINISTRATIVE SERVICES	B-5
129	TEST CELL (CHEMISTRY)	E-5
130	SPACE SCIENCE BUILDING (TEMP)	C-5
131	MAINTENANCE STORAGE	F-4
132	ACID STORAGE DOCK	E-6
133	SERVICE DOCK	D-4
134	LIQUID ROCKETS SHOP	F-4
135	GUARD HOUSE (SOUTH GATE)	D-6
136	COOLING TOWER	D-6
137	COOLING TOWER	D-5
138	ENGINEERING OFFICES	C-5
140	MAGAZINE X TEMP	D-4
141	MAGAZINE X TEMP	D-4

Bldg. Nº	Title	Location
142	UTILITIES DOCK	F-4
143	SOLID ROCKET DOCK	E-4
144	ENVIRONMENTAL LAB	C-4
145	MAGAZINE (PROPELLANT)	E-4
146	MAGAZINE (TEMP)	D-4
147	COOLING TOWER	E-4
148	MAGAZINE (LOW TEMP)	D-4
149	MAGAZINE (HIGH TEMP)	D-4
150	SPACE SIMULATOR	C-4
151	SPACE SIMULATOR EQUIPT BLDG	C-4
152	HAZARDOUS CHEMICAL STORAGE	E-5
153	MAGAZINE (SOLID PROPELLANT)	D-6
154	MAGAZINE (GENERAL STORAGE)	D-6
156	GUIDED MISSILE ENGINEERING	C-5
157	MATERIALS RESEARCH LAB	D-6
158	MATL RESEARCH PROCESS LAB	D-6
159	PUMP HOUSE (WATER)	F-4
160	PUMP HOUSE (SEWERAGE)	D-6
161	GUIDANCE LABORATORY	C-5
163	COOLING TOWER	E-5
165	COOLING TOWER	D-6
166	COOLING TOWER	D-4
170	FABRICATION SHOP	D-7
173	TEST SHELTER	F-4
174	COOLING TOWER	D-5
175	WATER RESEVOIR	F-5
176	FIRE HOUSE	E-5
177	TRANSPORTATION SERVICE SHED	E-5
178	BAILEY BRIDGE	F-4
179	VEHICLE ASSEMBLY BUILDING	C-7
180	CENTRAL ENGR BLDG	C-6
182	BUS STOP SHELTER	F-4
183	PHYSICAL SCIENCE LAB	C-6
184	GUIDANCE LAB ANNEX	D-6
185	GUIDED MISSILE ENGR. ANNEX	C-5
186	SPACE SCIENCE LAB	B-7
187	CHEMICAL STORAGE	E-6

Bldg. Nº	Title	Location
188	WIND TUNNEL STORAGE BLDG	C-4
189	ELECTRONICS LAB ANNEX	D-5
190	ENGINEERING OFFICES	C-8
191	HAZARDOUS TEST BAY	F-3
192	PROPELLANT COMPONENT STORAGE	E-5
193	HELIPORT DISPATCHERS OFFICE	D-6
195	GUARD HOUSE (VALDEZ)	C-7
196	GUARD HOUSE (NORTH GATE)	C-7
197	SOLID PROPELLANT PROCESSING LAB	E-4
198	GUIDANCE LABORATORY (ANNEX)	D-6
199	CELESTIAL SIMULATOR LAB	D-6
200	PLANT ENGINEERING SERVICES	C-8
201	CARPENTER SHOP	B-8
202	PLANT ENGINEERING BLDG	C-7
203	EMITTER STORAGE BLDG	D-6
204	TEST CELL F EQUIPT. BLDG	C-5
205	HIGH GAIN ANTENNA TOWER	C-2
206	ROTATOR PLATFORM	D-2
207	ROTATOR PAD	D-2
208	IMPEDANCE PLATFORM	D-2
209	ILLUMINATOR TOWER	D-2
210	BLAINE TRACK	E-2
211	MAGNETOMETER BLDG	B-5
212	ANTENNA LABORATORY	D-2
213	COOLING TOWER	B-5
214	COOLING TOWER	C-6
215	COOLING TOWER	D-6
224	SEWER STATION	C-8
225	GUARD SHELTER	C-7
226	SOLVENT STORAGE BLDG.	D-5
227	GUARD SHELTER	D-4
228	COOLING TOWER	B-4
229	SHIELDED ROOM BLDG.	D-5
231	PAINT SHOP	C-8
234	LUMBER STORAGE BLDG.	C-8
235	MICROWAVE LAB	D-2

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

ADDITION TO FABRICATION SERVICES BUILDING

DESCRIPTION:

An addition is requested for the fabrication services building currently under construction. The addition will provide approximately 18,000 square feet of floor space, and will include a sheet metal shop, machine shop, weld shop, assembly room, metal stores room, tool crib, and offices. The building will be a high bay structure, one story, completely air conditioned, and of permanent type construction similar to the fabrication services building. A drawing of the proposed addition is shown on the following page.

JUSTIFICATION:

The first phase of the fabrications services building, currently being constructed, will consist of a machine shop, inspection rooms, and offices. The sheet metal shop, weld shop, assembly room area, and metal stores area remain in the existing machine shop building. This means that the personnel and functions of this division will be widely separated, and must rely on short-line communications between supervision and key personnel in both areas.

The transport distance between the new facility and the existing fabrications shop is approximately one-mile round trip. Work in process in the new fabrications shop that requires sheet metal or weld service will have to be shuttled by truck between the two buildings. Approximately 50 per cent of the work in spacecraft and environmental test equipment requires this type of intermittent service. Raw stocks will also require transport between the two buildings.

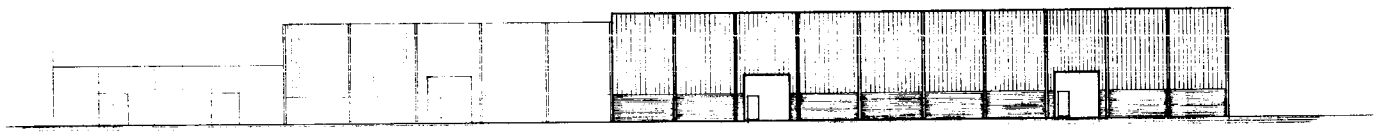
The proposed addition will insure the more effective operation of the Laboratory's fabrication facilities by consolidating all fabrication division personnel, by eliminating duplicate equipment, and by discontinuing the inefficient shuttle service between two areas. Upon completion of the fabrication services building and the addition proposed in this project, the existing shop building will be demolished.

COST ESTIMATE:

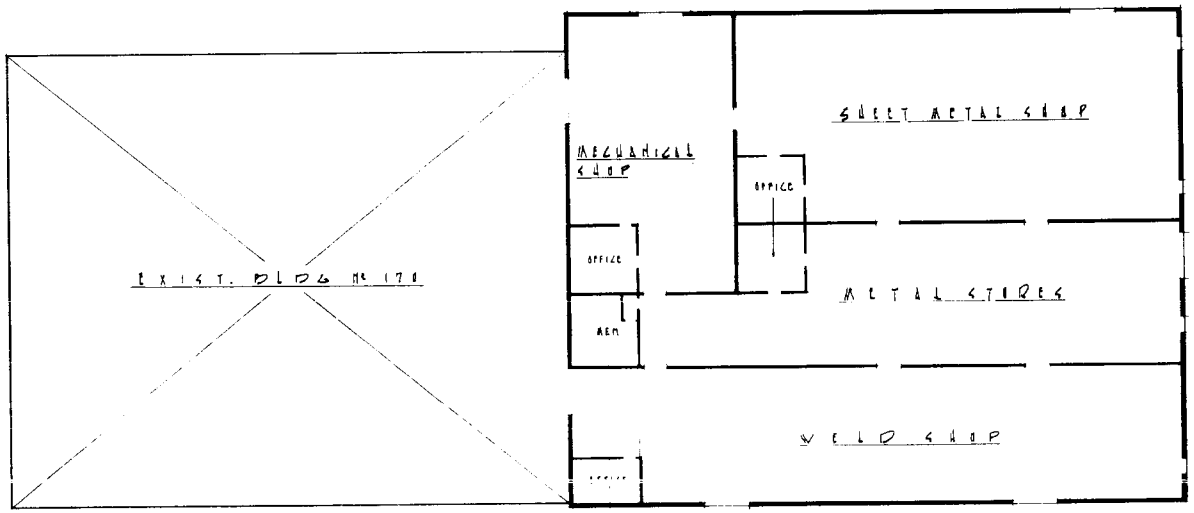
A. LAND ACQUISITION..... ---

JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

ADDITION TO FABRICATION SERVICES BUILDING



SOUTH ELEVATION



FLOOR PLAN

SCALE IN FEET

B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$25,000
Grading, paving, sidewalks, and landscaping.....	$5,000	
Substation.....	5,000	
Utility connections.....	15,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		435,000
Building .. (18,000 square feet at $24.20 per square foot).....	435,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		100,000
Welding shop equipment.....	28,500	
Saw shop equipment.....	8,300	
Sheet metal shop equipment.....	63,200	
E. DESIGN AND ENGINEERING SERVICES.....		45,000
Total estimated cost.....		$605,000

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

DATA OPERATIONS AND COMMAND FACILITY

DESCRIPTION:

This project proposes the construction of a 53,800 square foot laboratory-office building to provide the facilities for the computers, and for the operation and control centers required for the lunar and planetary programs. The facility will be of permanent type steel or concrete construction and completely air conditioned. It will be designed to house analogue and digital computers, a maintenance area, supporting laboratories, engineering and scientific display and analysis areas, status plotting boards, operations areas, a communications center, and exhibit areas. It will also contain conference rooms and offices for the technical personnel engaged in work in these areas.

The building will consist of two stories above ground, a basement, and a mechanical equipment room on the roof which will house air handling equipment. The basement will contain the mechanical equipment room, data and spare equipment storage areas, research equipment maintenance laboratories, a communications room, a crypto room, and a data processing laboratory.

The first floor will house the main data operations and control areas, communications and control rooms, a space sciences area, a customer engineering area, a spacecraft analysis area, a data conversion area, conference rooms, a control lobby, and a TV display room. The second floor will accommodate the engineering data display and evaluation area, scientific data display and evaluation areas, conference rooms, a data library, offices, and a stand-by room. The building will be structurally designed for the possible future addition of a third floor.

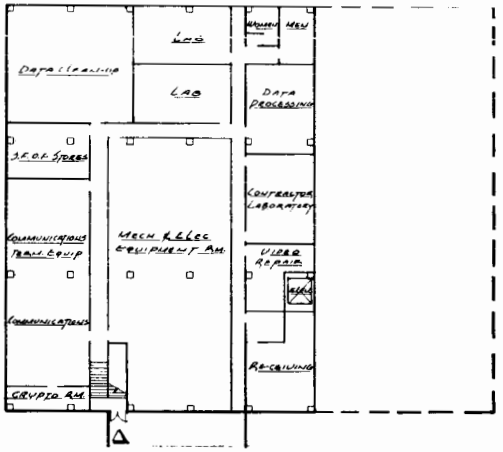
A drawing of the proposed facility is shown on the following page.

JUSTIFICATION:

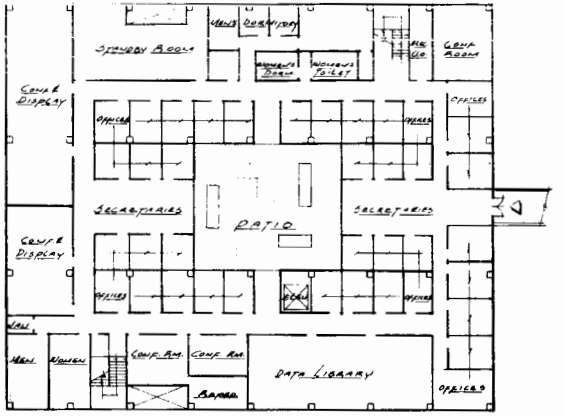
The data operations and command facility is planned as the mission operations command center from injection to the completion of a particular unmanned lunar or planetary mission. Pre-injection tracking information received from the Atlantic Missile Range will be evaluated and relayed to the deep space network as anticipatory information to facilitate the acquisition of the vehicle by the deep space facilities. When the spacecraft has been injected, the tracking data received from the deep space facilities will provide the necessary inputs to enable the Command Center to calculate

JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

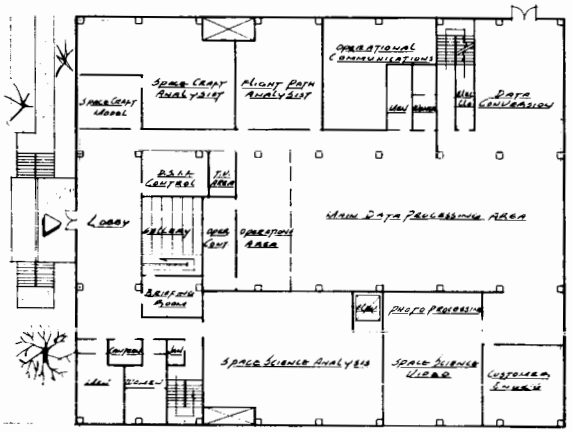
DATA OPERATIONS AND COMMAND FACILITY



BASEMENT PLAN

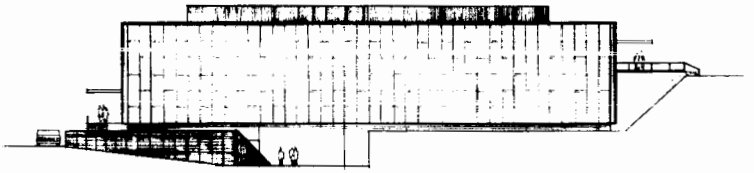


SECOND FLOOR PLAN



FIRST FLOOR PLAN

SOUTH ELEVATION



EAST ELEVATION

N

CF 6-32

the transit trajectory orbit. Real-time orbit determination calculations will be performed to establish the magnitude and direction of the trajectory corrections required. Appropriate commands will be initiated at the Command Center and transmitted to the spacecraft via the deep space network facilities.

The data operations and command facility will receive, record, and, where appropriate, display the spacecraft data, both engineering and scientific, for diagnostic and command decision purposes. Real-time and selected near-real-time data will be made available to the mission operations personnel and participating scientists, so that any necessary revisions and modifications to the sequence of scientific experiments may be determined and implemented during the spacecraft operating life. In addition, the facility will provide raw and processed data to the participating scientists for later analysis and interpretation.

At present the data operations and command functions required for the Ranger type spacecraft and missions are being carried out in portions of four buildings and in sixteen rented trailers. These areas do not include office space for the additional personnel required for future operations. As the lunar and planetary programs develop, the concurrent schedules, special processing and display requirements, greatly increased volume of data, greater mission life times, and more complex command and decision functions will exceed the maximum capability of these interim facilities. The proposed new facility will allow the 150 personnel engaged in data operations and command functions to be consolidated, will permit the rental trailers to be evacuated, and will eliminate the need for the rental of additional off-laboratory space. The geographical separation of certain of the functions in the data operations and command areas would impose great handicaps on the successful accomplishement of the lunar and planetary programs.

A review of currently planned and projected unmanned lunar and planetary projects and missions reveals the need for a single facility devoted to these projects to be operating on a near full-time basis shortly after its earliest completion. When it is realized that joint lunar and planetary operations will be conducted concurrently beginning in the mid-1962's, it becomes even more urgent that a separate facility to support these projects in a timely and closely integrated fashion be provided.

COST ESTIMATE:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$125,000
Grading, paving, sidewalks, and landscaping.....	$25,000	
Substation.....	60,000	
Utility connections.....	40,000	

C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		$1,495,000
	Building .. (53,800 square feet at $28.40 per square foot).....	$1,495,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		800,000
	Office equipment.....	20,000	
	Communications equipment.....	15,000	
	Stand by power system.....	55,000	
	Special display status boards and projection equipment.....	213,000	
	Computing equipment.....	265,000	
	Data handling equipment.....	232,000	
E.	DESIGN AND ENGINEERING SERVICES.....		---[1]
	Total estimated cost.....		$2,420,000

[1] Fiscal year 1962 funds in the amount of $140,000 have been allocated for advanced design services.

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

ENGINEERING MECHANICS BUILDING

DESCRIPTION:

This project proposes the construction of a 100,000 gross square foot building of which approximately 40,000 square feet will be in offices and 60,000 square feet in laboratories. The building will be multi-storied with a full basement, air conditioned, and of permanent type steel or concrete construction. The laboratories will be of various sizes to accommodate all types of laboratory work. They will be designed around a utility core which will provide the flexibility of changing from one function to another. Some details of the building are shown in the drawing on the following page.

JUSTIFICATION:

The space sciences division of the Jet Propulsion Laboratory has the primary technical responsibility for the NASA's lunar and planetary programs. The personnel of this division are currently scattered in five separate buildings and in rented laboratory-type trailers. Some consolidation of the division personnel will be possible upon completion of the space sciences laboratory authorized in the fiscal year 1961 program and currently under construction. The additional space to be provided by the building proposed in this project will accommodate the balance of the division personnel who cannot be housed in the space sceinces laboratory, and will provide office and laboratory space for the anticipated personnel growth of this division.

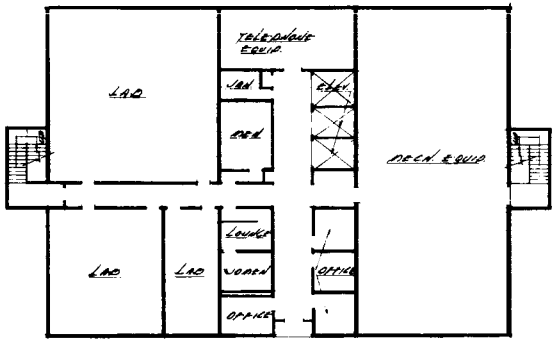
The construction of a permanent building of this type will permit sub-standard buildings to be vacated and demolished, and will allow rented trailers and off-laboratory rented space to be evacuated. The proposed building will provide office and laboratory space for a total of approximately 305 employees.

COST ESTIMATE:

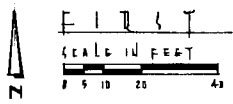
A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$95,000
Grading, paving, sidewalks, and landscaping.....	$20,000	
Substation.....	45,000	
Utility connections.....	30,000	

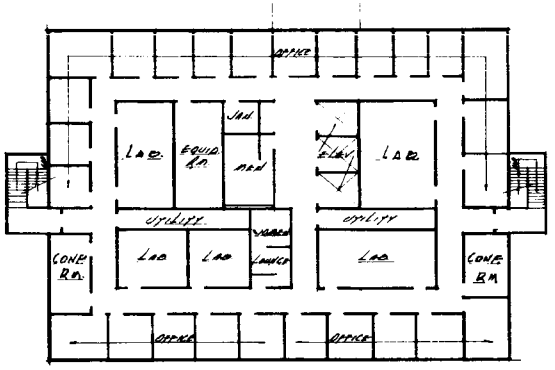
JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

ENGINEERING MECHANICS BUILDING

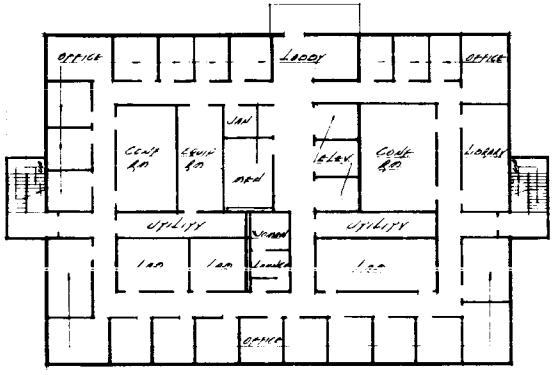


FIRST FLOOR PLAN

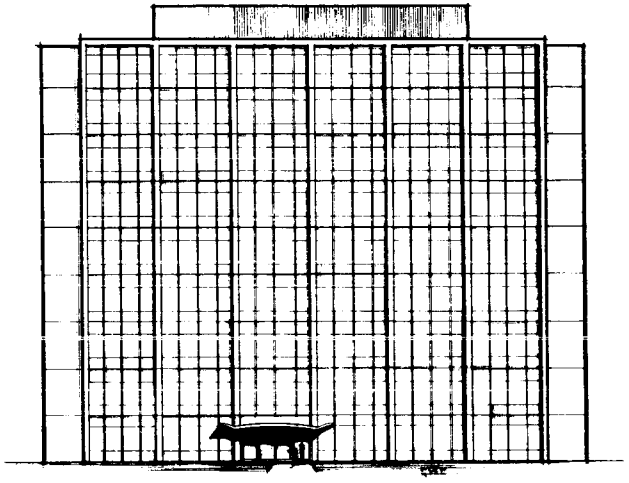




THIRD THRU TENTH FLOOR PLAN



SECOND FLOOR PLAN



NORTH ELEVATION

C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		$2,700,000
	Building .. (100,000 square feet at $27.00 per square foot).....	$2,700,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		---
E.	DESIGN AND ENGINEERING SERVICES.....		250,000
	Total estimated cost.....		$3,045,000

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

ADDITIONS TO MATERIALS RESEARCH LABORATORIES

DESCRIPTION:

It is proposed to add an additional 20,000 square feet of laboratory and office space to house additional personnel and to carry out supporting research and advanced development work on materials to be used in space vehicles. Approximately 10,000 square feet will be added by construction of two additional floors on the existing materials research laboratory; another 10,000 square feet will be provided by an addition to the existing materials research processing laboratory. Drawings of the proposed additions are presented on the following two pages.

JUSTIFICATION:

Additional facilities are needed to carry on supporting research and advanced development work on spacecraft and space vehicle materials. The performance of present day vehciles is limited by the lack of knowledge of the properties of materials at very high temperatures. The approach to a solution of these problems will be from the standpoint of metallurgy and ceramics, and also from that of solid state physics. Development and testing of improved materials will be carried out on many types of space vehicle components. These will include rocket nozzles and other propulsion components, fuel tanks and solid fuel rocket cases, and equipment to operate in the very high vacuum of outer space. Part of the work will be aimed at providing engineering data required to design advanced types of space vehicles. A substantial part of the work planned for the new laboratories will deal with the effects of high vacuum, radiation and particles found in space upon materials which may be used for spacecraft.

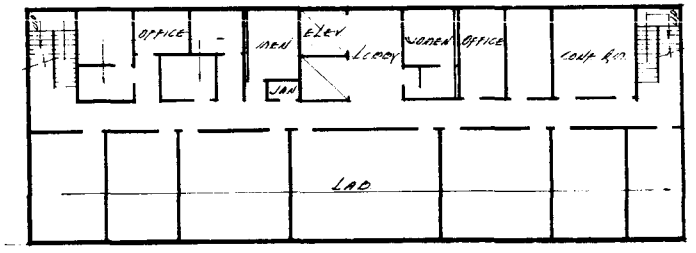
Research is also planned on materials for electronic applications which will lead toward the development of solid state electronic devices to permit major decreases in weight and increases in the performance of space vehicle electronic devices and instruments.

COST ESTIMATE:

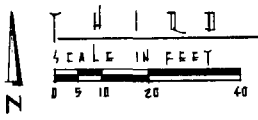
A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$30,000
	Grading, paving, sidewalks, and landscaping	$13,000	
	Substation	10,000	
	Utility connections	7,000	

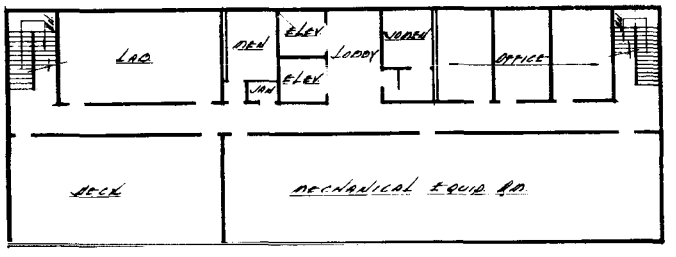
JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

ADDITIONS TO MATERIALS RESEARCH LABORATORIES

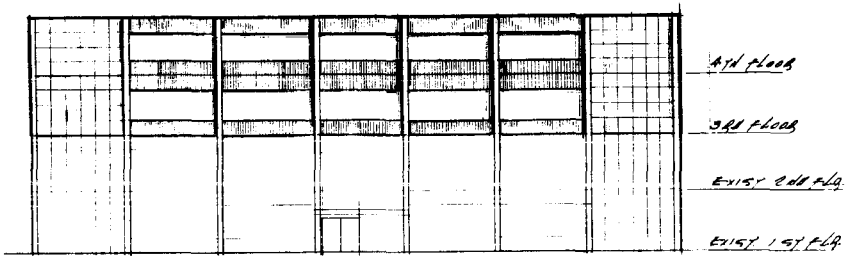


THIRD FLOOR PLAN





FOURTH FLOOR PLAN

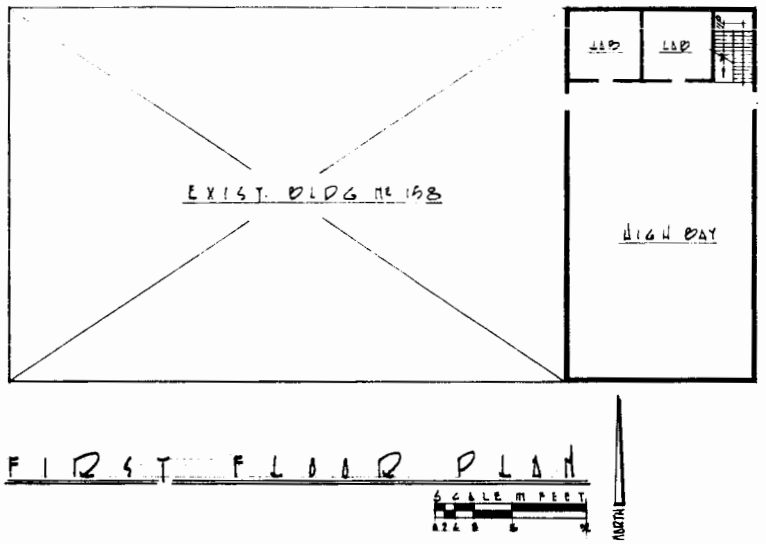


NORTH ELEVATION

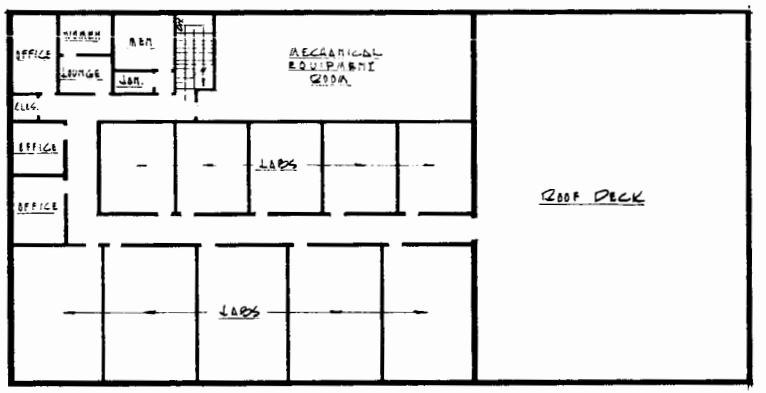
ADDITION TO MATERIALS RESEARCH LABORATORY

JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

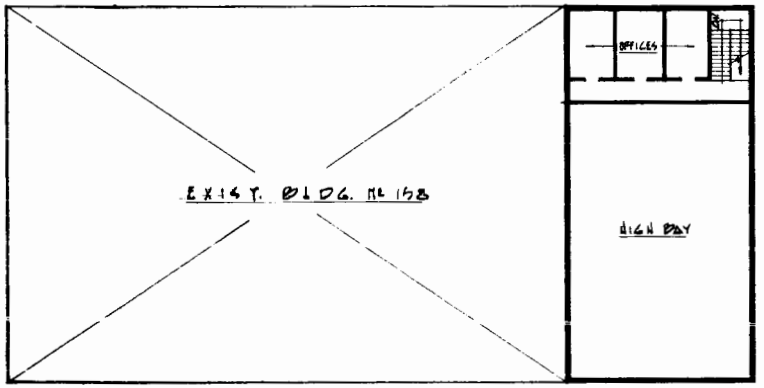
ADDITIONS TO MATERIALS RESEARCH LABORATORIES



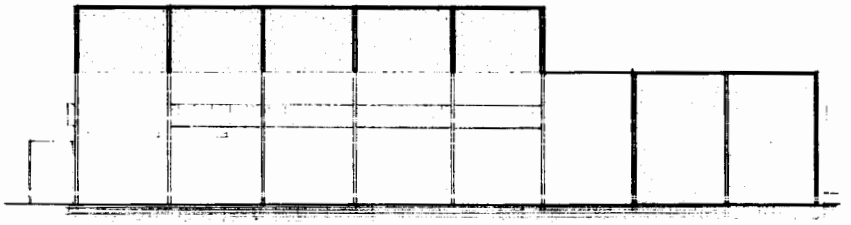
FIRST FLOOR PLAN



THIRD FLOOR PLAN



SECOND FLOOR PLAN



SOUTH ELEVATION

ADDITION TO MATERIALS RESEARCH AND PROCESSING LABORATORY

C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		$525,000
	Addition to materials research laboratory (10,000 square feet at $27.50 per square foot).....	$275,000	
	Addition to materials research processing laboratory .. (10,000 square feet at $25.00 per square foot).....	250,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		---
E.	DESIGN AND ENGINEERING SERVICES.....		55,000
	Total estimated cost.....		$610,000

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

TELECOMMUNICATIONS LABORATORY

DESCRIPTION:

This project proposes the construction of an 82,000 gross square foot building to provide approximately 40,000 square feet of laboratory space and 42,000 square feet of office space. The multistory building will have an adjacent ground area available for instrumentation vans to be used in connection with the laboratories located at that level. The building will be completely air conditioned and of a permanent type steel or concrete construction. The general office and laboratory areas will be designed with special emphasis on high capacity air conditioning for the laboratory areas and with adequate power allowance for certain laboratories with high power requirements. Drawings of the laboratory are shown on the following page.

JUSTIFICATION:

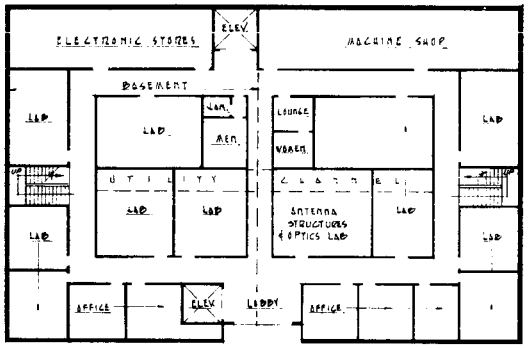
The telecommunications laboratory requested in this project will house personnel engaged in the central administration and direction of the deep space instrumentation facilities and in research and advanced development programs in this area. Their work includes the design, installation, and operation of suitable ground tracking and communications facilities required in the lunar and planetary programs. The work is accomplished both through in-house efforts and by the technical direction of outside contractors.

Facility requirements for telecommunications work include the accessibility of technical trailer and laboratory space; an adequate location for testing antennas with good visibility for long distances; the need for a consolidated location where transmitting work may be done without interference to the work of other activities; and the need for a location where antenna receiving work can be done without electrical interference from surrounding activities.

The proposed new laboratory will allow scattered communications activities throughout the station to be consolidated, will permit substandard buildings to be vacated and demolished, and will contribute to a reduction in the need for rented trailer facilities and off-laboratory space. The telecommunications laboratory will provide office and laboratory space for approximately 325 employees.

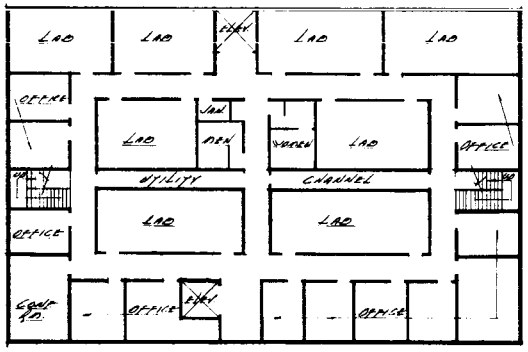
JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

TELECOMMUNICATIONS LABORATORY

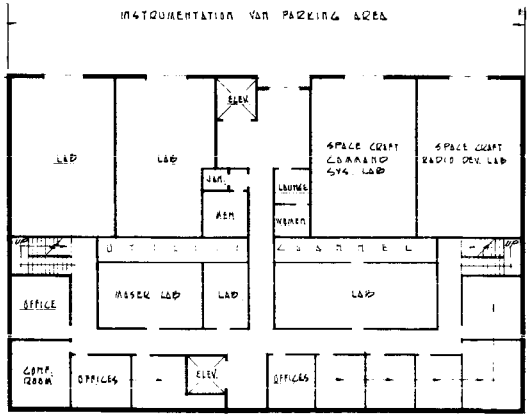


FIRST FLOOR PLAN

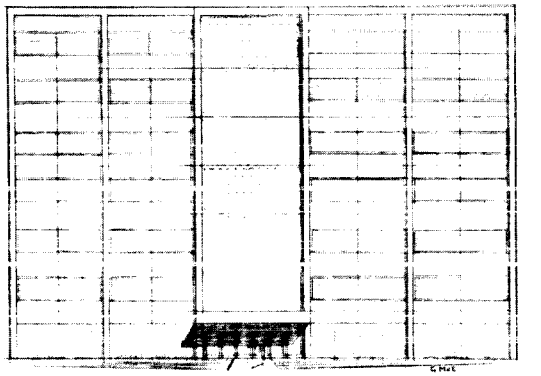
SCALE IN FEET



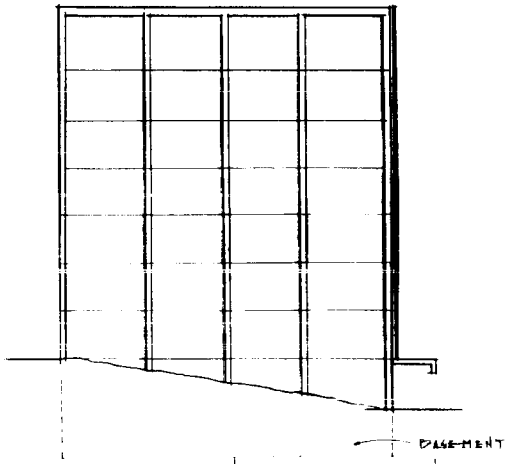
THIRD THRU SEVENTH FLOOR PLAN



SECOND FLOOR PLAN



SOUTH ELEVATION



WEST ELEVATION

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$135,000
	Grading, paving, sidewalks, and landscaping	$30,000	
	Substation	60,000	
	Utility connections	45,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		2,290,000
	Building .. (82,000 square feet at $28.00 per square foot)	2,290,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		200,000
	Radio frequency screening for laboratories	125,000	
	Instrumentation	35,000	
	Laboratory equipment	40,000	
E.	DESIGN AND ENGINEERING SERVICES		235,000
	Total estimated cost		$2,860,000

JET PROPULSION LABORATORY

FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS

DESCRIPTION:

Funds are requested in this project for the modification and expansion of the laboratory's utility systems. In addition to the utility improvements normally required to support new facilities, this project includes improvements to two major laboratory access roads and the development of a new parking area. The location of these items is indicated in the drawing on the following page.

JUSTIFICATION:

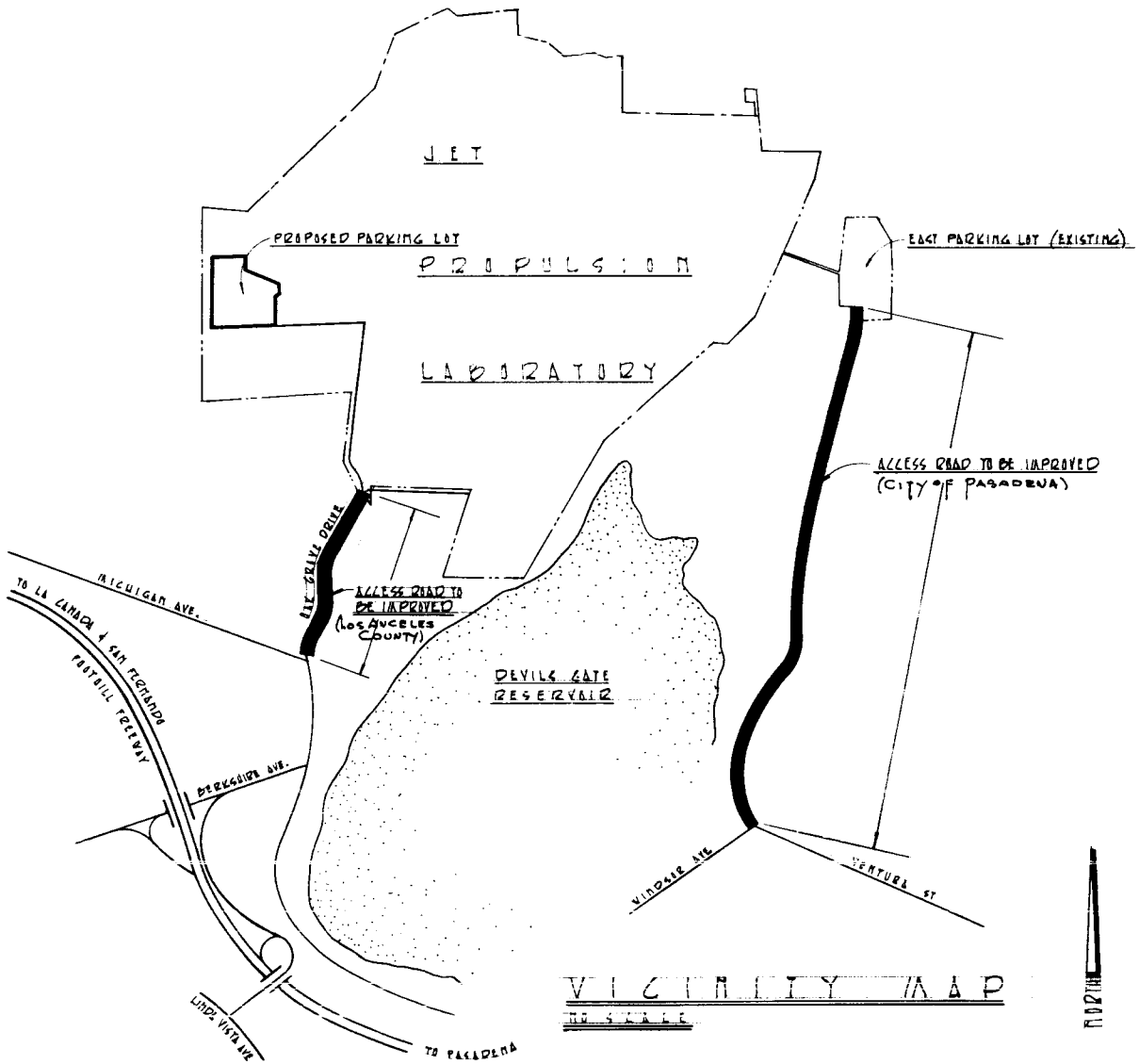
Modifications and expansion of the laboratory's utility systems are required to support the facilities proposed for construction in the fiscal year 1963 budget. The resurfacing of the two access roads shown in the drawing is urgently required. The roads must also be widened to handle an increasing volume of personal and industrial vehicular traffic. The Jet Propulsion Laboratory is not served by public transportation and all employees travel by the use of privately owned vehicles. An additional parking area is necessary to keep pace with the authorized and anticipated staffing levels.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$730,000
	Site grading and general landscaping	$50,000	
	Roads, sidewalks, grading, and paving	116,000	
	Parking areas, grading, and paving	110,000	
	Storm drains	45,000	
	Water distribution system	10,000	
	Sanitary sewer system	5,000	
	Gas distribution system	3,000	
	Air distribution system	3,000	
	Power distribution and communications systems	60,000	
	Substation	25,000	
	Improvements to East access road	115,000	
	Improvements to West access road	97,000	
	West parking lot	81,000	
	Street lighting	10,000	

JET PROPULSION LABORATORY
FISCAL YEAR 1963 ESTIMATES

UTILITY INSTALLATIONS



C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....	---
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....	---
E.	DESIGN AND ENGINEERING SERVICES.....	$90,000
	Total estimated cost.....	$820,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

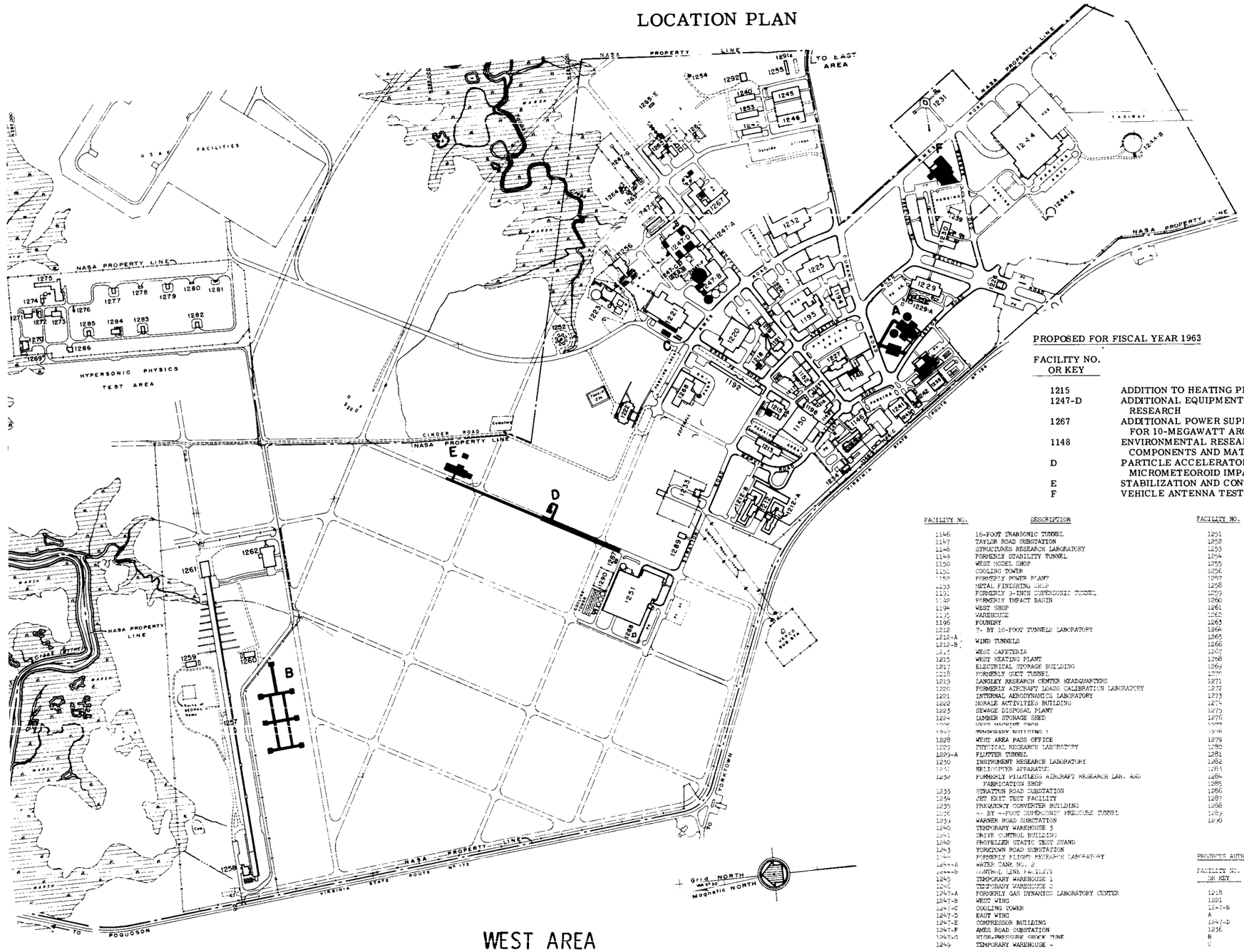
CONSTRUCTION OF FACILITIES - 1963 PROGRAM

LANGLEY RESEARCH CENTER

Page No.		
CF7-A2	Location plan	
CF7-A3	Addition to heating plant.....	$ 858,000
CF7-B1	Additional equipment for magnetoplasmadynamics research.....	1,450,000
CF7-C1	Additional power supply and improved arc chamber for 10-megawatt arc tunnel.....	760,000
CF7-D1	Environmental research facilities for spacecraft components and materials.....	997,000
CF7-E1	Particle accelerator for simulation of micrometeoroid impact.....	936,000
CF7-F1	Stabilization and control equipment laboratory.	1,366,000
CF7-G1	Vehicle antenna test facility.....	1,725,000
	Total.....	$8,092,000

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN



WEST AREA

PROPOSED FOR FISCAL YEAR 1963

FACILITY NO. OR KEY	NAME
1215	ADDITION TO HEATING PLANT
1247-D	ADDITIONAL EQUIPMENT FOR MAGNETOPLASMADYNAMICS RESEARCH
1267	ADDITIONAL POWER SUPPLY AND IMPROVED ARC CHAMBER FOR 10-MEGAWATT ARC TUNNEL
1148	ENVIRONMENTAL RESEARCH FACILITIES FOR SPACECRAFT COMPONENTS AND MATERIALS
D	PARTICLE ACCELERATOR FOR SIMULATION OF MICROMETEOROID IMPACT
E	STABILIZATION AND CONTROL EQUIPMENT LABORATORY
F	VEHICLE ANTENNA TEST FACILITY

FACILITY NO.	DESCRIPTION
1146	16-FOOT TRANSONIC TUNNEL
1147	TAYLOR ROAD SUBSTATION
1148	STRUCTURES RESEARCH LABORATORY
1149	FORMERLY STABILITY TUNNEL
1150	WEST MODEL SHOP
1151	COOLING TOWER
1152	FORMERLY POWER PLANT
1153	METAL FINISHING SHOP
1154	FORMERLY 9-INCH SUPERSONIC TUNNEL
1155	FORMERLY IMPACT BASIN
1194	WEST SHOP
1195	WAREHOUSE
1196	FOUNDRY
1212	7- BY 10-FOOT TUNNELS LABORATORY
1212-A	WIND TUNNELS
1212-B	
1214	WEST CAFETERIA
1215	WEST HEATING PLANT
1217	ELECTRICAL STORAGE BUILDING
1218	FORMERLY GAST TUNNEL
1219	LANGLEY RESEARCH CENTER HEADQUARTERS
1220	FORMERLY AIRCRAFT LOADS CALIBRATION LABORATORY
1221	INTERNAL AERODYNAMICS LABORATORY
1222	MORALE ACTIVITIES BUILDING
1223	SEWAGE DISPOSAL PLANT
1224	LUMBER STORAGE SHED
1225	[illegible]
1227	TEMPORARY BUILDING 1
1228	WEST AREA PASS OFFICE
1229	TYPICAL RESEARCH LABORATORY
1229-A	FLUTTER TUNNEL
1230	INSTRUMENT RESEARCH LABORATORY
1231	HELICOPTER APPARATUS
1232	FORMERLY PILOTLESS AIRCRAFT RESEARCH LAB. AND FABRICATION SHOP
1233	STRATTON ROAD SUBSTATION
1234	JET EXIT TEST FACILITY
1235	FREQUENCY CONVERTER BUILDING
1236	[illegible] BY [illegible]-FOOT SUPERSONIC PRESSURE TUNNEL
1237	WARNER ROAD SUBSTATION
1240	TEMPORARY WAREHOUSE 3
1241	DRIVE CONTROL BUILDING
1242	PROPELLER STATIC TEST STAND
1243	YORKTOWN ROAD SUBSTATION
1244	FORMERLY FLIGHT RESEARCH LABORATORY
1244-A	WATER TANK NO. 2
1244-B	[illegible] LINE FACILITY
1245	TEMPORARY WAREHOUSE 1
1246	TEMPORARY WAREHOUSE 2
1247-A	FORMERLY GAS DYNAMICS LABORATORY CENTER
1247-B	WEST WING
1247-C	COOLING TOWER
1247-D	EAST WING
1247-E	COMPRESSOR BUILDING
1247-F	AMES ROAD SUBSTATION
1247-G	HIGH-PRESSURE GREEN PUMP
1249	TEMPORARY WAREHOUSE 4

FACILITY NO.	DESCRIPTION
1251	UNITARY PLAN WIND TUNNEL
1252	WATER TANK NO. 1
1253	TEMPORARY WAREHOUSE 5
1254	AMMUNITION STORAGE 1
1255	TEMPORARY WAREHOUSE 6
1256	9- BY 6-FOOT THERMAL STRUCTURES TUNNEL
1257	LANDING LOADS TRACK
1258	LANDING LOADS TRACK COMPRESSOR BUILDING
1259	NORTH ARRESTING GEAR HOUSING
1260	SOUTH ARRESTING GEAR HOUSING
1261	LANDING LOADS TRACK SHOP
1262	HIGH-SPEED HYDRODYNAMICS OFFICE AND SHOP
1263	CERAMIC-HEATED JET (PILOT MODEL)
1264	HIGH-TEMPERATURE MACH 7 JET (PILOT MODEL)
1265	8-FOOT HIGH-TEMPERATURE STRUCTURES TUNNEL
1266	MOFFETT ROAD SUBSTATION
1267	HIGH-TEMPERATURE MATERIALS LABORATORY
1268	DATA REDUCTION BUILDING
1269	GATE HOUSE (HYPERSONIC PHYSICS TEST AREA)
1270	ROCKET PROPELLANT TEST UNIT, HPTA
1271	OPEN SHED, HPTA
1272	HEATING PLANT, HPTA
1273	OPERATIONS CENTER, HPTA
1274	CERAMIC-HEATED MACH 15 JET, HPTA
1275	IMPACT AND FRAGMENTATION UNIT, HPTA
1276	IGNITER ASSEMBLY BUILDING, HPTA
1277	STORAGE A
1278	STORAGE B
1279	STORAGE C
1280	STORAGE D
1281	STORAGE E
1282	STORAGE F
1283	STORAGE G
1284	ROCKET PROPELLANT PROCESSING BUILDING, HPTA
1285	STORAGE H
1286	ROCKET ASSEMBLY AND PROPELLANT ALTERATION BLDG.
1287	TEMPORARY SHED
1288	SOLAR ENERGY COLLECTOR
1289	TEMPORARY STORAGE
1290	SUBSTATION

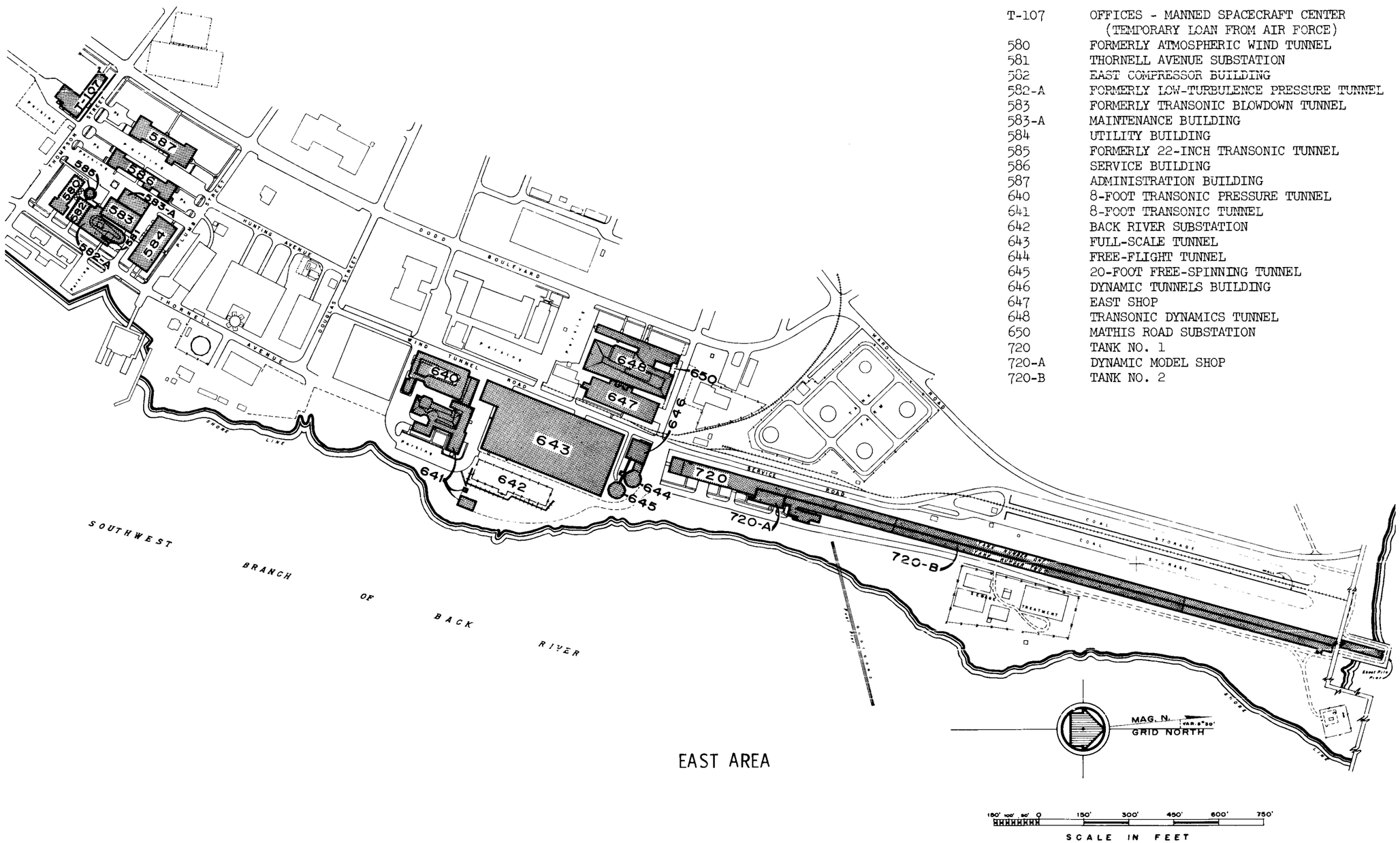
PROJECTS AUTHORIZED AND UNDER CONSTRUCTION

FACILITY NO. OR KEY	NAME	PROJECT NO.
1218	NOISE RESEARCH LABORATORY	3053
1221	NOISE TEST FACILITY	3054
12-7-B	HYPERSONIC AERODYNAMICAL DYNAMICS FACILITY	3180
A	DYNAMICS RESEARCH LABORATORY	3181
1247-D	EQUIPMENT FOR MAGNETOPLASMADYNAMICS RESEARCH	3342
1256	HIGH VACUUM SPACE STRUCTURES FACILITY	3343
B	LUNAR LANDING RESEARCH FACILITY	3440
C	LOW FREQUENCY ENVIRONMENTAL NOISE FACILITY	[illegible]

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN

FACILITY NO.	DESCRIPTION
T-107	OFFICES - MANNED SPACECRAFT CENTER (TEMPORARY LOAN FROM AIR FORCE)
580	FORMERLY ATMOSPHERIC WIND TUNNEL
581	THORNELL AVENUE SUBSTATION
582	EAST COMPRESSOR BUILDING
582-A	FORMERLY LOW-TURBULENCE PRESSURE TUNNEL
583	FORMERLY TRANSONIC BLOWDOWN TUNNEL
583-A	MAINTENANCE BUILDING
584	UTILITY BUILDING
585	FORMERLY 22-INCH TRANSONIC TUNNEL
586	SERVICE BUILDING
587	ADMINISTRATION BUILDING
640	8-FOOT TRANSONIC PRESSURE TUNNEL
641	8-FOOT TRANSONIC TUNNEL
642	BACK RIVER SUBSTATION
643	FULL-SCALE TUNNEL
644	FREE-FLIGHT TUNNEL
645	20-FOOT FREE-SPINNING TUNNEL
646	DYNAMIC TUNNELS BUILDING
647	EAST SHOP
648	TRANSONIC DYNAMICS TUNNEL
650	MATHIS ROAD SUBSTATION
720	TANK NO. 1
720-A	DYNAMIC MODEL SHOP
720-B	TANK NO. 2



EAST AREA

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

ADDITION TO HEATING PLANT

DESCRIPTION:

It is proposed to enlarge the capacity of the existing heating plant located in the West Area of the Langley Research Center by the addition of a 105,000-pound-per-hour steam boiler and a new 110-psi air compressor and dryer. The project includes a 5,000-psi pressure reducing station, supplied by a new 1-inch, 5,000-psi air line from the gas dynamics storage field. The equipment will be housed in a new 50- by 60-foot addition to the heating plant building and in adjacent areas in the existing building. A sketch of the proposed building addition is shown on the next page.

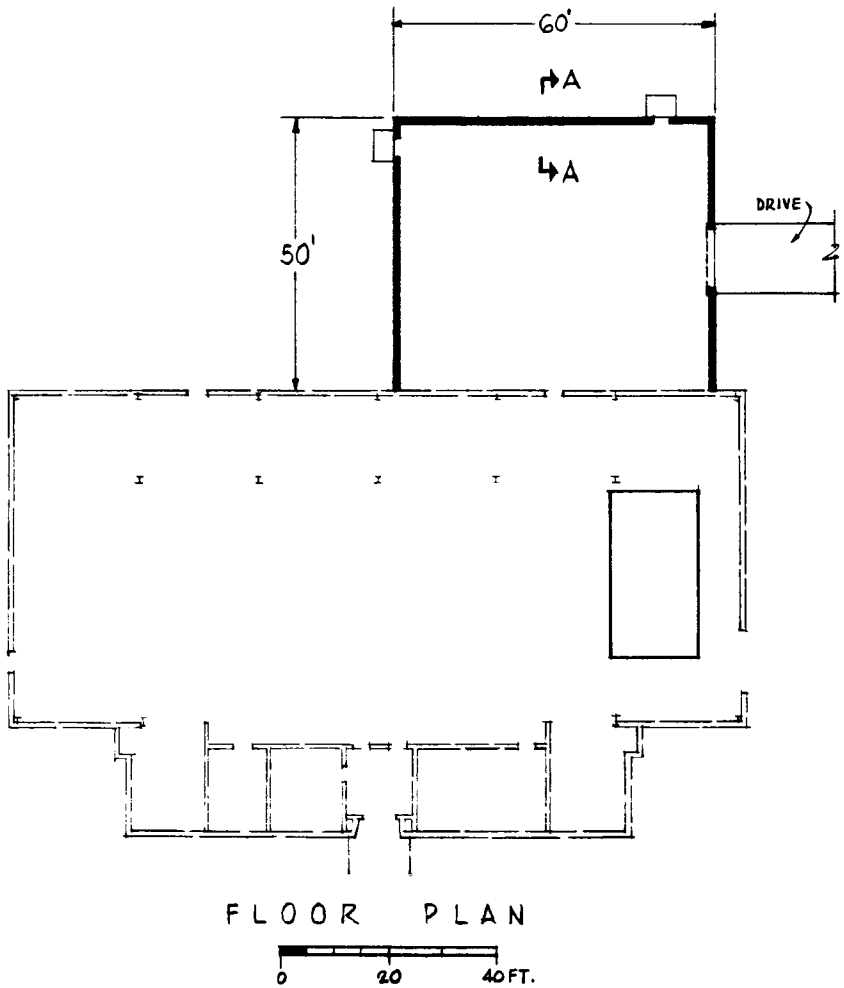
JUSTIFICATION:

The central heating plant which supplies steam throughout the West Area will soon be inadequate. The present boiler capacity is 108,000 pounds per hour at design temperatures. The steam load has become acute in that the existing connected steam load is now 114,000 pounds per hour. This situation will be intensified when facilities presently under way, such as the dynamics research laboratory and the hypersonic aerothermal dynamics facility, begin to use steam. The requested boiler will provide the needed additional steam capacity for these facilities and will provide some reserve capacity for new construction. In addition, the requested boiler will aid in carrying the load when another boiler is shut down for maintenance.

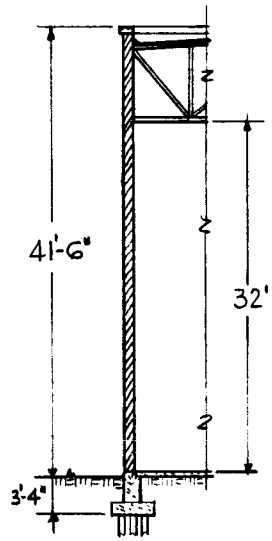
The heating plant's location at the hub of an underground duct system has led to the building's serving as a control source for compressed air. The demand for compressed air has grown to such an extent that several of the existing systems are inadequate. The 100-psi air system, which supplies air to all West Area buildings, is inadequate during peak demand periods. In the event of a major breakdown of the existing air compressor, research work would be delayed. The proposed air compressor will be a supplement to the existing compressor, supply the needed additional air supply, and will maintain service in the event of a major breakdown of the existing compressor. The demand by several research facilities for air over 2,000 psi is met by filling bottles with an existing 2,500-psi compressor. However, this compressor even with booster is inadequate to meet existing research demands. The proposed 5,000-psi service connection will utilize an existing source to supply the increasing demand in this area for high-pressure air.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

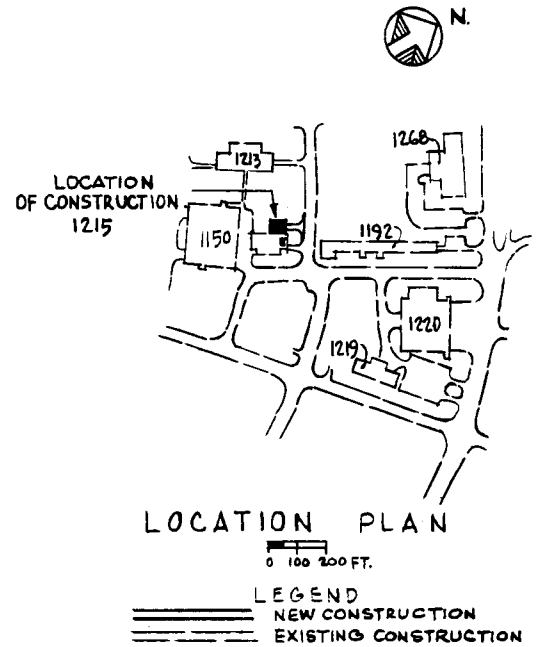
ADDITION TO HEATING PLANT



FLOOR PLAN



SECTION "A-A"



LOCATION PLAN

The existing heating plant was constructed in 1943, and 10 years later one additional boiler was installed. There is no more space available in the building. The proposed building addition will house the feed water pump, other boiler auxiliaries, and air compressors. Some equipment will be relocated from the existing building in order that the new boiler may be placed alongside existing boilers.

This proposed addition to the heating plant will require about 30 months from the initiation of design to the completion of construction. Design funds have been approved in the amount of $42,500 in the fiscal year 1962 for this project so that a construction contract may be awarded early in the fiscal year 1963. The advanced construction date will reduce the critical heating situation from four heating seasons to three before added boiler capacity is available.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$41,000
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		605,000
	Building alteration...(3,000 square feet at $42.60 per square foot)	$144,000	
	Boiler	335,000	
	Piping revisions	126,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		212,000
	Electrical system	87,000	
	Air compressor	125,000	
E.	DESIGN AND ENGINEERING SERVICES ($42,500 allocated from fiscal year 1962 funds)		---
	Total estimated cost		$858,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

ADDITIONAL EQUIPMENT FOR MAGNETOPLASMADYNAMICS RESEARCH

DESCRIPTION:

The equipment requested in this project is needed to permit investigations with plasma generators and accelerators of larger size and more advanced research capabilities than can be provided with currently available equipment and systems. The following items will be procured and, as indicated in the sketch on the next page, located in existing and converted space in the former gas dynamics laboratory:

(a) Electrical energy storage bank of capacitors having low inductance and very fast discharge rate.

(b) Specially constructed channel for larger scale d-c, steady-flow plasma accelerator.

(c) Plasma source utilizing high-power arc jet.

(d) Large superconducting magnet with cryostat for application to plasma accelerators.

(e) High-capacity steam-ejector evacuating system for receiving and neutralizing plasma flows with alkali metal seeding elements.

(f) High-current d-c transmission line to power arc plasma source (item (c)) from existing remote d-c power supply.

(g) General laboratory instrumentation including microwave and other electronic and electrical equipment.

JUSTIFICATION:

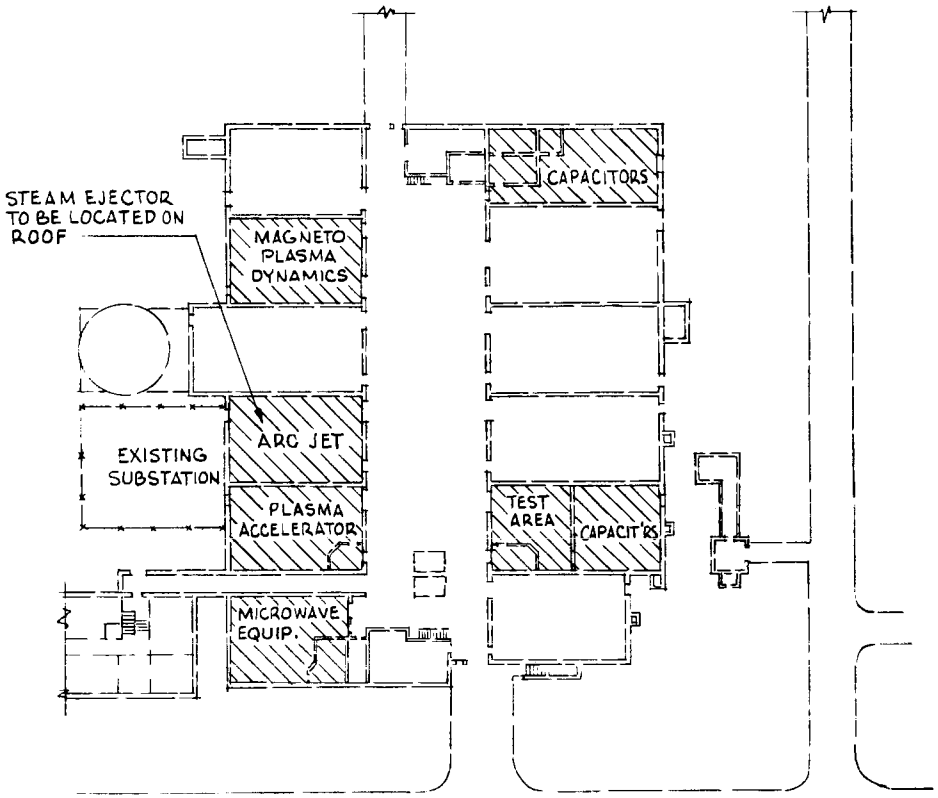
It has become apparent that significant benefits will flow from the application of research results in the sciences of magnetohydrodynamics and plasma physics in future space flight and other technological developments. Many advances have been made at the Langley Center and elsewhere toward understanding the basic plasma phenomena involved in efforts to accelerate plasmas, to extract electrical energy from moving plasmas, and to convert plasma energy to radio-frequency energy. All of these latter efforts are directly applicable to space flight technology and are leading to concepts and advanced ideas that can be applied to plasma propulsion, plasma power generation, and space communication. Much of the research accomplished to date, however, has been qualitative in the sense that the equipment has been too small in scale and the energy levels

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

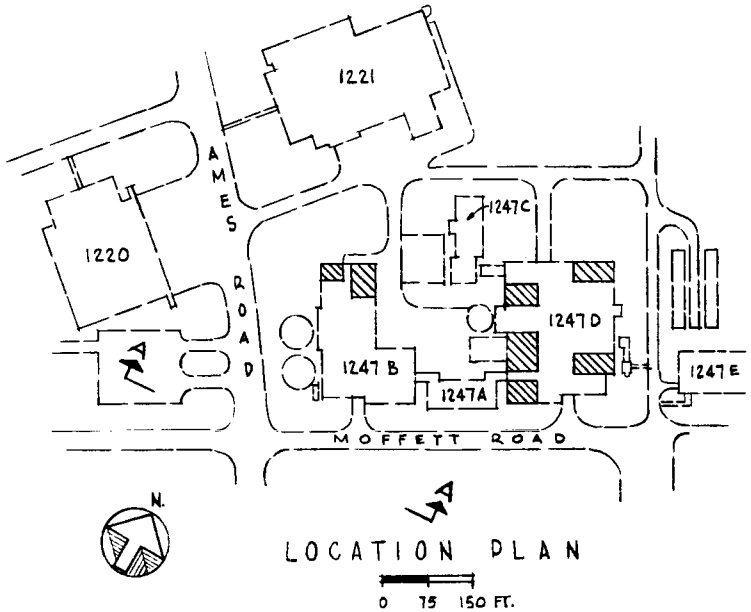
ADDITIONAL EQUIPMENT FOR MAGNETOPLASMADYNAMICS RESEARCH

VIEW A-A



FIRST FLOOR PLAN

0 10 30 60 FT.



LOCATION PLAN

0 75 150 FT.

LEGEND

EXISTING CONSTRUCTION

AREAS ASSIGNED TO PLASMA PHYSICS

CF7-B2

involved have been too low to permit detailed quantitative study and evaluation of the significant parameters involved and of the effects of variations in these parameters. Although various plasma devices which have been studied appear to offer attractive possibilities for various applications, sufficient quantitative information has not been obtained to permit realistic evaluation. The equipment being requested in this project is aimed primarily at providing facilities for studying such devices as plasma accelerators and plasma guns on a scale and with power levels sufficiently high to permit the very necessary quantitative understanding of the phenomena involved. The project is a continuation of the work undertaken with fiscal year 1962 funds which is providing the capability for clarifying magnetoplasmadynamics phenomena in a quantitative fashion.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$340,000
	Power transmission line	$300,000	
	Extension of steam line	40,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		645,000
	Steam ejector evacuating pump	$85,000	
	Plasma source (arc jet)	160,000	
	D-c stead-flow plasma accelerator channel	100,000	
	Capacitor bank	300,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		465,000
	Superconducting magnet and cryostat	$250,000	
	Instrumentation and support equipment	215,000	
E.	DESIGN AND ENGINEERING SERVICES		---
	Total estimated cost		$1,450,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

ADDITIONAL POWER SUPPLY AND IMPROVED ARC CHAMBER

FOR 10-MEGAWATT ARC TUNNEL

DESCRIPTION:

It is proposed to increase the capability of the existing 10-megawatt arc tunnel to simulate the reentry conditions experienced by vehicles returning to earth from lunar or planetary missions. The project includes the addition to the electrical power equipment of the arc tunnel of rectifiers and associated auxiliaries which will convert a part of the a-c power to d-c power; the construction of an improved arc chamber incorporating newest techniques in arc heating of air for generating higher temperature airstreams; and the addition of cooling system components to convert the present open water-cooling system to a closed water-cooling system.

A sketch of the improvements proposed under this project is presented on the following page.

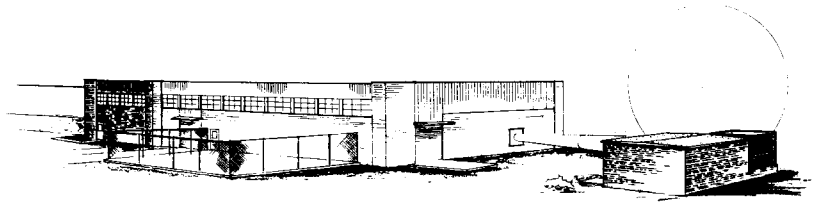
JUSTIFICATION:

When space vehicles reenter the earth's atmosphere from lunar or planetary missions, the air immediately adjacent to the vehicle surface will be heated to a temperature of approximately 16,000° F. The flow of heat from this high-temperature air into the vehicle structure creates the exceedingly difficult problem of protecting the vehicle and its occupants against flaming destruction. The potentiality for destruction of the vehicle as if it were a meteor is evident from the fact that all known materials are vaporized at temperatures below 7,200° F.

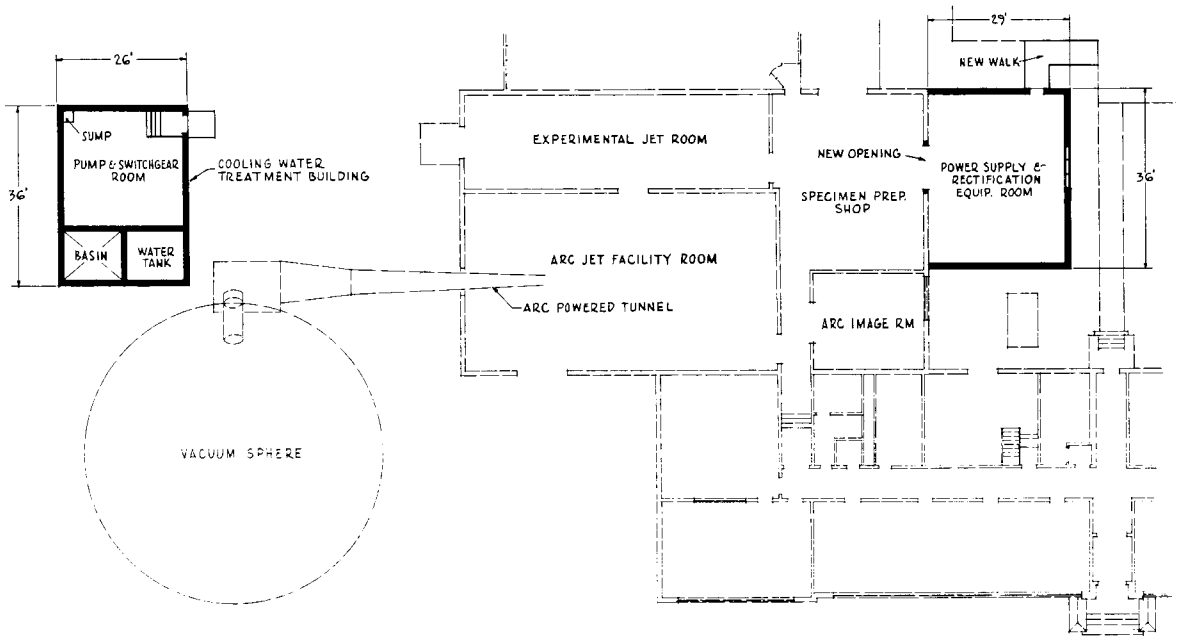
Structures and materials research on the problems of thermal protection for space vehicles, requires ground-based facilities which can simulate the reentry environment. This means that research facilities must be capable of generating and handling airstreams of 16,000° F and higher. Various methods of heating airstreams have been used in supersonic research facilities, including combustion of chemical fuels and electrical resistance heating of heat exchangers, but none of these methods are capable of producing the temperatures experienced in reentry. Approximately 3 years ago, a significant breakthrough occurred when methods were developed for using high-intensity electric arcs to heat air to the required temperatures. The Langley Center developed a number of subsonic and supersonic arc jets and a subsonic arc tunnel for

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

ADDITIONAL POWER SUPPLY AND IMPROVED ARC CHAMBER FOR 10-MEGAWATT ARC TUNNEL

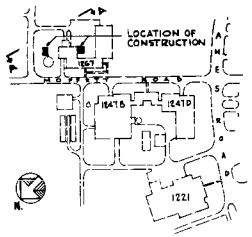


VIEW A-A



PARTIAL FLOOR PLAN

0 5 10 20 FT.



LOCATION PLAN

0 100 200 400 FT.

LEGEND

EXISTING CONSTRUCTION
NEW CONSTRUCTION
EXISTING TO BE REMOVED

CH7-C2

performing research on small materials test specimens in airstreams at temperatures up to 11,000° F, the temperature encountered in reentry from near earth orbits. In recognition of the fact that a larger facility was needed for tests of models of reasonable size, a 10,000-kilowatt arc tunnel was provided in the fiscal year 1958 appropriation.

The existing 10-megawatt arc tunnel was designed to produce in the test section the high temperatures (11,000° F) and enthalpies of energy content (8,000 Btu/lb) which simulate the environment experienced by a vehicle on reentry from near-earth orbit at approximately 25,000 feet per second. However, lunar vehicles such as Apollo and future planetary vehicles will reenter the earth's atmosphere at 36,000 feet per second, the velocity required to escape from the earth's gravitational field, and higher. To simulate this environment in the test section, the arc chamber must be capable of generating air with temperatures approximately 50 percent higher (16,000° F) and enthalpies approximately 100 percent higher (18,000 Btu/lb) than its present capability. The most advanced techniques for electric arc heating of air will be applied to achieve these temperatures and enthalpies.

Reentry from space remains one of the most difficult problems of successful manned space flight. Intense effort must be applied to the solution of this problem. The electric arc-heated tunnel is the only adequate experimental method of investigating the reentry problem. The requested improvements in the capabilities of the existing 10-megawatt arc tunnel will provide information of direct and immediate use in the design of manned space vehicles.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$48,000
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		684,000
	D-c power supply and accessories	$308,000	
	Piping	98,000	
	Arc chamber and accessories	226,000	
	Equipment housing...(1,980 square feet at $26.25 per square foot).	52,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		---
E.	DESIGN AND ENGINEERING SERVICES		28,000
	Total estimated cost		$760,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

ENVIRONMENTAL RESEARCH FACILITIES FOR

SPACECRAFT COMPONENTS AND MATERIALS

DESCRIPTION:

A variety of vacuum chambers and accessory equipment will be installed in the existing structures research laboratory to test materials, structural components, and equipment of spacecraft in the simulated environment of space. The vacuum chambers will range in size from 1 cubic foot to approximately 50 cubic feet. All will be capable of minimum pressures below 10^{-6} millimeters of mercury (corresponding to altitudes in excess of 200 miles). Accessory equipment will be provided to simulate ultraviolet radiation and solar thermal radiation, to measure weight loss of materials resulting from evaporation in space vacuum, to apply structural loads (both static and dynamic) to the test specimens, and to measure resulting strains, displacements, and temperatures.

JUSTIFICATION:

Materials and structures of space vehicles must reliably withstand a space environment that is drastically different from the earth-surface environment. The nearly complete absence of an atmosphere and atmospheric pressure, the presence of ultraviolet and other solar radiation of high intensity (undiminished by an absorbing atmosphere as for the earth's surface), and other factors degrade to some degree the surface, physical, and thermal properties of materials and threaten their very survival on missions of long duration. While both metallic and nonmetallic materials are affected, nonmetallic materials are expected to be more adversely affected; nonmetallic materials must, however, be more extensively used because of other desirable characteristics. An important example of a nonmetallic material that must not be degraded in the space environment is the ablating material that constitutes the thermal protection system of reentry vehicles.

In the hard vacuum of space some materials evaporate very rapidly, but a significant loss of material during a mission cannot be tolerated. Metals tend to weld on contact in vacuum and the dynamic characteristics of structures may change as the environment affects the characteristics of components. Ultraviolet and infrared radiation embrittle many plastics; the embrittlement of flexible seals on windows, doors, and hatches of a spacecraft could cause a catastrophic loss of the atmosphere within the vehicle. These and many other problems must be investigated

to assure a high degree of reliability in the materials and component parts of spacecraft during flight through space and subsequent reentry, if required.

Degradation of materials in the space environment is time dependent, months or years often being required to detect significant changes. Most of the accomplished space missions have been of relatively short duration, but present plans envision manned flights ranging from 2 weeks for initial lunar exploration to more than a year for the first planetary missions. Orbital space stations and lunar bases must have long lives to be economically feasible. Tests of even longer durations are required to satisfactorily determine the properties of materials required in design.

The research and testing planned for the chambers will consist of the measurement of changes in the surface, physical, thermal, optical, mechanical, and other important properties of materials, structural components, and equipment resulting from long exposure to the simulated space environment, including the single and combined effects of each aspect of that environment. Both test chambers and specimens will be small to provide a large volume of data at low cost.

Only a few vacuum chambers are presently available at the Langley Center for work of this type; consequently, several long duration experiments can completely dominate the program. A substantial number of chambers is required so that single tests can run for the weeks, months, or years required in a program composed of a reasonable total number of experiments. The proposed addition is the first step in the augmentation and consolidation of small-scale vacuum facilities at the Langley Research Center. All but a few of the proposed chambers are commercially available and can be placed in operation without delay. Test results can therefore be available promptly for early application to the space program.

COST ESTIMATE:

A.	LAND ACQUISITION.....	---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....	$22,000
C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....	---

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$945,000
Vacuum equipment.....	$602,000	
Installation and accessories.....	157,000	
Cryogenic panels.....	96,000	
Solar lamps.....	62,000	
Electrical systems.....	28,000	
E. DESIGN AND ENGINEERING SERVICES.....		30,000
Total estimated cost.....		$997,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

PARTICLE ACCELERATOR FOR SIMULATION OF MICROMETEOROID IMPACT

DESCRIPTION:

The particle accelerator proposed for construction in this project will consist of three principal components: a high-voltage Van de Graaff machine of 5.5 million volts capacity, an ion beam particle charger and injector, and a detector for counting the particles and measuring their velocity. The principle of operation is that the highly charged particles, when exposed to the large potential difference generated by the Van de Graaff machine, are accelerated to high velocity in an evacuated tube. The particles strike the surface of the test specimen at meteoroid velocities. Performance predictions for this apparatus indicate that a velocity of 80,000 feet per second will be attained by highly charged tungsten particles of 1-micron diameter and 30,000 feet per second by 10-micron particles.

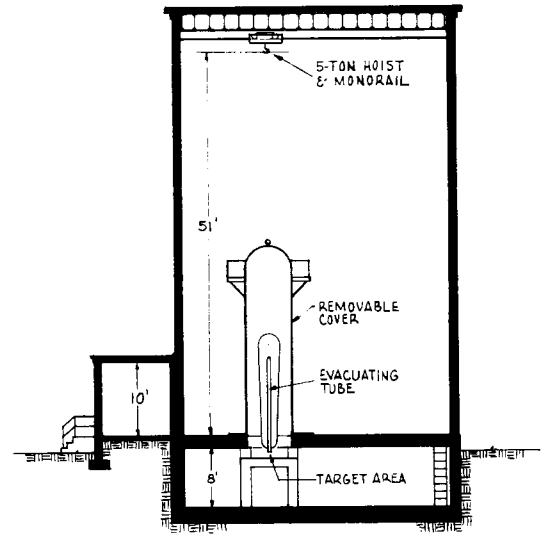
The accelerator will be housed in a separate concrete enclosure with adequate thicknesses of concrete to provide shielding of personnel against secondary radiation produced by this equipment. A sketch of the facility is shown on the following page.

JUSTIFICATION:

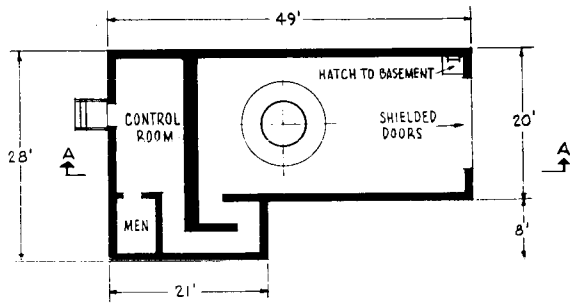
The available information on comet and asteroid debris in space clearly indicates that a serious meteoroid impact problem exists for manned space vehicles. The meteoroid impact may result in penetration of the vehicle by the larger particles or it may result in erosion of the surface of the vehicle by the smaller particles which are encountered in great numbers. Considering the specific case of a vehicle of the Apollo type, the probability is high that several penetrations by meteoroids will be experienced in a lunar mission of 2 weeks. In addition, a sandblast-type erosion will be experienced from the more frequently encountered micrometeoroids. These micrometeoroids might not penetrate the vehicle shell, but their erosive action will obliterate surface treatments which, through ability to reflect or absorb solar heat and radiate internally generated heat, have the very important function of controlling the internal temperature of the space vehicle and making it habitable by men and by instruments. Although this loss of temperature control proceeds slowly, it constitutes a hazard to the success of manned space flight just as much as impacts by penetrating meteoroids.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

PARTICLE ACCELERATOR FOR SIMULATION OF MICROMETEOROID IMPACT

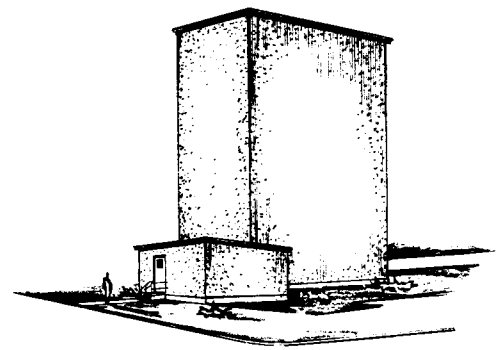


SECTION A-A

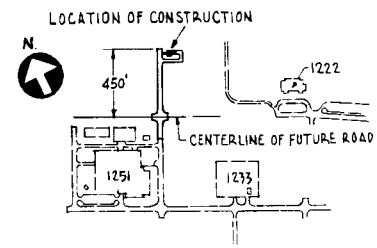


FLOOR PLAN

0 5 10 FT.



PERSPECTIVE



LOCATION PLAN

0 200 400 FT

LEGEND

EXISTING CONSTRUCTION

NEW CONSTRUCTION

CH7-E2

Existing research facilities for launching high-speed particles are incapable of producing velocities in the range of 30,000 to 250,000 feet per second which are attained by meteoroids. The highest velocities now attained are below the lower limit of meteoroid velocities. No other technique appears capable of developing velocities as high as those which appear feasible with the particle accelerator. The facility proposed in this project is particularly well-suited to the purpose of simulating the most frequently encountered meteoric particles, those with high velocity and density but small mass.

In comparison with the known costs of conducting meteoroid impact research in space by means of satellites, a ground facility of the type proposed is very economical. Because the major component of the facility, the electrostatic accelerator, is a well-developed and readily available piece of equipment, the particle accelerator can be placed in operation within a time period such that significant research can be performed toward the goal of understanding and minimizing the micrometeoroid hazard for manned space vehicles.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATION		$124,000
	Electrical distribution	$54,000	
	Grading, paving, and mechanical utilities	70,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		709,000
	Accelerator	$452,000	
	Auxiliaries for accelerator	142,000	
	Shielded accelerator housing and control room...(1,148 square feet at $100 per square foot)	115,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		70,000
E.	DESIGN AND ENGINEERING SERVICES		33,000
	Total estimated cost		$936,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

STABILIZATION AND CONTROL EQUIPMENT LABORATORY

DESCRIPTION:

A stabilization and control equipment research laboratory is proposed for construction consisting of a building with special research facilities and including associated offices and shops. The building will house inertial simulators, special high-pressure air supplies for air bearing inertial simulators, electronic simulation facilities for closed loop integrated systems studies, medium high-vacuum facilities for low torque control system investigation over long time periods, long-throw optical facilities for use with simulators, rate tables and servoed tables for use with rate and integrating rate gyroscopes, equatorial mount tables for gyroscope testing, a time drive mount for use with sun, star, and planet seekers, and a magnetic field control to simulate the fields which may be encountered by a space vehicle.

The stabilization and control equipment laboratory will include a long-throw optical facility for use with the simulation equipment and special provisions for eliminating or avoiding externally induced vibrations. The laboratory building will provide one floor for shop and workrooms over a basement for the long-throw optical facility, with a 40- by 40-foot by 35-foot high simulator room at one end as shown in the drawing on the following page.

JUSTIFICATION:

Research investigations in reentry aerodynamics and heating, and trajectory analyses and control studies for lunar and planetary missions require the use of research vehicles and probes which must be accurately and efficiently guided and controlled through a flight-test program.

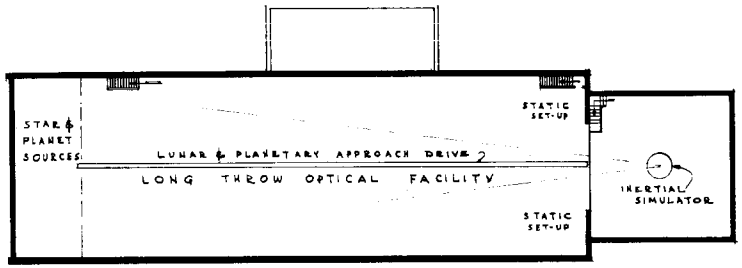
Research and development which will result in improved reliable equipment for sensing and controlling vehicle position and orientation is urgently needed. Stabilization and control work is at present hampered by the lack of the facility proposed in this project. Present and future work can be grouped into three categories:

(a) Research and development activities with respect to specific space flight and reentry projects.

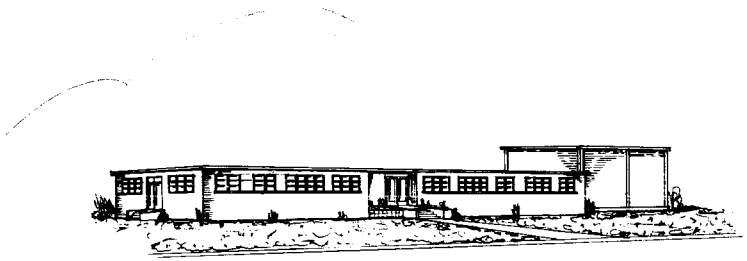
(b) Testing and evaluation of contractor furnished guidance and control equipment used in the Langley Center activities.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

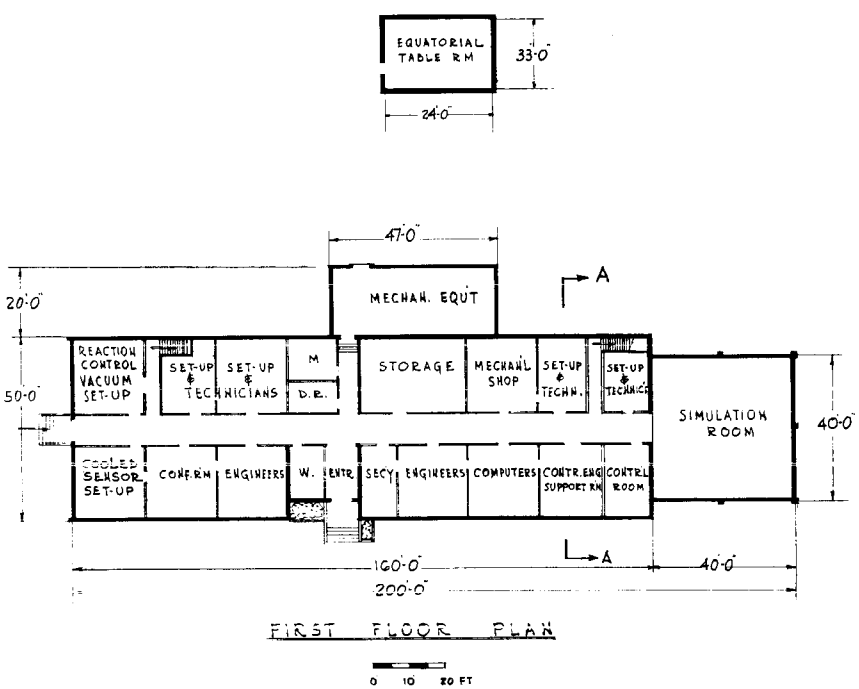
STABILIZATION AND CONTROL EQUIPMENT LABORATORY



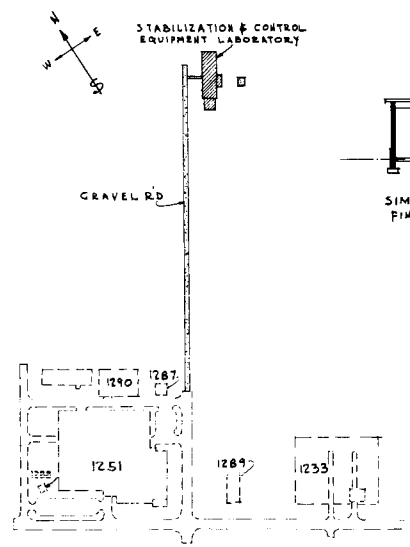
BASEMENT FLOOR PLAN



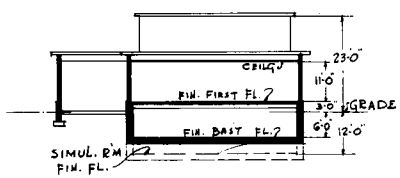
PERSPECTIVE VIEW



FIRST FLOOR PLAN



LOCATION PLAN



SECTION A-A

CH7-F2

(c) Research and development to provide information and techniques needed to secure acceptable guidance and control systems.

Specific examples of recurring needs in the first two categories are the Little Joe and the Scout control system projects. Similar future work on extensions of the Scout vehicle and its payload, and on the monitoring of control equipment that might be used in large-scale reentry tests will require even more complex and accurate equipment than was needed in the past. The need for reentry data at lunar return velocities requires that the requested facility be available to check out the precise, complex booster and payload control equipment systems which will be used.

In addition to vehicle guidance, support work is required in conjunction with conceptual lunar orbit and landing control studies to evaluate and test guidance and control concepts employing optical sensing devices and efficient attitude control techniques. Examples of work in the third category are projects seeking to define the optical characteristics of the earth's horizon, and the development of simple horizon scanning sensors. Work is under way and will continue using flight research vehicles to provide needed design data which will be directly usable for the lunar reentry maneuvers. The requested simulation facility will allow testing of the sensing devices needed for this work.

The manned planetary flight, rendezvous, and docking programs will require the development and evaluation of sensor concepts for star trackers, map matchers, high sensitivity accelerometers, sextants, and optical radars. The incorporation of such sensors into attitude control systems will require complete simulation of the over-all control loop, including the lags and nonlinearities of the actual control jets used. The requested facility will provide the necessary optical facilities, inertial simulation facilities, special exhaust facilities for special fuel, and supporting instrumentation to allow rapid progress in the development of such systems.

COST ESTIMATE:

A.	LAND ACQUISITION.....	---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....	$90,000
C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....	371,000

Laboratory building ...(18,600 square feet at $19.95 per square foot).....$371,000

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$875,000
Test apparatus.....	$300,000	
Instrumentation and read-out equipment.....	550,000	
Electrical equipment.....	25,000	
E. DESIGN AND ENGINEERING SERVICES.....		30,000
Total estimated cost.....		$1,366,000

LANGLEY RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

VEHICLE ANTENNA TEST FACILITY

DESCRIPTION:

An antenna test facility is required for use in reentry environment and other flight programs and to serve as a tool for advanced general research and development on antenna systems for vehicles utilizing radio telemetry.

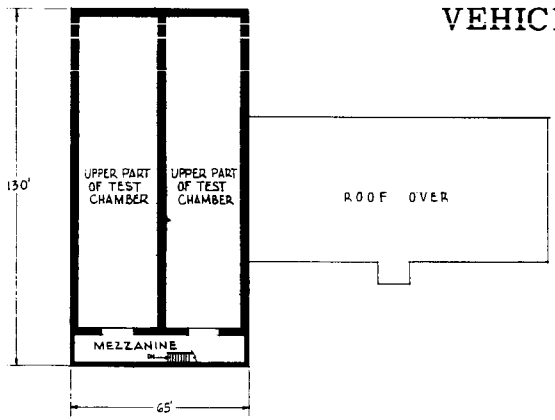
The facility will include two indoor radio-frequency anechoic antenna test chambers, one chamber to be used for antennas utilizing the frequency range between 100 mc and 1 kmc and the second for the frequency range 1 kmc to 80 kmc. An antenna assembly area will be provided. A separate screened room will be available as either a microwave systems laboratory or as a low noise receiving techniques laboratory. The laboratory building will consist of the test range area having a ceiling height of approximately 35 feet and a one-story wing containing the remaining work area. A sketch of the proposed facility is shown on the following page.

JUSTIFICATION:

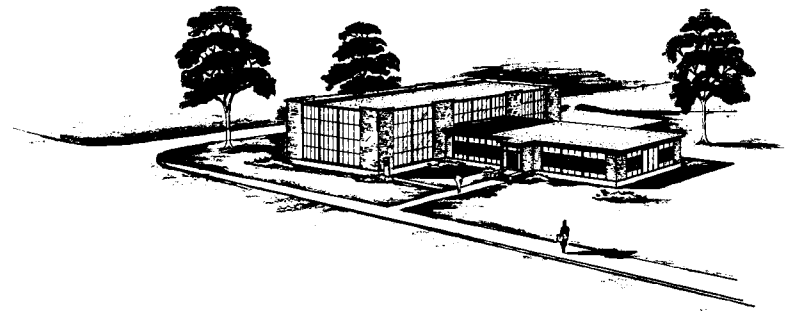
Work is underway on several space flight projects involving the use of multistage launch vehicles and their payloads, and on general long range research and development projects on data transmission techniques utilizing radio telemetry. These projects involve the simultaneous use of several radio-frequency receivers and transmitters which must be provided with noninterfering antenna systems which radiate efficiently to illuminate the ground telemetry and tracking stations. The problem is further aggravated by the fact that the data transmission must continue when the vehicle is immersed in highly ionized gases during reentry. At present, antenna tests are accomplished on an outdoor range under the difficulties imposed by extraneous signals due to reflection from surrounding objects and by environmental radio noise due to nearby equipment. Inclement weather also limits the amount of work that can be done. The more complex antenna systems which are evolving are more critical of noise environment and cannot be satisfactorily tested on the outdoor range. The proposed facility is required so that design, development, and adjustment of new high gain antenna systems can be accomplished effectively and economically to meet the expanding requirements. The screened room, which will be provided as a microwave and low noise receiver techniques laboratory, is required for the development of high sensitivity receiver equipments and for the adjustment of receiver-transmitter units required for antenna testing.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

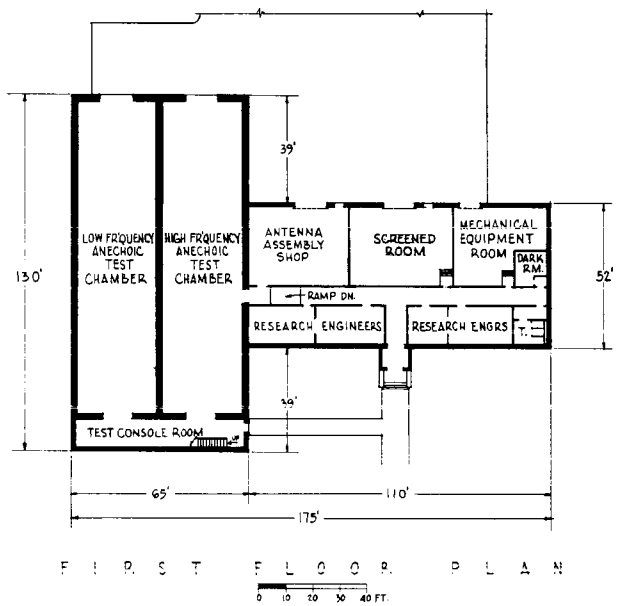
VEHICLE ANTENNA TEST FACILITY



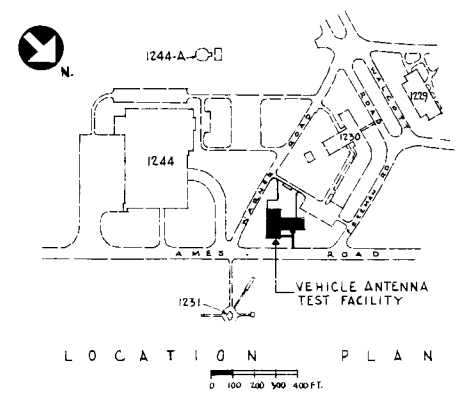
SECOND FLOOR PLAN



PERSPECTIVE



FIRST FLOOR PLAN



LOCATION PLAN

LEGEND
EXISTING CONSTRUCTION
NEW CONSTRUCTION

CF7-G2

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$220,000
	Utilities	$190,000	
	Grading and paving	30,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		830,000
	Anechoic-shielded chambers	$410,000	
	Screened room	30,000	
	Laboratory building...(14,820 square feet at $26.32 per square foot)	390,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS		645,000
	Antenna range instrumentation	$200,000	
	Microwave instrumentation	100,000	
	Laboratory standards	200,000	
	Laboratory test and shop equipment	145,000	
E.	DESIGN AND ENGINEERING SERVICES		30,000
	Total estimated cost		$1,725,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1963 ESTIMATES

CONSTRUCTION OF FACILITIES - 1963 PROGRAM

LEWIS RESEARCH CENTER

Page No.		
CF8-A2	Location plan	
CF8-A3	Development engineering building.....	$4,650,000
CF8-B1	Hydrogen heat transfer facility.....	2,400,000
CF8-C1	Lunar propulsion research facility.....	6,275,000
CF8-D1	Modernization and reconditioning of Plum Brook service facilities.....	1,508,000
CF8-E1	Nuclear rocket dynamics and controls facility.....	3,500,000
CF8-F1	Space propulsion facility.....	25,500,000
	Total.....	$43,833,000

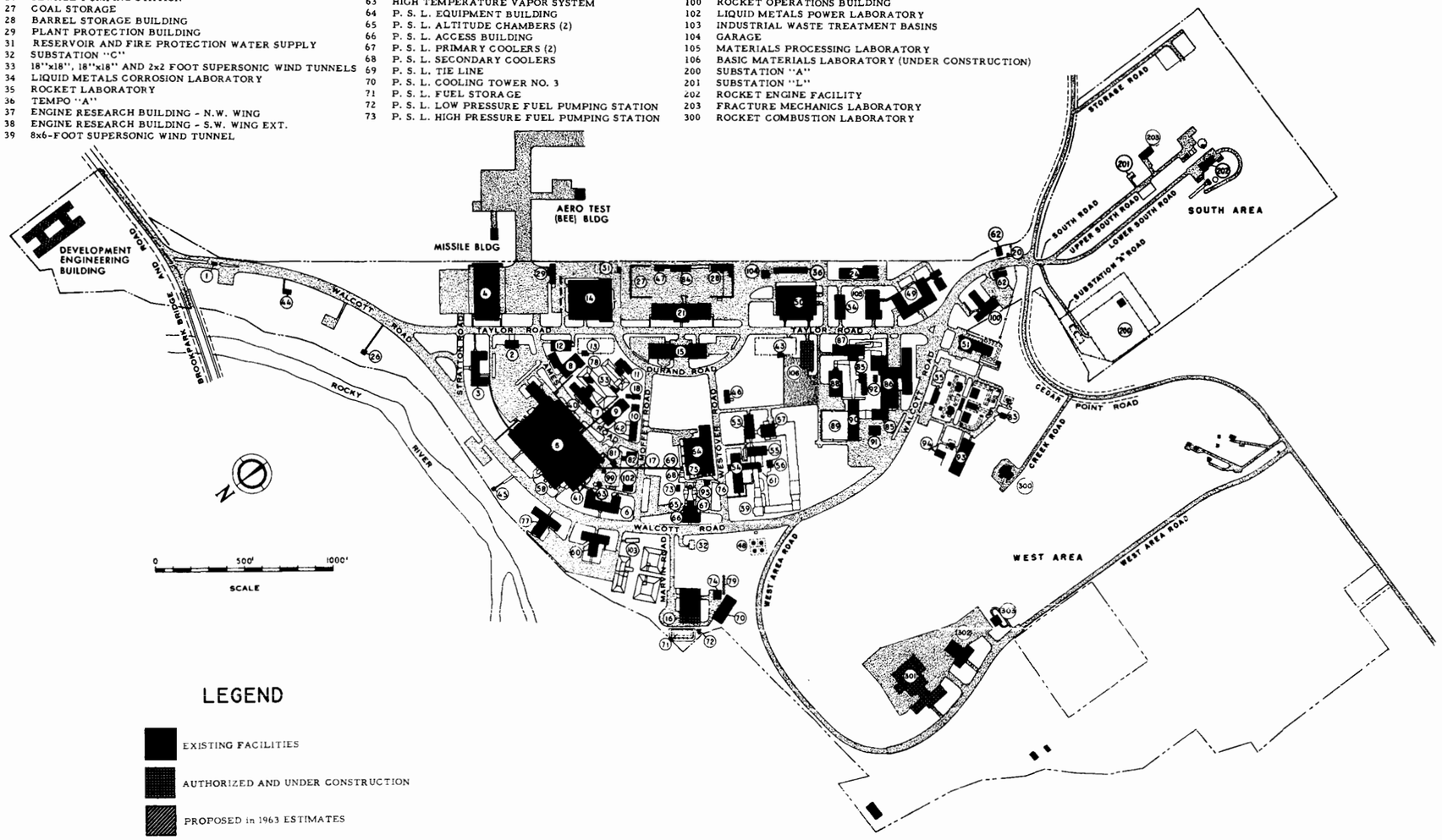
LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN

1 GATEHOUSE (MAIN)
2 PERSONNEL BUILDING
3 ADMINISTRATION BUILDING
4 FLIGHT RESEARCH BUILDING
5 ENGINE RESEARCH BUILDING
6 CHEMISTRY LABORATORY
7 ALTITUDE WIND TUNNEL
8 EXHAUSTER BUILDING
9 REFRIGERATION BUILDING
10 COOLING TOWER NO. 1
11 ICING RESEARCH TUNNEL
12 STEAM GENERATING PLANT
13 SUBSTATION "B"
14 TECHNICAL SERVICE BUILDING
15 UTILITIES BUILDING
16 ELECTRIC PROPULSION RESEARCH BUILDING
17 UNDERGROUND FUEL STORAGE
18 AIR DRYER NO. 1
20 SOUTH GATEHOUSE
21 PROCUREMENT & SUPPLY BUILDING
23 ENGINE RESEARCH BUILDING - WEST WING
24 SPECIAL PROJECTS LABORATORY
26 SEWAGE PUMPING STATION
27 COAL STORAGE
28 BARREL STORAGE BUILDING
29 PLANT PROTECTION BUILDING
31 RESERVOIR AND FIRE PROTECTION WATER SUPPLY
32 SUBSTATION "C"
33 18"x18", 18"x18" AND 2x2 FOOT SUPERSONIC WIND TUNNELS
34 LIQUID METALS CORROSION LABORATORY
35 ROCKET LABORATORY
36 TEMPO "A"
37 ENGINE RESEARCH BUILDING - N.W. WING
38 ENGINE RESEARCH BUILDING - S.W. WING EXT.
39 8x6-FOOT SUPERSONIC WIND TUNNEL
40 SUBSTATION "D"
41 SUBSTATION "F"
42 SUBSTATION "E"
43 SUBSTATION "G"
44 GAS METER HOUSE
45 DROP TOWER
46 COOLING TOWER NO. 2
47 STORAGE BUILDING NO. 47
48 FUEL STORAGE TANKS
49 MATERIALS AND STRESSES BUILDING
50 FABRICATION SHOP
51 HIGH ENERGY FUELS LABORATORY
53 8x6-FOOT SUPERSONIC DRIVE EQUIPMENT BLDG.
54 8x6-FOOT SUPERSONIC WIND TUNNEL RESEARCH AND CONTROL BUILDING
55 8x6-FOOT SUPERSONIC MODELS PREPARATION BLDG.
56 8x6-FOOT SUPERSONIC EXHAUSTER BUILDING
57 8x6-FOOT SUPERSONIC AIR DRYER BUILDING
58 SUBSTATION "H"
60 P. S. L. OPERATIONS BUILDING
61 8x6-FOOT SUPERSONIC FUEL BUILDING
62 PLANT SERVICES BUILDING
63 HIGH TEMPERATURE VAPOR SYSTEM
64 P. S. L. EQUIPMENT BUILDING
65 P. S. L. ALTITUDE CHAMBERS (2)
66 P. S. L. ACCESS BUILDING
67 P. S. L. PRIMARY COOLERS (2)
68 P. S. L. SECONDARY COOLERS
69 P. S. L. TIE LINE
70 P. S. L. COOLING TOWER NO. 3
71 P. S. L. FUEL STORAGE
72 P. S. L. LOW PRESSURE FUEL PUMPING STATION
73 P. S. L. HIGH PRESSURE FUEL PUMPING STATION
74 P. S. L. CIRCULATING WATER PUMPING STATION
75 P. S. L. SUBSTATION "J"
76 P. S. L. COMBUSTION AIR HEATER
77 INSTRUMENT RESEARCH LABORATORY
78 A. W. T. PUMP HOUSE
79 P. S. L. COOLING WATER DEAERATORS
81 E. R. B. SPRAY COOLER BUILDING
82 COOLING TOWER NO. 4
83 CRYOGENICS SERVICES BUILDING
84 STORAGE BUILDING NO. 84
85 10'x10' SUPERSONIC WIND TUNNEL
86 10'x10' - SWT RESEARCH AND CONTROL BUILDING
87 10'x10' - SWT SECONDARY COMPRESSOR AND DRIVE BLDG.
88 10'x10' - SWT AIR DRYER BUILDING
89 10'x10' - SWT SUBSTATION "K"
90 10'x10' - SWT MAIN COMPRESSOR AND DRIVE BUILDING
91 10'x10' - SWT LOW PRESSURE FUEL PUMPING STATION
92 10'x10' - SWT HIGH PRESSURE FUEL PUMPING STATION
93 10'x10' - SWT COOLING TOWER NO. 5
94 10'x10' - SWT COOLING TOWER WATER PUMPING BUILDING
95 P.S. L. DESICCANT AIR DRYER
99 E. R. B. COMBUSTION AIR HEATER
100 ROCKET OPERATIONS BUILDING
102 LIQUID METALS POWER LABORATORY
103 INDUSTRIAL WASTE TREATMENT BASINS
104 GARAGE
105 MATERIALS PROCESSING LABORATORY
106 BASIC MATERIALS LABORATORY (UNDER CONSTRUCTION)
200 SUBSTATION "A"
201 SUBSTATION "L"
202 ROCKET ENGINE FACILITY
203 FRACTURE MECHANICS LABORATORY
300 ROCKET COMBUSTION LABORATORY
301 ION AND PLASMA JET FACILITY (UNDER CONSTRUCTION)
302 ENERGY CONVERSION LABORATORY
303 SUBSTATION "M"

* MODIFICATIONS TO A SPACE ENVIRONMENT TANK (IN STRUCTURE 16 - UNDER CONSTRUCTION)

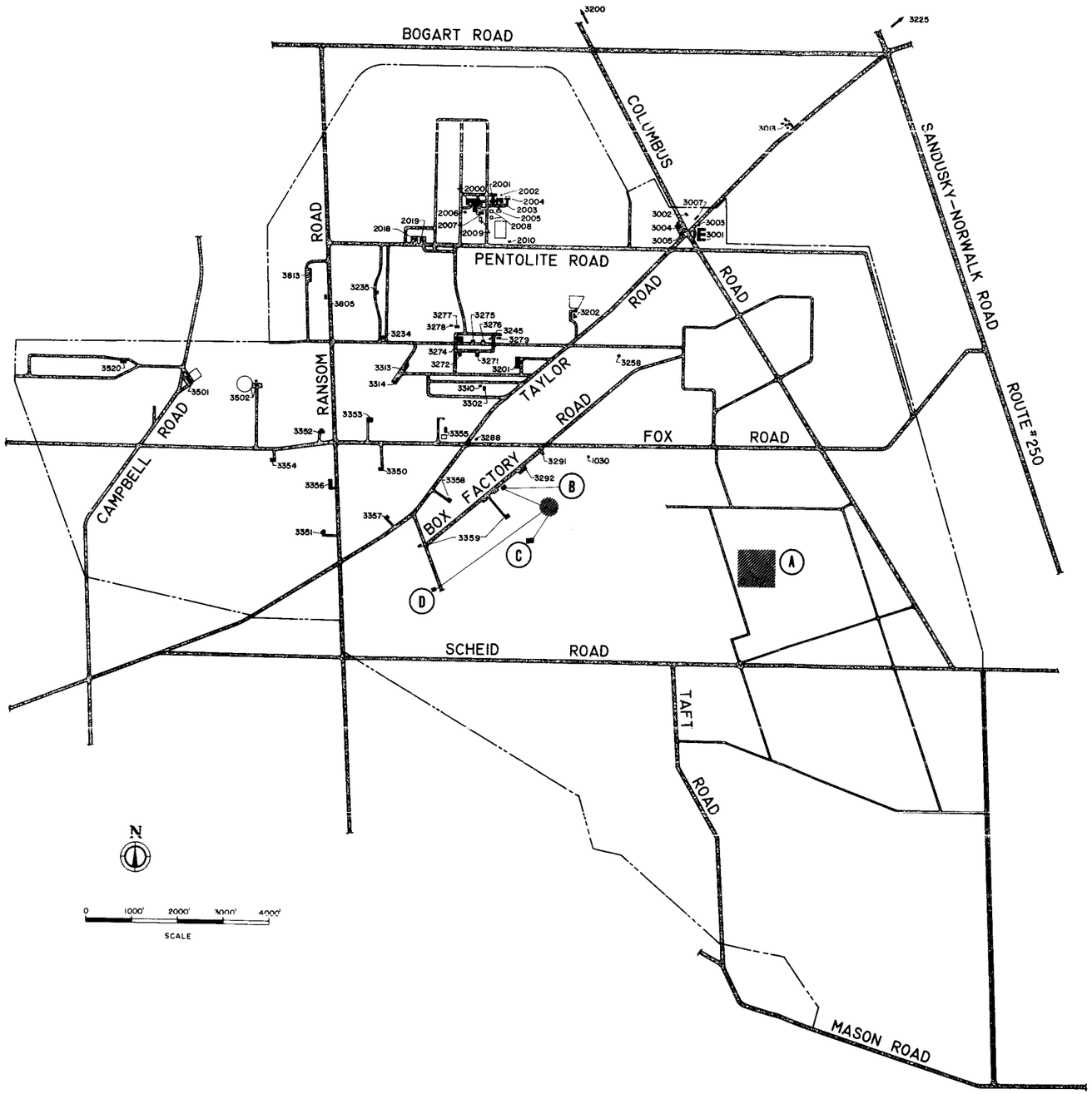
* FACILITIES FOR RESEARCH ON SPACE POWER GENERATION SYSTEMS AND COMPONENTS (IN STRUCTURE 7 - UNDER CONSTRUCTION)



CF 8-A2

PLUM BROOK STATION
FISCAL YEAR 1963 ESTIMATES

LOCATION PLAN



1030	FIRE WATER TOWER
2000	REACTOR BUILDING (OFFICE ETC.)
2001	REACTOR SERVICES BUILDING
2002	REACTOR WATER TOWER
2003	REACTOR COOLING TOWER
2004	REACTOR SLUDGE BASINS
2005	REACTOR SUBSTATION A
2006	REACTOR SECURITY BUILDING
2007	REACTOR FAN HOUSE
2008	REACTOR COLD RETENTION BASINS
2009	REACTOR HOT RETENTION BASINS
2010	REACTOR EFFLUENT METERING STATION
2018	WAREHOUSE
2019	WAREHOUSE
3001	ADMINISTRATION BUILDING
3002	HEATING PLANT AND ELECTRICAL SHOP
3003	GATE HOUSE
3004	PLANT PROTECTION BUILDING
3005	MEDICAL SERVICES BUILDING
3007	PERSONNEL BUILDING (INACTIVE)
3013	SEWAGE PLANT
3200	BIG ISLAND PUMPING STATION
3201	SUBSTATION B (AND POWER PLANT)
3202	RESERVOIR AND PUMP STATION #1
3225	RYE BEACH PUMPING STATION
3234	RAILROAD SCALES
3235	FUEL OIL TANK AND PUMP
3245	FUEL OIL TANK AND PUMP
3258	WATER TOWER (INACTIVE)
3271	WAREHOUSE
3272	WAREHOUSE
3274	MAINTENANCE SHOP
3275	WAREHOUSE
3276	WAREHOUSE
3277	GARAGE
3278	GARAGE
3279	WAREHOUSE
3288	DOMESTIC WATER TOWER
3291	WAREHOUSE
3292	WAREHOUSE
3302	AIR COMPRESSOR BUILDING
3310	PUMP HOUSE (INACTIVE)
3313	WAREHOUSE
3314	WAREHOUSE
3350	ROCKET PUMP LABORATORY
3351	ROCKET TURBO-PUMP LABORATORY
3352	ROCKET TURBINE LABORATORY
3353	ROCKET SYSTEMS DYNAMICS LAB.
3354	ROCKET SYSTEMS HYDRAULICS LAB.
3355	ROCKET TURBINE AND PUMP PILOT LAB.
3356	CENTRAL CONTROL AND DATA BUILDING
3357	FLUORINE PUMP LABORATORY
3358	ROCKET SYSTEMS LAB.----(PORTABLE RIGS)
3359	ALTITUDE ROCKET TEST FACILITY
3501	SUBSTATION C (AND POWER PLANT)
3502	RESERVOIR AND PUMPING STATION NO. 2
3520	WAREHOUSE
3805	TRUCK SCALE
3813	WAREHOUSE

LEGEND

EXISTING FACILITIES

AUTHORIZED AND UNDER CONSTRUCTION

PROPOSED IN 1963 ESTIMATES

A. SPACE PROPULSION FACILITY
B. NUCLEAR ROCKET DYNAMICS AND CONTROLS FACILITY
C. LUNAR PROPULSION RESEARCH FACILITY
D. HYDROGEN HEAT TRANSFER FACILITY
E. MODERNIZATION AND RECONDITIONING OF PLUM BROOK SERVICE FACILITIES (VARIOUS LOCATIONS)

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

DEVELOPMENT ENGINEERING BUILDING

DESCRIPTION:

The building proposed in this project will provide office space for approximately 1250 research and engineering personnel, plus service areas for associated mechanical and electrical equipment.

The structure will be of steel frame, masonry and preformed wall panel exterior, aluminum sash and doors, acoustical ceilings, vinyl tile floors, and prefabricated interior partitions. Services will include hot water heating and air conditioning, the usual plumbing, electrical and elevator services, and communications systems. Grounds will be landscaped and parking space for approximately 500 cars will be provided.

The building will be located on the north side of Brookpark Road, directly across from the Lewis Center's present entrance as shown in the drawing on the following page. A short roadway, passing under the eastern end of the Brookpark Road Bridge, will connect the new and old areas. The new roadway, plus a relocation of the present entrance road, will also alleviate an existing serious traffic congestion at this point by eliminating all left hand turns on the highway.

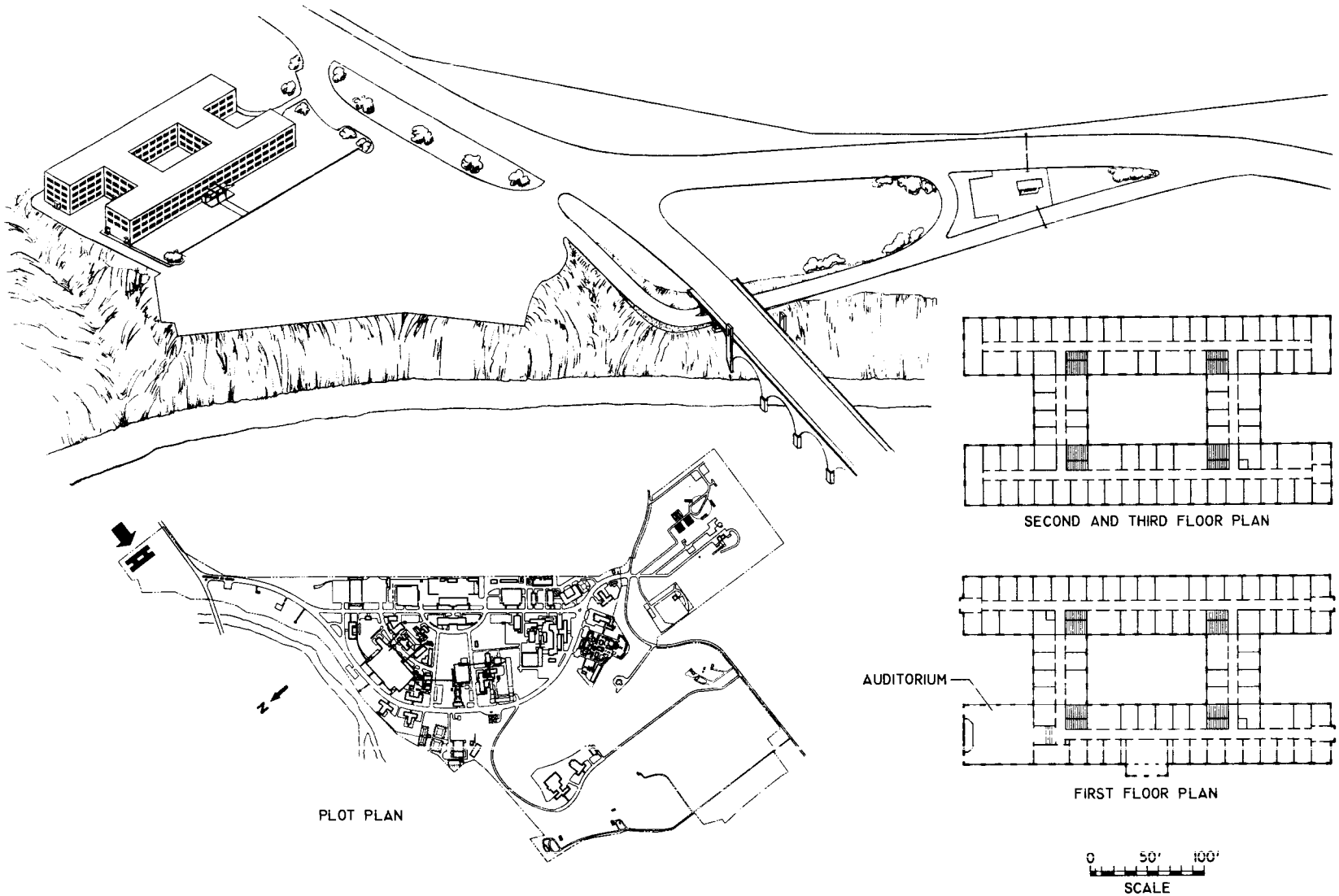
JUSTIFICATION:

The proposed development engineering building is needed to house the new employees scheduled to be added to the Lewis Center staff. Space for those reporting during the current fiscal year, and early in the fiscal year 1963, will be provided by altering and enlarging existing buildings. However, the total number of employees anticipated by the end of 1963 cannot be accommodated in existing or presently authorized buildings.

Most of the new employees will be engaged in the management and direction of system development contracts placed with various industrial organizations. At the same time, it is important that they keep in close touch with the latest research and other supporting test programs being conducted in the Lewis Center's own facilities. The site proposed for the new building is admirably situated for both these functions.

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

DEVELOPMENT ENGINEERING BUILDING



COST ESTIMATE:

A.	LAND ACQUISITION.....		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$787,500
	Site preparation.....	$94,700	
	Underpass and access road.....	200,000	
	Entry gate.....	25,000	
	Roads and parking areas.....	110,000	
	Utility extensions and connections.....	357,800	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		3,330,000
	Building construction...(171,000 square feet at $19.50 per square foot).....	3,330,000	
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		322,500
	Office furniture, fire fighting equipment, and auditorium equipment.....	322,500	
E.	DESIGN AND ENGINEERING SERVICES.....		210,000
	Total estimated cost.....		$4,650,000

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

HYDROGEN HEAT TRANSFER FACILITY

DESCRIPTION:

This facility consists of an inductively-heated heat reservoir (pebble bed) and associated fluid storage and flow systems connected to a test section wherein research studies will be conducted. The electric induction heater will heat the pebble bed to a temperature of 5,000°R over a period of hours with an inert atmosphere present in the bed. By means of a suitable valving arrangement, the bed will then be used to raise the temperature of gaseous hydrogen to about 5,000°R. At a design flow condition of 4-1/2 pounds per second, 1200 psi and 5,000°R, the length of run will be 2 minutes. Maximum heat-flux levels of 40 btu per square inch per second, which is comparable to those calculated for nuclear rocket nozzles, will be theoretically attainable in the test section.

This facility will be located at the Plum Brook Station to minimize the complexity of the hydrogen disposal problem. Included in the facility are all safety systems, fuel handling systems, utilities, structures and site improvements that are required. A schematic diagram of the proposed installation is shown on the following page.

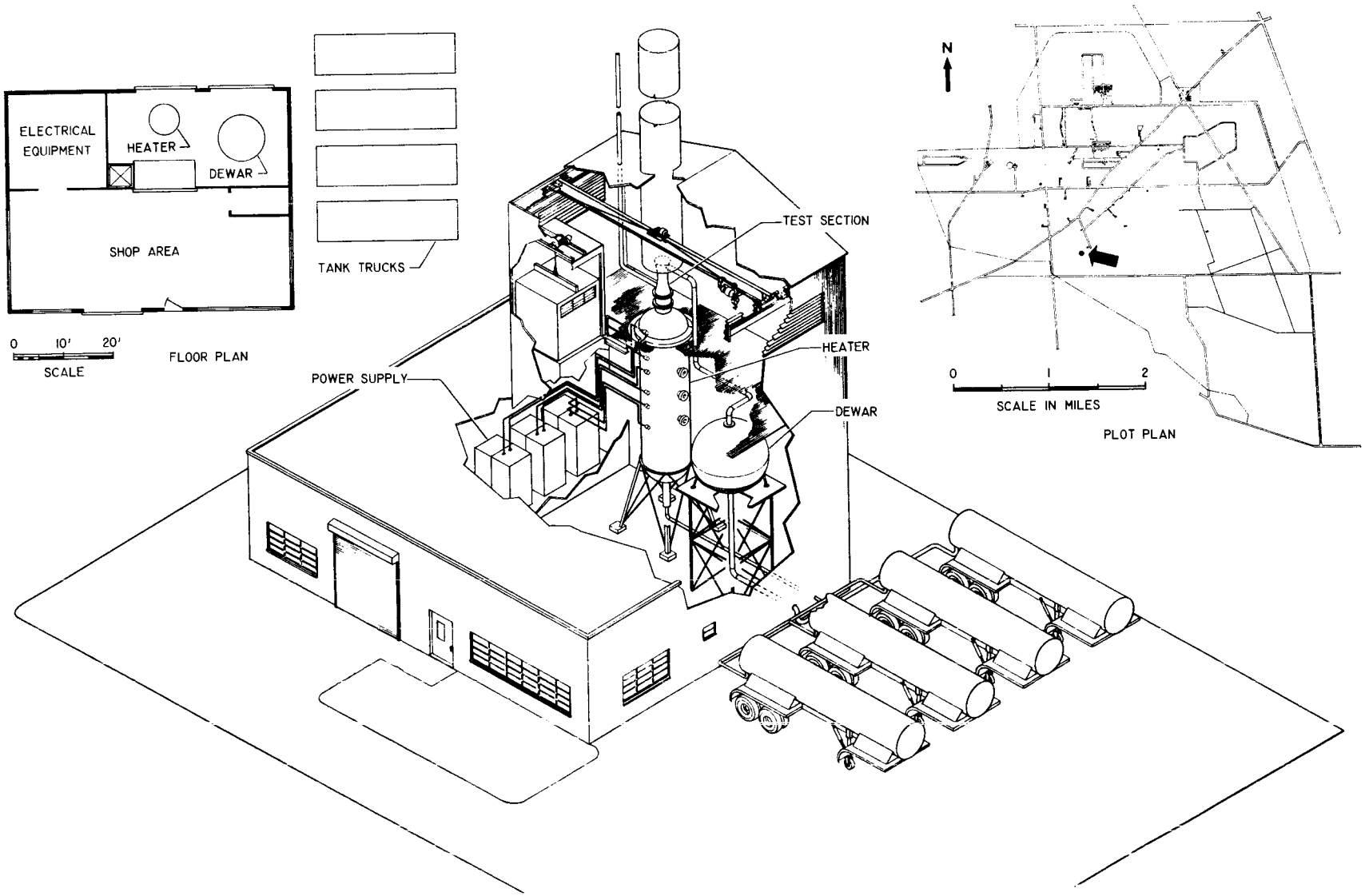
The facility as originally included in the fiscal year 1962 program was proposed for construction on the site of the Lewis Center at Cleveland, Ohio. The project was temporarily deferred so that other projects of more immediate priority could be built with the available funds. Design studies were continued, however, and the Plum Brook site was determined to be preferable. The main consideration for the Cleveland site was the large connected electrical load required for continuous heating of the hydrogen. Present plans for a pebble-bed heater greatly reduce the load. The new site also provides a better margin of safety because of its remote location. A reduction in the estimated cost of the facility was also possible.

JUSTIFICATION:

With the increased use of hydrogen as a propellant in nuclear and thermal rockets, a need for a hot hydrogen facility is evident. Of most immediate interest is the nozzle cooling and heat transfer problem. Exhaust nozzles for nuclear rockets will be required to operate with hydrogen gas heated to temperatures in the range of 5,000°R. The present state of the art does not permit delineation of the heat transfer and cooling analyses relationships required for the development of optimum flight-type exhaust nozzles.

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

HYDROGEN HEAT TRANSFER FACILITY



Research will be conducted on this facility to provide the information necessary for the design and development of satisfactory nuclear rocket nozzles. This research will include basic heat transfer research and development of various types of nozzle cooling systems such as regenerative, ablative, and radiation cooling. Research to evaluate and develop protective and insulating coatings will also be undertaken. Compatability of materials with hot hydrogen and various problems of fluid mechanics can also be studied.

Full scale research on nuclear rocket nozzles would be desirable, but the cost would be prohibitive and a suitable test facility would be extremely complex. The proposed facility will permit scale model evaluation of a majority of the heat transfer and cooling problems. The facility will not be limited to applications for the nuclear rocket but will also provide a wide range of capability for fundamental high temperature studies related to electrical propulsion systems and materials.

COST ESTIMATE:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$205,000
Clearing, filling, grading, and paving..	$37,250	
Electrical power extension and substation.....	129,000	
Sewage treatment plant.....	2,000	
Utility extensions and connections.....	36,750	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		251,550
Test building and shop; explosion proof (1,100 square feet of high bay area plus 1,750 square feet of low bay area; 2,850 square feet at $63.00 per square foot).....	179,550	
Addition to control room at existing altitude rocket test stand; pill box construction...(1,600 square feet at $45.00 per square foot).....	72,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		1,747,450
Heater, including pebble bed and induction heater.....	865,000	
Hydrogen dewars, trailers, and piping systems.....	445,000	

Electrical controls and instrumentation...	$223,000	
Test section and support systems.....	195,000	
Crane.....	19,450	
E. DESIGN AND ENGINEERING SERVICES.....		$196,000
Total estimated cost.		$2,400,000

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

LUNAR PROPULSION RESEARCH FACILITY

DESCRIPTION:

This project proposes the construction of test facilities for conducting altitude performance evaluations necessary to the development of the propulsion system for the lunar landing stage of the Apollo vehicle.

As indicated in the sketch on the following page, the facility will consist of a vertical firing test stand at the Plum Brook Station similar to but larger than the present altitude facility (B-1). The new facility will be located about 2,000 feet from the present stand and will be large enough to provide sufficient work area around a test chamber approximately 30 feet in diameter by 35 feet high. A test chamber of this size should be large enough to contain both the engine and fuel tanks of this stage. The facility will be designed for testing hydrogen-oxygen engines of appropriate chamber pressures and expansion ratios, up to 60,000 pounds thrust under gimballing and various part-thrust operating conditions.

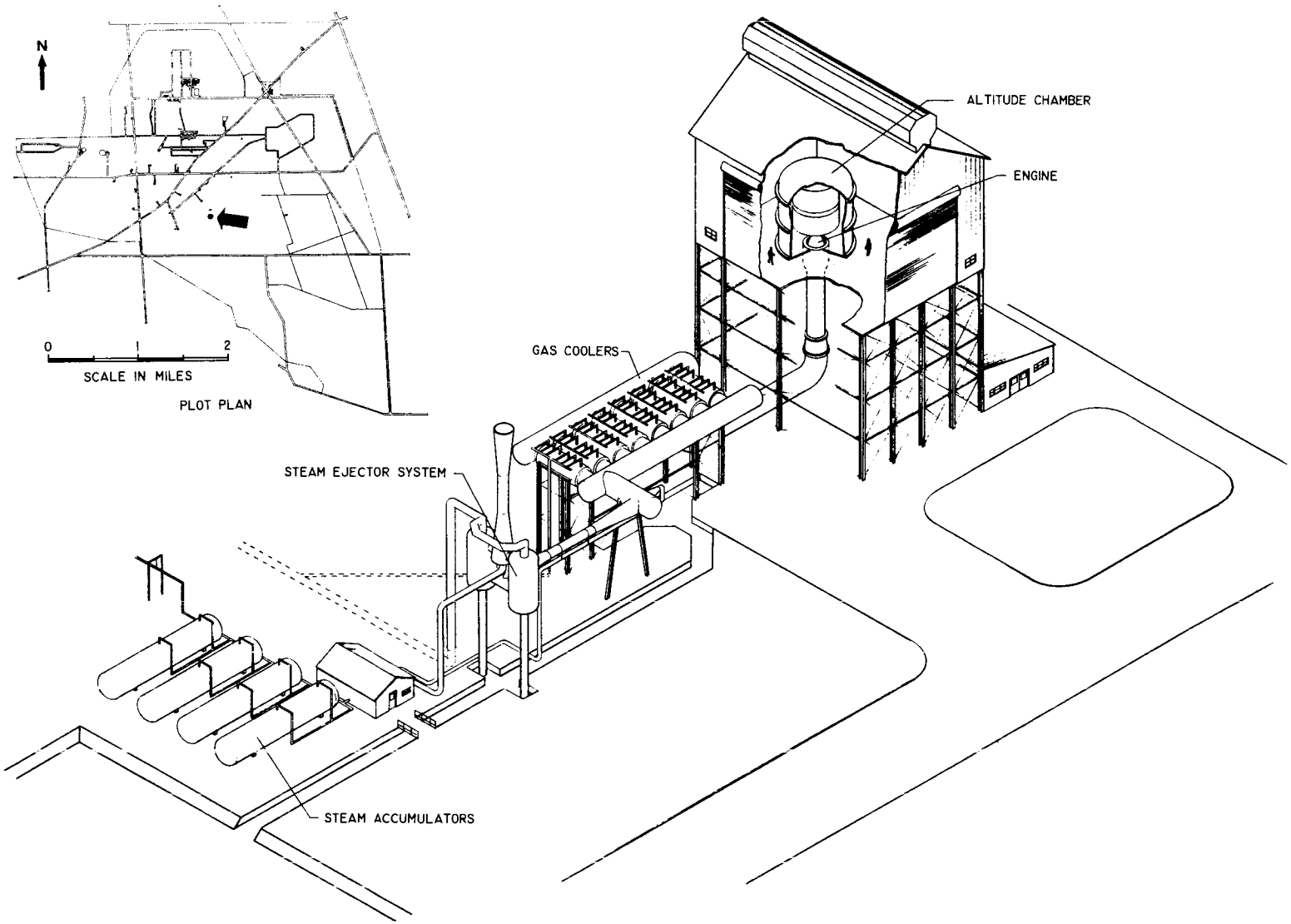
A jacket around the engine and fuel tanks will be cooled with liquid nitrogen to obtain a low temperature environment. Low pressures in the test chamber will be obtained by using a diffuser on the rocket engine exhaust in addition to a multi-stage steam ejector system. The steam boilers associated with the present stand will supply the high pressure steam for the new facility. The steam will be piped to accumulators located at the new site. A new steam ejector system and spray coolers will also be installed. The circulating water system at the existing stand will be increased by adding additional pumps. The water supply and return lines will be extended to the new site.

JUSTIFICATION:

A manned lunar landing mission will require engines with the ability to start instantly upon receipt of the demand for thrust and with control characteristics and response rates which are compatible with landing trajectory requirements. Such engines will use high energy propellants and will be required to start under the very low temperature and pressure conditions existing in space. It will be necessary to study the ignition characteristics and the starting and stopping transients and to develop an ignition system which will give reliable starts under low pressures and after being exposed to very low temperatures for a long time. The guidance and control systems will also require the development of engines in which the thrust can be varied over a wide range to insure "soft" landings and control of the touch-down point.

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

LUNAR PROPULSION RESEARCH FACILITY



The successful accomplishment of the manned lunar mission will ultimately depend upon how well the individual components have been integrated into a reliable propulsion system. It is therefore necessary that the many components, including fuel tankage, propellant delivery system, rocket engines, and controls, be designed so that they operate free from undesirable interactions and as an effective and reliable entirety. Only by testing these components functioning as portions of the complete system can their interactions be accurately determined and a reliable, trouble-free system of adequate performance be developed.

The facility proposed in this project will provide a sufficient simulation of the space conditions to permit the satisfactory development of the lunar landing propulsion system and for the qualification testing of the flight hardware. By the use of significant portions of the existing altitude facility, the construction of the new facility can be accomplished with important savings in cost and on a schedule which will be compatible with the Apollo program requirements.

COST ESTIMATE:

A. LAND ACQUISITION.....		---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS.....		$240,000
Site development.....	$170,000	
Utility connections.....	70,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....		1,352,000
Test stand structure; three floors.. (15,200 square feet at $80.00 per square foot).....	1,216,000	
Pump house addition at existing altitude rocket test stand... (3,200 square feet at $20.00 per square foot).....	64,000	
Control room addition at existing altitude rocket test stand.. (1,600 square feet at $45.00 per square foot).....	72,000	
D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		4,078,000
Exhaust system coolers.....	486,000	
Exhaust system piping, heaters, and expansion joints.....	954,000	
Water system.....	572,000	
Propellant system.....	505,000	
Steam system accumulators.....	700,000	
Steam system piping, valves, and insulation.....	375,000	
Instrumentation and electrical equipment.....	486,000	

E. DESIGN AND ENGINEERING SERVICES.....	$605,000
Total estimated cost....	$6,275,000

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

MODERNIZATION AND RECONDITIONING OF PLUM BROOK SERVICE FACILITIES

DESCRIPTION:

The Lewis Research Center is now operating its Plum Brook Station on a site under lease from the U. S. Army Ordnance Department. Arrangements for permanent transfer of the site are under way. On the site are the facilities of the former Plum Brook Ordnance Works built during World War II as an emergency and temporary installation. After the war, operations were suspended and the installation kept in reserve. The reconditioning of a number of structures and service facilities is now required to provide for their safe utilization by NASA personnel.

This project consists of the alteration and reconditioning of a number of existing buildings; the construction of two small additional buildings; the renovation and extension of rail facilities; the decontamination of certain areas and buildings; the demolition of surveyed buildings and process piping lines; and road extensions and improvements. The location of the proposed work is shown in the sketch on the following page.

JUSTIFICATION:

The construction of NASA facilities at the Plum Brook Station began in 1955. The NASA capital investment at the station is now approximately $40,000,000; the additional projects being proposed in this budget will increase this figure to approximately $75,000,000.

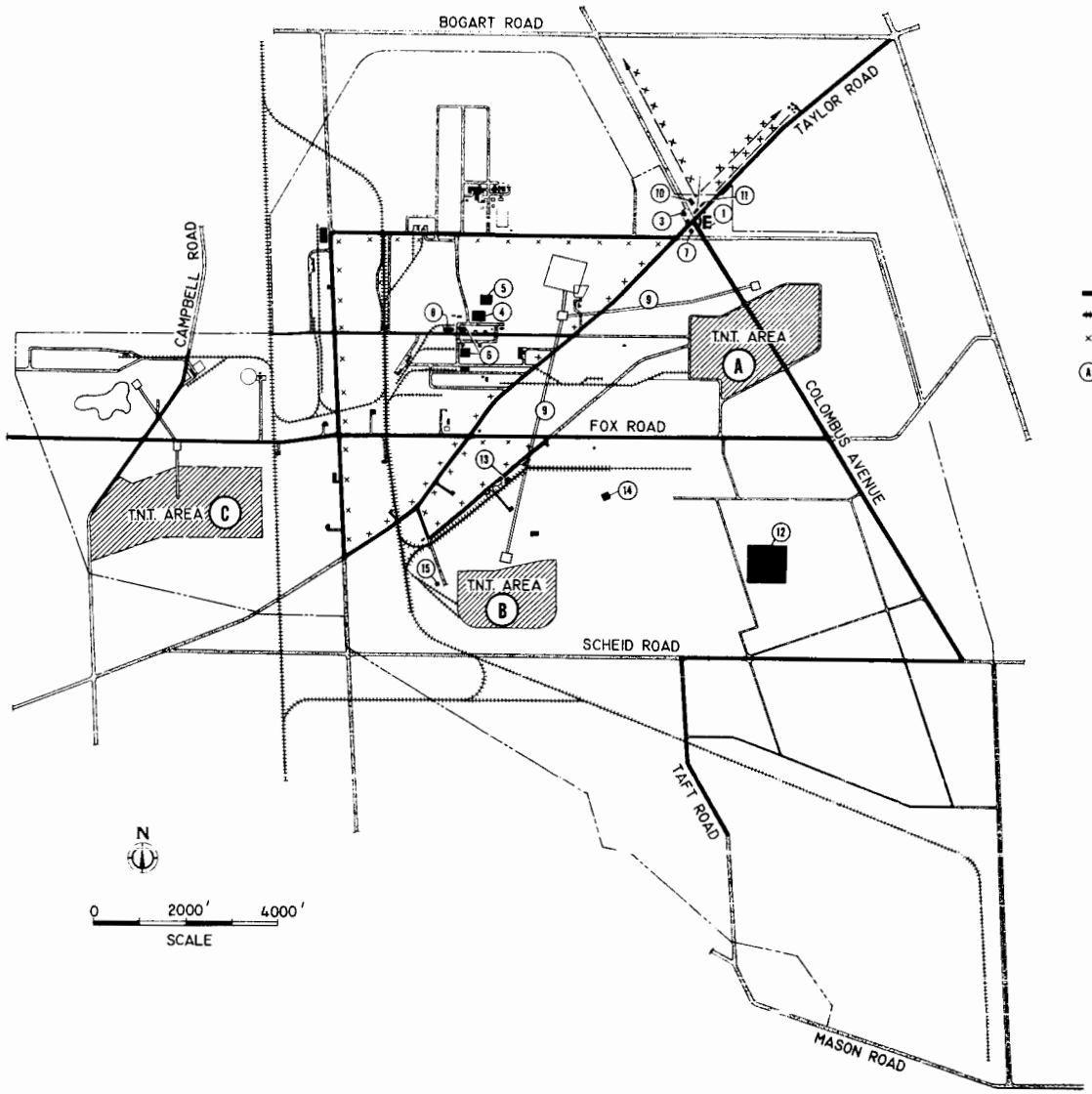
This volume of research facilities must depend for support upon a war-period built facility involving many miles of highway, railroads, underground services, and electrical power services. After more than 20 years of use many of these utility installations are beginning to show volume failures.

To date, NASA activities have mainly involved the construction of facilities for which existing services have not been of critical importance. However, with the completion of many of the facilities now under construction it is a matter of serious concern that services be functional to a high degree of efficiency.

The repair and modernization of utility and service installations must be undertaken promptly. Power failures, breaks in water mains, bad road conditions, and other breakdowns have already caused some delays and postponements in research operations. As more facilities are

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

MODERNIZATION AND RECONDITIONING OF PLUM BROOK SERVICE FACILITIES



ROADS
RAILROAD TRACKS } RECONDITION
UTILITIES

(A) (B) (C) T.N.T. AREAS (DECONTAMINATE AND REMOVE)

(1) ADMINISTRATION BUILDING
(2) HOSPITAL BUILDING
(3) MAIN FIRE STATION
(4) COMBINE SHOP
(5) GARAGE
(6) STORAGE BUILDINGS
} RECONDITION AND ALTER

(7) MAIN GUARD HOUSE
(8) CRYOGENIC SANITARY CLEANING BUILDING } NEW

(9) WASTE DISPOSAL LINES 19000 LIN. FT. (DECONTAMINATE)

(10) BOILER HOUSE
(11) OLD HOSPITAL BUILDING } DEMOLISH

OTHER PROPOSED FISCAL YEAR 1963 FACILITIES

(12) SPACE PROPULSION FACILITY
(13) NUCLEAR ROCKET DYNAMICS AND CONTROLS FACILITY
(14) LUNAR PROPULSION RESEARCH FACILITY
(15) HYDROGEN HEAT TRANSFER FACILITY

put into service it can be expected that these interruptions will increase until the protective remedies proposed in this project are completed. The significant improvements being proposed are discussed below:

Buildings:

Working space is needed for the additional administrative, service, and research personnel being added to the staff of the Plum Brook Station. Additional space is also needed to house military and contractor personnel participating in research projects being conducted at Plum Brook. No suitable space is available to take care of increased requirements for office space. The reconditioning of an existing administration building will meet these needs.

The hospital building requires renovation. The project includes new floor tile, painting, acoustical ceiling, and lighting for this building. The main fire station also requires renovation. The work to be performed will consist of repairs to the floors and ceiling, and to the lighting, heating, and communications systems.

The combine shop provides space for shipping, receiving, fabrication, maintenance, pipefitting and carpentry services. Repairs will be made to plumbing, drainage, roofing, and electrical systems. Repairs at the garage are required for the water, heating, and lighting facilities, and to the building structure. A new vehicle lift will also be installed. Storage buildings must be renovated to provide space for the storage of stock supplies and equipment. As the use of the facilities at Plum Brook increases it is necessary to provide additional storage capability.

A new main guard house is needed to provide an adequate facility for security purposes and to serve as a control center for communications during emergencies. The cryogenic sanitary cleaning building is required to provide sterile and controlled atmospheric conditions for the cleaning of dewars, tanks, vessels, and engine components. Foreign material in any part of a test installation can result in explosive reactions.

Utility Systems:

The reconditioning and extension of all major utility systems are needed to provide operational reliability. The reactor requires a reliable source of raw water in large quantities; the water reservoir and pumping facilities must be renovated and extended to insure the required reliability. Improvements to gas and steam distribution lines; to sanitary and storm sewers; and to the electrical and communication systems are required to meet an increasing demand for services and as a matter of good business practice.

Railroad trackage:

The renovation and extension of rail facilities will permit the shipment of tank car quantities of helium and liquid hydrogen directly to the user facilities. At present only trailer deliveries can be made. The use of rail facilities will result in lower operating costs and longer uninterrupted test runs, and will help insure that adequate supplies of helium and hydrogen are available to maintain research schedules.

Decontamination, demolition, and removal:

The decontamination of several areas is required to utilize the sites for construction purposes. Several underground TNT waste disposal lines must also be decontaminated and removed as they represent a potential hazard for explosion. Buildings which have been surveyed and overhead abandoned process piping and poles represent a hazard to personnel. The project includes their demolition and removal.

Road extension and improvement:

The existing roadway network consists of narrow country-type roads constructed of a waterbound base with either a bituminous surface treatment (penetration) or bituminous concrete surface. The road system must now be improved to provide for adequate and safe transportation and for off-road parking facilities for hazardous gases and cryogenic liquids in dewars and tube trailers. The recommended road improvements will provide the necessary widths, load bearings, and safety features for the transportation of the large dewars and tube trailers needed by the rocket systems research facilities.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$ 975,000
	Reconditioning and extension of utility systems	$400,000	
	Railroad repairs	25,000	
	Repair and extension of roads	110,000	
	Decontamination and demolition	440,000	
C.	FACILITY CONSTRUCTION AND MODIFICATIONS		458,000

Reconditioning of administration building	$203,000
Reconditioning of hospital.....	8,000
Reconditioning of main fire station	5,000
Reconditioning of combine shop	60,000
Reconditioning of garage	35,000
Reconditioning of storage buildings	70,000
New main guard house	12,000
New cryogenic sanitary cleaning facility.	65,000

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS..... ---

E. DESIGN AND ENGINEERING SERVICES 75,000

Total estimated cost $1,508,000

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

NUCLEAR ROCKET DYNAMICS AND CONTROLS FACILITY

DESCRIPTION:

This project consists of modifications and improvements to the existing altitude rocket test stand (B-1) at the Plum Brook Station to permit continued experimental investigations of a wide range of important research problems concerning the dynamics and control of nuclear rocket propulsion systems. The reactor performance will be simulated by an analog computer acting on inputs from neutron sensors (or other instrumentation) and by controlling valves and other system components. Primary research equipment will be provided by a propellant tank, a turbodrive unit, suitable lines and controls, and by pertinent reactor parts such as a reflector, a pressure shell, a simulated core, and an exhaust nozzle. A gas generator system and heat exchanger system will provide proper drive power for the turbine, thus allowing study of various nuclear engine cycles. Expansion of the existing instrumentation and improvements in the altitude pumping system will also be made.

The facility will require service from a new 50,000 KVA electric power substation included in this project. This improvement in electric power service is required because of the increasing demands of existing and contemplated facilities. In the nuclear rocket program this power improvement will provide appropriate heating of the engine reflector so that a wide range of engine start-up dynamics may be investigated. A 138,000 volt transmission line will be constructed by the electric power utility company and terminated at the new substation. The substation will include automatic voltage regulating transformers, switch gear, controls, metering, and protective equipment to provide 34,500 volt electric power for distribution to existing and new facilities at the Plum Brook Station. The existing 34,500 volt distribution system will be modified to obtain maximum reliability and utilization of the over-all electric power system.

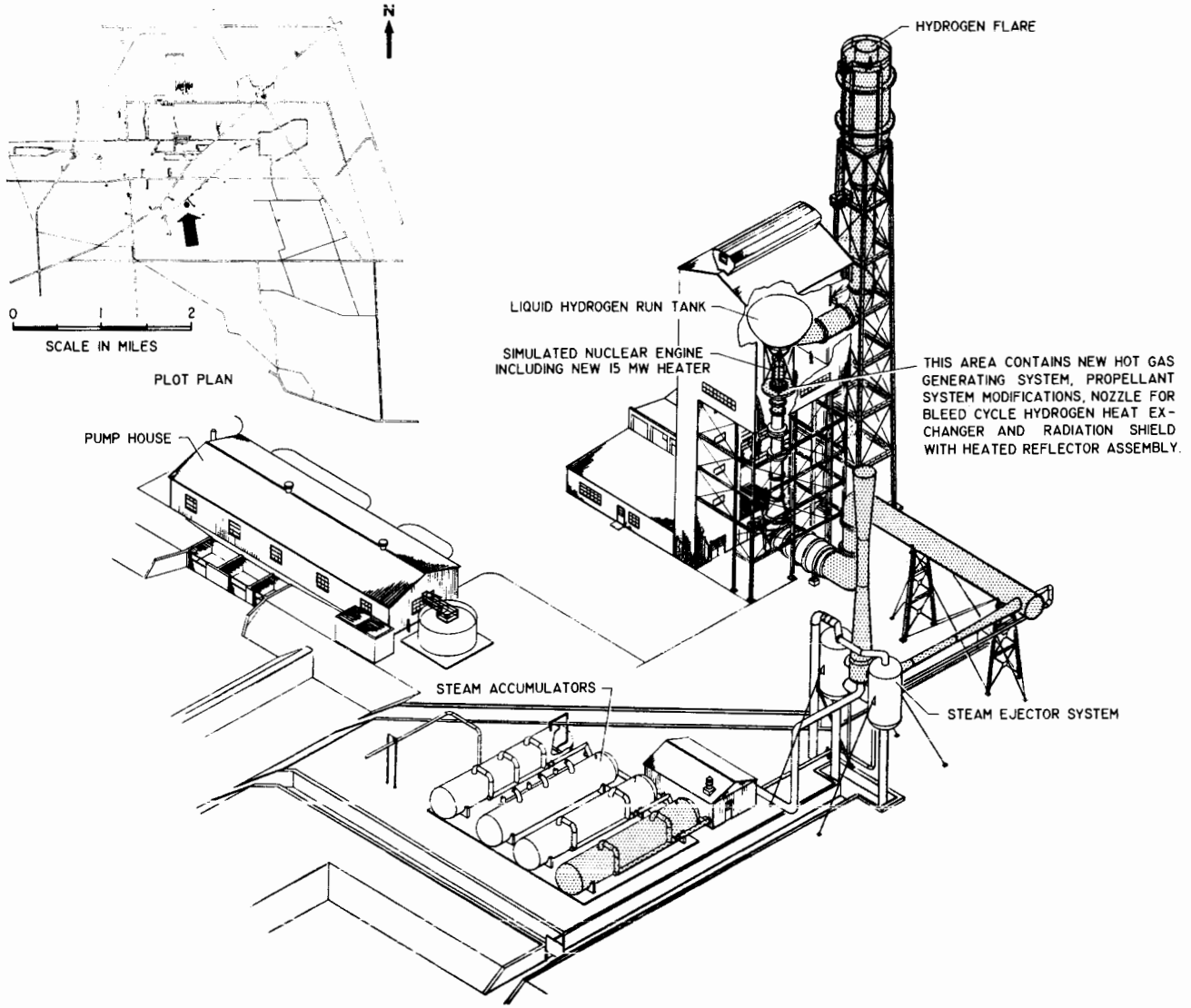
A sketch of the proposed facility is shown on the following page.

JUSTIFICATION:

All studies of future space propulsion requirements reveal the importance of the nuclear rocket. The studies further indicate that the nuclear rocket must be a highly sophisticated device, capable of operational flexibility, reliability, and sufficient performance versatility to adapt to many missions. The engine must be capable of zero-g starts and restarts, it must be throttleable, able to perform retro or landing maneuvers, and capable of powering manned vehicles. Relative to these ultimate objectives, current research facilities, research programs, and hence our current knowledge of engine design and operation, are in a very rudimentary state.

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

NUCLEAR ROCKET DYNAMICS AND CONTROLS FACILITY



To advance the technology of nuclear propulsion will require considerable research in new and expanded facilities. As far as component research is concerned, the Plum Brook rocket systems research facility and the proposed fiscal year 1963 project for a hydrogen heat transfer facility will provide capability for the immediate future. The nuclear rocket engine is, however, a very complex and highly interrelated device wherein the various influences of one component or process on all of the others in the engine very strongly dictate both individual component requirements and the basic design, operation, and performance requirements of the total system. Some examples of these overriding and critical research problems are the following:

(a) A primary difficulty lies in the adaptation of the propellant feed system to the reactor transient and control requirements. The fluid pumping cycle must be controllable from both a hydrodynamic and a nuclear standpoint to assure quick, safe start-up and shut-down transients. Several possible turbodrive cycles (gas generator, bleed, and topping) must be investigated to establish both the suitability of currently envisaged systems to present reactor designs, and a rational basis for a selection of components and pumping systems for future engines. Reactor designs with and without radiation shields will be investigated.

(b) The achievement of satisfactory engine start-ups is a particularly difficult research problem. The transient heat transfer in the reactor, which couples reactor power with reactor flow, produces appreciable thermal lags that have a strong influence on the turbopump and propellant flow acceleration and on the engine control system. These reactor heat transfer kinetics must also be related to reactor nucleonics and to the rest of the system to determine proper gas temperature schedules during startup.

(c) Inadvertent injection of liquid hydrogen into the reactor core can cause an uncontrolled increase in reactor power. Sufficient heat capacity must therefore exist in the reflector and engine cooling passages to assure complete vaporization of the liquid hydrogen without instabilities in the flow control. Analyses of these complex processes require experimental investigations of unsteady and discontinuous boiling of liquid hydrogen in the several components of the fluid system and under the flow control of the fluid system.

(d) Pressurization of liquid by hydrogen gas - a system of considerable advantage - imposed many problems of control and stability of the pressurization system.

(e) Future nuclear rockets will probably utilize multiple pump-turbine combinations. Important research problems concerning the stability of flow and proportioning of loads upon the several turbopumps and on their controls for safe operation are thereby introduced.

(f) The off-design operation requirements introduced by throttled, or part load, power outputs force all of the components into regions of limited performance or unsafe operation depending upon the mutually interacting flow, heat transfer, energy input, and energy extraction characteristics of the various parts of the system.

Most of the above problem areas involve or are closely related to reactor characteristics, both steady state and in transient. To investigate the basic nature and to develop solutions for all of these problems with a complete system that includes a nuclear reactor will, however, be extremely difficult if not impossible. Fortunately, reactor flow impedance and nuclear kinetics can be simulated by analog representations and the reactor effects adequately reproduced in the flow and control system by suitable valves and sensors. What is needed is an improved research facility in which the principal components of a propellant delivery system are coupled to simulated reactors and the many non-nuclear system and control problems experimentally investigated without the large cost, hazard, time, and effort involved with a nuclear environment. The facility modifications and improvements of this proposal will provide this unique and essential research capability.

The present electrical service at the Plum Brook Station consists of two 34,500 volt circuits provided by the electric power utility company. These two circuits are of limited capacity and are just sufficient to serve the existing facilities. In the event of difficulty with either service, or outages for maintenance work, it may be necessary to curtail operations in parts of the Plum Brook site other than the reactor.

The 1963 construction program proposes two new facilities at the Plum Brook Station which have large power requirements, a space propulsion facility and the nuclear rocket dynamics and controls facility discussed in this project writeup. It is estimated that these two projects will require 10,000 KVA and 20,000 KVA respectively. The existing electrical services do not have sufficient capacity to supply this additional load. The installation of a new 50,000 KVA substation will provide additional reliability to the power supply for the existing facilities and will add the necessary capacity for the proposed new facilities. The new substation will include a reasonable additional capacity for future loads.

COST ESTIMATE:

A.	LAND ACQUISITION		---
B.	SITE DEVELOPMENT AND UTILITY INSTALLATIONS		$960,000
	34,500 volt power lines	$50,000	
	50,000 KVA substation	710,000	
	20,000 KVA step-down substation.....	200,000	

C.	FACILITY CONSTRUCTION AND MODIFICATIONS.....		---
D.	EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....		$2,423,000
	Hot gas generator system	$234,000	
	Analog computer.....	295,000	
	Steam system	195,000	
	Instrumentation	95,000	
	Electric heater elements	150,000	
	Electric heater control system	700,000	
	Propellant system modification and hydrogen dewar.....	214,000	
	Nozzle for bleed cycle	80,000	
	Hydrogen heat exchanger	100,000	
	Radiation shield and heated reflector assembly.....	360,000	
E.	DESIGN AND ENGINEERING SERVICES.....		117,000
	Total estimated cost		$3,500,000

LEWIS RESEARCH CENTER

FISCAL YEAR 1963 ESTIMATES

SPACE PROPULSION FACILITY

DESCRIPTION:

The unique capabilities of the proposed space environment facility will permit the evaluation and development testing of complete advanced power generation and electric propulsion systems. Startup, power change and shutdown transients, system control and component interactions will be determined. The components of these systems will include a flight-type nuclear reactor, turbo-electric power generation systems, radiator or condenser with associated heat exchangers, pumping and control equipment, and electro-static or electro-magnetic rocket engines.

One end of the facility will house an operating nuclear reactor and will be heavily shielded to protect the adjacent chamber and surrounding area from radiation. Separating the two areas will be either a flight-weight shadow shield for control system and transient investigations or a fully protective shield for endurance studies. The two chambers will have independent pumping systems to avoid contamination of the large tank in case of failure of any of the radioactive components.

Integral with the nuclear reactor chamber will be a heavily shielded maintenance, assembly, and disassembly area which will have provision to service the power generation unit as well as the reactor. Remotely operated mechanical hands and tools will be provided for model repair or complete disassembly and encapsulation following completion of an investigation. This provision in relation to existing environmental chambers gives the facility its uniqueness.

The non-nuclear portion of the chamber will be constructed of stainless steel and will be capable of maintaining at least 10^{-6} mm Hg pressure. The walls will be cooled by modular type baffles to temperatures ranging from 70°F. to -320°F. as required. Cryo-pumping of the electric rocket exhaust will be accomplished with liquid nitrogen baffles (-320°F.) and local areas will be cryo-pumped with gaseous helium to -450°F.

The building to house the facility will be approximately 100 x 350 feet and will extend about 60 feet above grade level. The building will contain the space environment chamber, the pumping and power supplies area, a shop and model assembly area, a control room, and the hot disassembly area. A water cooling tower and nitrogen storage tanks

will be located adjacent to the facility building. A two-story office building will be attached to one end of the larger building. The facility will be located at the Lewis Research Center's Plum Brook station. Sketches and location drawings of the facility are presented on the following two pages.

The facility design will include the versatility required for adding in the future a radiant heat source, made of quartz tubes and/or an arc source to simulate the magnitude and spectrum of solar radiation. Further, capacity for lunar, earth, or other planetary albedo simulation will also be incorporated into the design. In conjunction with the modular baffles, such an installation would permit the simultaneous study of extremes of hot and cold on two sides of the vehicle in space.

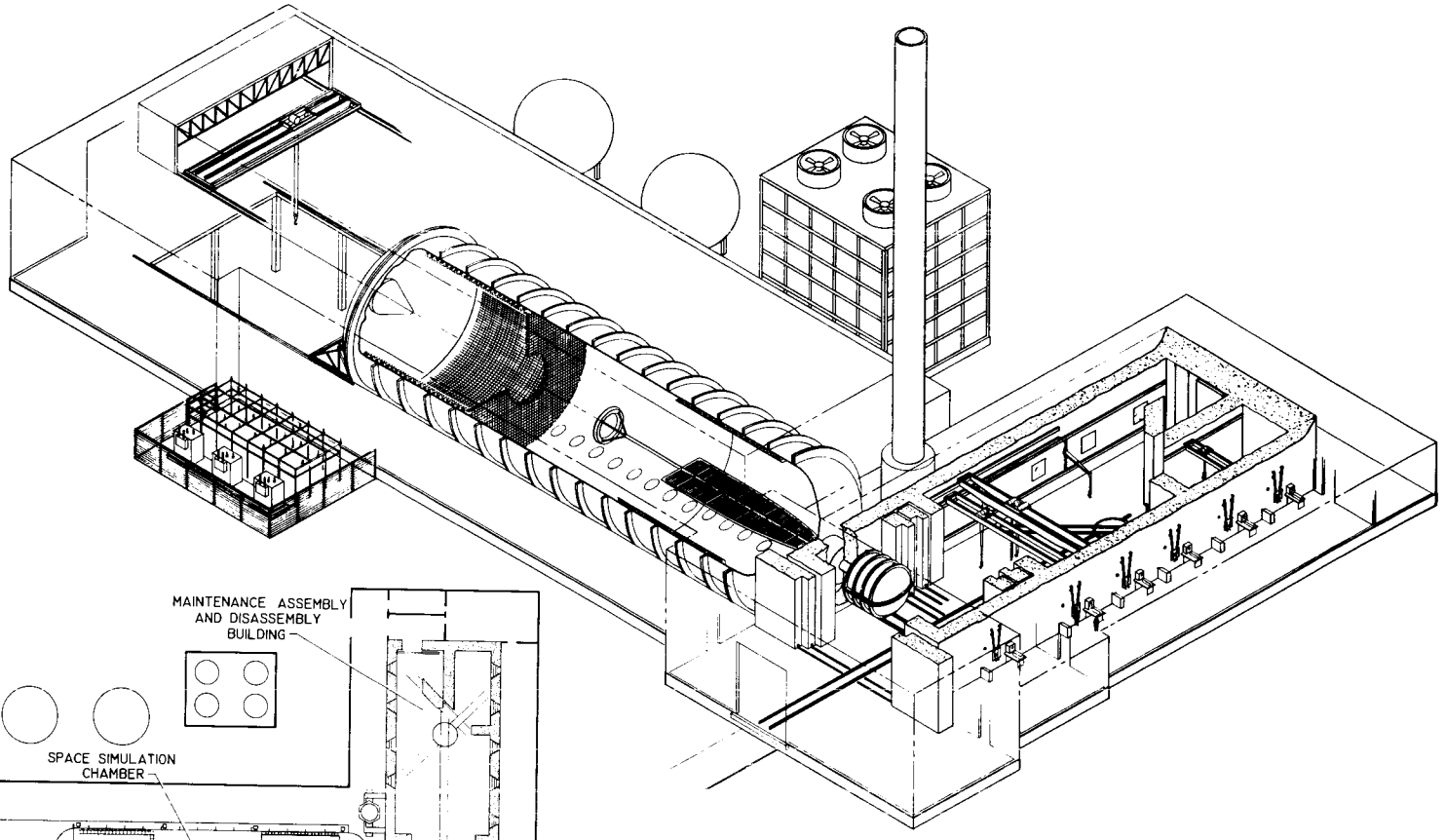
JUSTIFICATION:

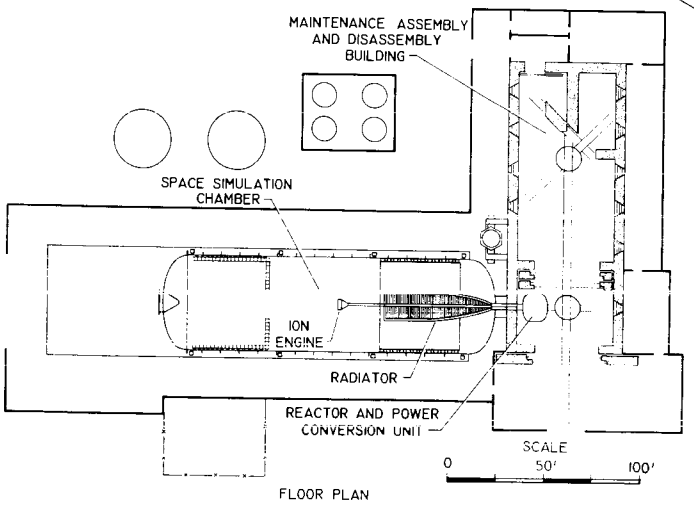
This nation's advanced propulsion and power generation units currently under construction or in the design stage must be capable of executing complex modes of operation with assurance of complete reliability after exposure to space environment for extended periods of time. The proposed facility will be unique in that it will be capable of investigating a complete operating nuclear system. The facility is essential to the successful accomplishment of advanced space programs. It will: (1) reduce the time required for development and evaluation to a small fraction of that required by flight testing alone; (2) allow direct observation of the operating system and enable more detailed measurements to be made compared to a flight program; and (3) greatly enhance the delineation and solution of problem areas for the various components of the system from both performance and reliability aspects. To illustrate, the Snap-8 power generation system cannot be successfully developed by flight testing alone. The components of this system, the nuclear reactor heat source, the primary and secondary heat transfer loops, the liquid metal pumps, the liquid metal turbine, and the condensing radiator must all operate compatibly in a space environment not only during steady state conditions but during all the transient operations each component performs during system startup. A malfunction of any of the sequence of operations involved in each component during startup negates a whole flight test. As has been demonstrated repeatedly in past project development programs, ground-based facilities are essential; the cost saved in time and money by eliminating a single failure in the flight program may more than repay the cost of the entire facility.

Although the various components, such as the nuclear reactor, boiler, radiator, and accelerator, which make up a complete operating nuclear system will be investigated as components, no other facility will be capable of investigating the interactions of the various components on each other. These interactions can seriously affect the

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

SPACE PROPULSION FACILITY

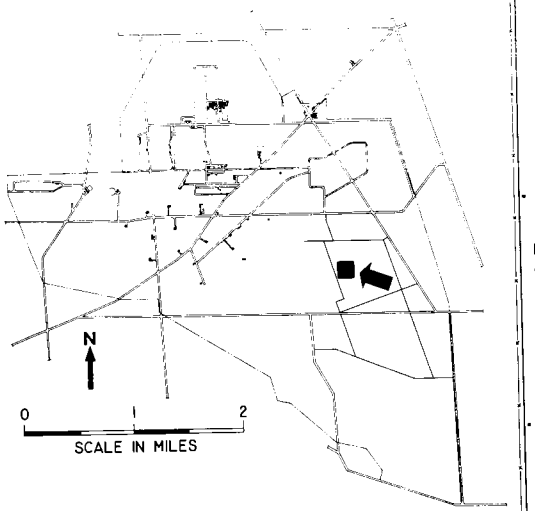




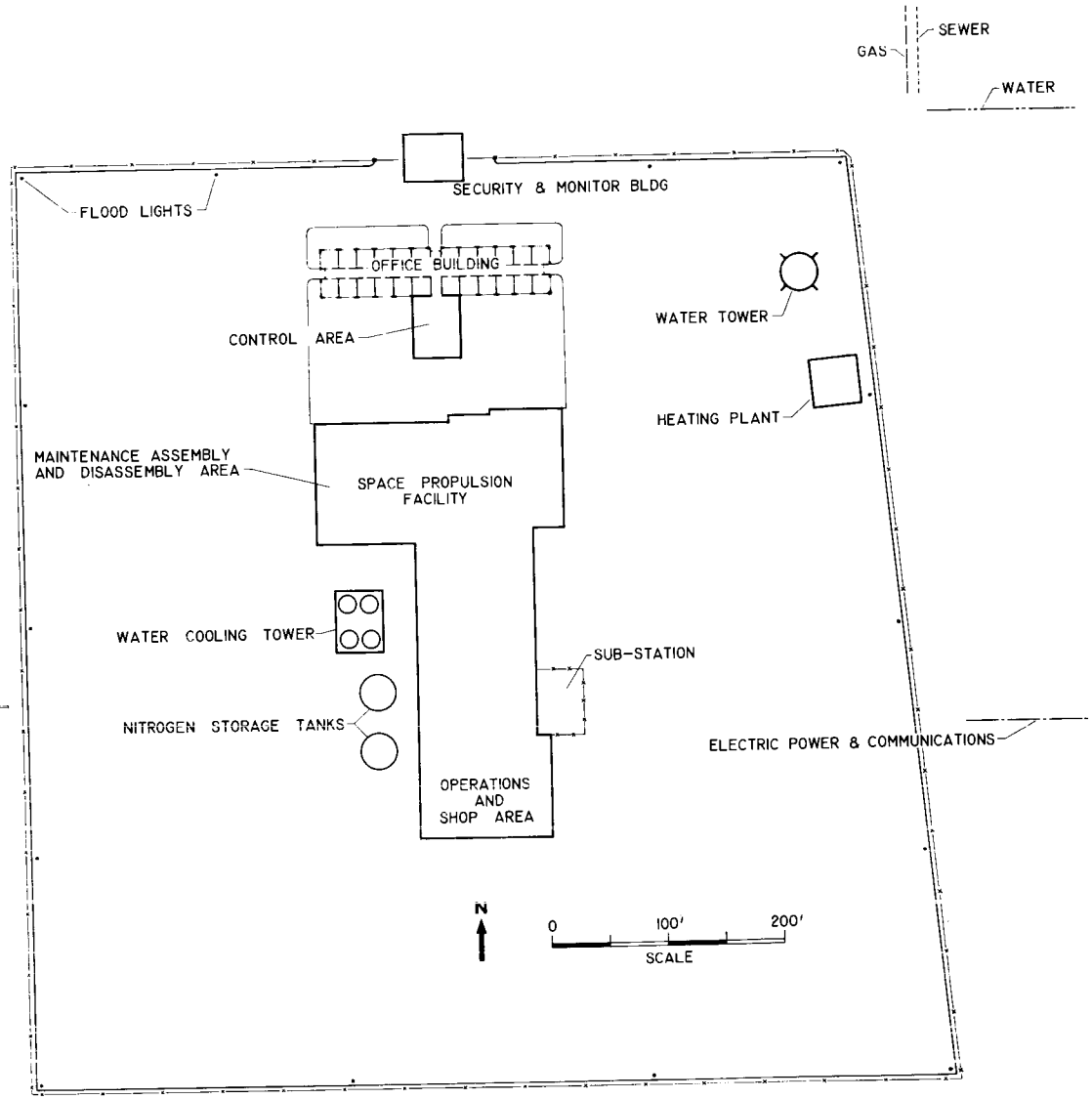
FLOOR PLAN

LEWIS RESEARCH CENTER
FISCAL YEAR 1963 ESTIMATES

SPACE PROPULSION FACILITY



PLOT PLAN



system performance, dynamic control characteristics and operational startup and shutdown procedures. For example, the dynamic characteristics of the reactor startup (which may have to be accomplished in flight for the actual vehicle) must be matched to the introduction, pumping, and control of the liquid metal heat transfer working fluid. The primary fluid in turn affects the heat exchanger and the method and control of startup of the secondary loop liquid metal fluid. Power level changes or shutdown transients affect all components to degrees that can only be crudely estimated until the actual operation.

The facility must be available to accomplish the development of both the Snap-8 power generation system and the electric propulsion system based on this unit. Construction of the proposed facility should therefore be started early in the fiscal year 1963. Engineering and design funds for those portions of the facility which must be planned first have therefore been allocated in the fiscal year 1962.

During and after completion of the development of propulsion systems on the Snap-8 level, the proposed facility will be used for more advanced systems, at ion beam power levels greater than the Snap-8 capabilities, and for work on major components of the more powerful systems that will be needed for manned interplanetary vehicles.

COST ESTIMATE:

A. LAND ACQUISITION			---
B. SITE DEVELOPMENT AND UTILITY INSTALLATIONS			$2,027,000
Site development		$761,000	
New roads and repair of existing roads	$401,000		
Railroad spur to site	75,000		
Drainage, open and underground	211,000		
Demolition, cleanup, grading and filling	65,000		
Walks and landscaping	9,000		
Electrical installations		800,000	
34,500-volt power supply	110,000		
Step-down substation	70,000		
Low-voltage transformers, switch-gear, and power distribution	520,000		
Control and metering systems	20,000		
Telephone and communication systems	80,000		

Water, sewer, and gas installations.....		$420,000	
Water tower.....	125,000		
Water lines.....	75,000		
Gas lines.....	65,000		
Sewers.....	155,000		
Steam distribution system.....		46,000	
C. FACILITY CONSTRUCTION AND MODIFICATIONS.....			7,109,000
Space propulsion facility (main structure).....		5,563,000	
Maintenance, assembly, and disassembly area; 210 feet by 100 feet(21,000 square feet at $190 per square foot).....	3,990,000		
Operations and shop area; 110 feet by 260 feet (28,600 square feet at $55 per square foot).....	1,573,000		
Nuclear shield and load supports.....		900,000	
Office and control building.....		530,000	
Office area; 30 feet by 200 feet; 2 stories plus half basement..... (15,000 square feet at $22 per square foot).....	330,000		
Control area; 50 feet by 50 feet; 1 floor plus basement...(5,000 square feet at $40 per square foot).....	200,000		
Security and monitor building; 40 feet by 50 feet; one floor...(2,000 square feet at $18 per square foot).		36,000	
Heating plant.....		80,000	
Building; 40 feet by 40 feet... (1,600 square feet at $15 per square foot)....	24,000		
Boilers.....	56,000		

D. EQUIPMENT, INSTRUMENTATION, AND SUPPORT SYSTEMS.....			$14,239,000
Cryogenic and other cooling systems....		$4,370,000	
Electric engine propellant condensing system utilizing liquid nitrogen ...(Approximately 80,000 square feet at $29 per square foot).....	2,320,000		
Ion engine water cooled target system, including water tower.....	600,000		
Heat rejection system for Snap-type condenser.....	700,000		
Space temperature environment system for payloads.....	750,000		
Vacuum tanks.....		4,000,000	
Space simulation chamber; 50 feet in diameter by 150 feet long...(830 tons at $4,200 per ton)	3,500,000		
Special hatches, flanges, and vacuum pump nozzles.....	260,000		
Chamber for reactor and power conversion unit; 18 feet in diameter and 22 feet long... (60 tons at $4,000 per ton).....	240,000		
Pumping systems.....		2,400,000	
Cryogenic pumps, controls, piping, and filters for reactor area.....	1,100,000		
Cryogenic pumps for electric engine exhaust, nonnuclear area.....	800,000		
Helium pumps.....	500,000		
Instrumentation and controls.....		1,400,000	
Data acquisition instrumentation	500,000		
Control systems and programmers.....	600,000		
Consoles, recorders, and digitizers.....	300,000		

Water treatment system.....	$475,000	
Safety and radioactivity monitoring equipment.....	169,000	
Cranes.....	175,500	
Special foundations for equipment.....	150,000	
Decontamination equipment.....	33,500	
Mechanized entry doors.....	300,000	
Slavemasters and manipulators.....	616,000	
Special tools for shop in hot area.....	150,000	
E. DESIGN AND ENGINEERING SERVICES..... (An additional $175,000 has been allocated from fiscal year 1962 funds)		$2,125,000
Total estimated cost.....		$25,500,000