

*National Aeronautics  
and Space Administration*

---

**BUDGET ESTIMATES**



**FISCAL YEAR 1972**  
**Volume III**

**CONSTRUCTION OF FACILITIES**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

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

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

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

SPACE APPLICATIONS: No projects for 1972.

SPACE RESEARCH AND TECHNOLOGY: No projects for 1972.

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

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

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1972 ESTIMATES

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

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1972 ESTIMATES

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

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

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

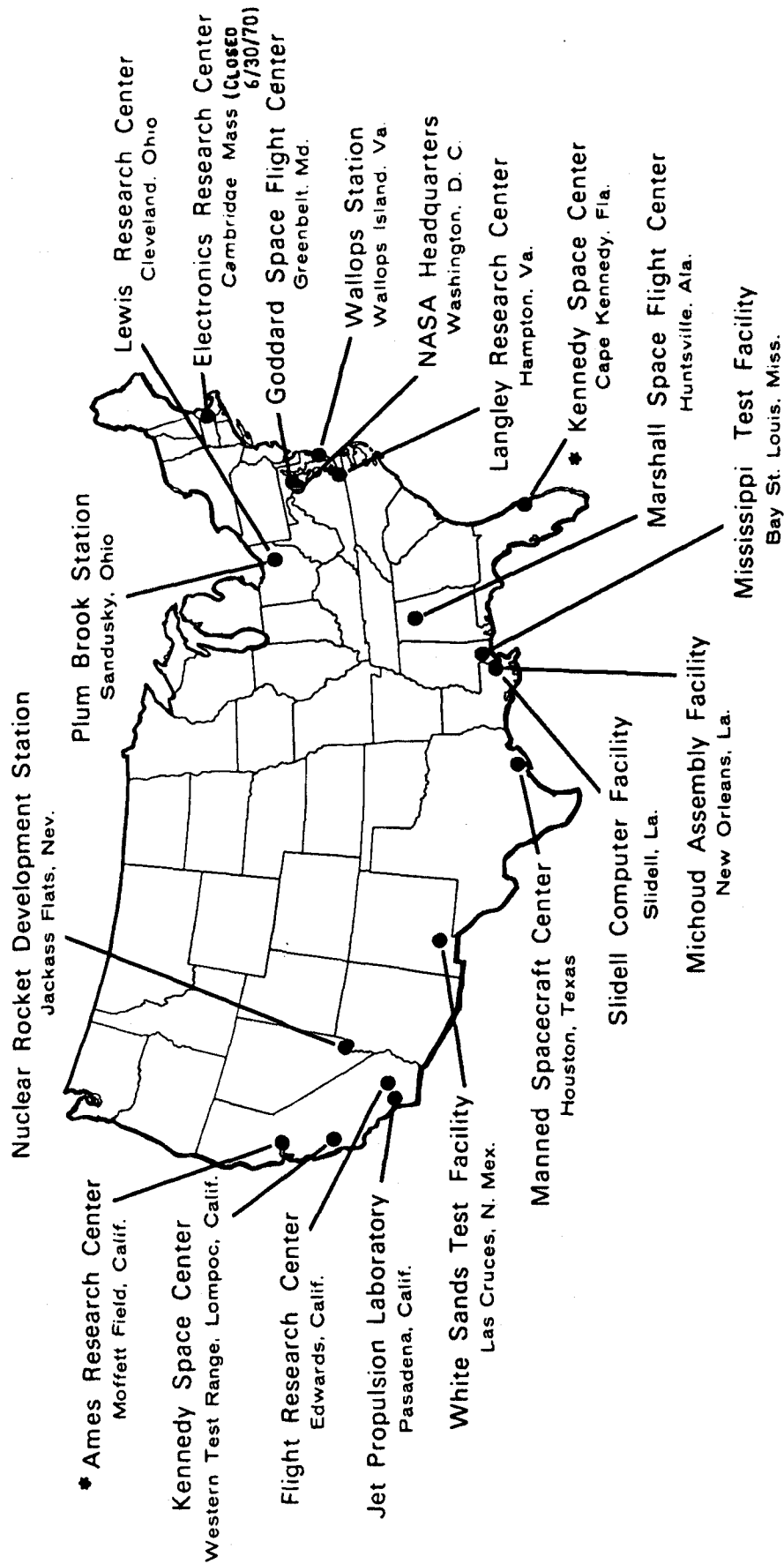
## FISCAL YEAR 1972 ESTIMATES

### SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

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

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

# NASA INSTALLATIONS



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

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

| Reporting Installation                            | Real Property  |                  |                                 |                        | Total            | Equipment <sup>3/</sup> | Fixed Assets in Progress | Grand Total      |
|---------------------------------------------------|----------------|------------------|---------------------------------|------------------------|------------------|-------------------------|--------------------------|------------------|
|                                                   | Land           | Buildings        | Other Structures and Facilities | Leasehold Improvements |                  |                         |                          |                  |
| <b>OFFICE OF MANNED SPACE FLIGHT</b>              | <b>112,012</b> | <b>731,073</b>   | <b>750,393</b>                  | <b>---</b>             | <b>1,593,678</b> | <b>1,191,479</b>        | <b>24,429</b>            | <b>2,809,586</b> |
| Kennedy Space Center                              | 72,173         | 285,847          | 415,583                         | ---                    | 773,603          | 222,097                 | 9,448                    | 1,005,148        |
| KSC - Florida                                     | 72,173         | 285,847          | 415,583                         | ---                    | 773,603          | 74,515                  | 9,448                    | 857,566          |
| Western Test Range Operations                     | ---            | ---              | ---                             | ---                    | ---              | 3,832                   | ---                      | 3,832            |
| Division Longac, California                       | ---            | ---              | ---                             | ---                    | ---              | 143,750                 | ---                      | 143,750          |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| Manned Spacecraft Center                          | 9,029          | 172,787          | 53,158                          | ---                    | 234,974          | 500,607                 | 12,998                   | 748,579          |
| MSC - Houston, Texas                              | 5,459          | 138,756          | 29,749                          | ---                    | 173,964          | 207,624                 | 12,998                   | 394,586          |
| White Sands Test Facility                         | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| WSTF - Las Cruces, New Mexico                     | ---            | 8,712            | 17,797                          | ---                    | 26,509           | 28,346                  | ---                      | 54,855           |
| Various Locations <sup>1/</sup>                   | 3,570          | 25,319           | 5,612                           | ---                    | 34,501           | 264,637                 | ---                      | 299,138          |
| Marshall Space Flight Center                      | 30,810         | 272,439          | 281,852                         | ---                    | 585,101          | 468,775                 | 1,983                    | 1,055,859        |
| MSFC - Huntsville, Alabama                        | 95             | 111,324          | 48,501                          | ---                    | 159,920          | 221,967                 | 1,832                    | 383,719          |
| Michoud Assembly Facility                         | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| MAF - New Orleans, Louisiana                      | 7,504          | 63,908           | 25,361                          | ---                    | 96,773           | 40,694                  | 151                      | 137,618          |
| Mississippi Test Facility                         | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| MTF - Bay St. Louis, Mississippi                  | 19,648         | 65,673           | 168,249                         | ---                    | 253,570          | 23,201                  | ---                      | 276,771          |
| Slidell Computer Facility                         | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| SCF - Slidell, Louisiana                          | 63             | 4,450            | 823                             | ---                    | 5,336            | 16,920                  | ---                      | 22,256           |
| Various Locations <sup>1/</sup>                   | 3,500          | 27,084           | 38,918                          | ---                    | 69,502           | 165,993                 | ---                      | 235,495          |
| <b>OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY</b> | <b>7,454</b>   | <b>529,965</b>   | <b>219,616</b>                  | <b>140</b>             | <b>757,175</b>   | <b>426,706</b>          | <b>40,334</b>            | <b>1,224,215</b> |
| Ames Research Center                              | 2,374          | 170,901          | 3,302                           | 1                      | 176,578          | 73,617                  | 6,022                    | 256,217          |
| ARC - Moffett Field, California                   | 2,374          | 170,763          | 3,288                           | ---                    | 176,425          | 69,526                  | 6,022                    | 251,973          |
| Various Locations <sup>1/</sup>                   | ---            | 138              | 14                              | 1                      | 153              | 4,091                   | ---                      | 4,244            |
| Electronics Research Center <sup>2/</sup>         | 1,573          | 18,468           | 1,716                           | ---                    | 21,757           | 28,253                  | 567                      | 50,579           |
| ERC - Cambridge, Massachusetts                    | 1,573          | 18,468           | 1,716                           | ---                    | 21,757           | 28,253                  | 567                      | 50,579           |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| Flight Research Center                            | ---            | 7,726            | 2,222                           | ---                    | 9,948            | 52,914                  | 366                      | 63,228           |
| PRC - Edwards, California                         | ---            | 7,726            | 2,222                           | ---                    | 9,948            | 50,347                  | ---                      | 60,661           |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | 2,567                   | ---                      | 2,567            |
| Langley Research Center                           | 116            | 121,891          | 143,935                         | ---                    | 265,982          | 122,671                 | 14,335                   | 402,968          |
| LaRC - Hampton, Virginia                          | 110            | 106,521          | 143,930                         | ---                    | 250,561          | 112,909                 | 14,335                   | 377,805          |
| Various Locations <sup>1/</sup>                   | 6              | 15,370           | 25                              | ---                    | 15,401           | 9,762                   | ---                      | 25,163           |
| Lewis Research Center                             | 3,391          | 191,979          | 61,493                          | 139                    | 257,002          | 122,032                 | 19,017                   | 398,051          |
| LeRC - Cleveland, Ohio                            | 322            | 112,400          | 39,947                          | 139                    | 152,808          | 56,993                  | 11,399                   | 221,200          |
| Plum Brook Station                                | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| PBS - Sandusky, Ohio                              | 2,970          | 75,415           | 17,895                          | ---                    | 96,280           | 11,417                  | 7,618                    | 115,315          |
| Various Locations <sup>1/</sup>                   | 99             | 4,164            | 3,651                           | ---                    | 7,914            | 53,622                  | ---                      | 61,536           |
| Space Nuclear Propulsion Office                   | ---            | 19,000           | 6,928                           | ---                    | 25,928           | 27,217                  | 27                       | 53,172           |
| NRDS - Jackass Flats, Nevada                      | ---            | 19,000           | 6,928                           | ---                    | 25,928           | 4,351                   | 23                       | 30,302           |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | 22,866                  | 4                        | 22,870           |
| <b>OFFICE OF SPACE SCIENCE AND APPLICATIONS</b>   | <b>3,779</b>   | <b>163,372</b>   | <b>134,407</b>                  | <b>723</b>             | <b>302,281</b>   | <b>648,250</b>          | <b>20,095</b>            | <b>970,626</b>   |
| Coddard Space Flight Center                       | 1,640          | 87,283           | 62,798                          | 303                    | 152,024          | 474,147                 | 2,623                    | 628,794          |
| CSFC - Greenbelt, Maryland                        | 1,301          | 69,704           | 13,080                          | 299                    | 84,384           | 158,623                 | 2,623                    | 245,630          |
| Tracking Stations (Excl DSNS) <sup>4/</sup>       | 339            | 17,491           | 49,673                          | ---                    | 67,503           | 270,966                 | ---                      | 338,469          |
| Various Locations <sup>1/</sup>                   | ---            | 88               | 45                              | 4                      | 137              | 44,558                  | ---                      | 44,695           |
| Jet Propulsion Laboratory                         | 1,067          | 53,864           | 28,401                          | 420                    | 83,752           | 131,587                 | 16,129                   | 231,468          |
| JPL - Pasadena, California                        | 1,067          | 44,667           | 6,813                           | 420                    | 52,967           | 99,460                  | 16,129                   | 168,556          |
| Tracking Stations (DSNS) <sup>4/</sup>            | ---            | 9,197            | 21,588                          | ---                    | 30,785           | 32,127                  | ---                      | 62,912           |
| Wallops Station                                   | 1,072          | 22,225           | 43,208                          | ---                    | 66,505           | 42,516                  | 1,343                    | 110,364          |
| WS - Wallops Island, Virginia                     | 1,072          | 22,225           | 43,208                          | ---                    | 66,505           | 42,073                  | 1,343                    | 109,921          |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | 443                     | ---                      | 443              |
| NASA Pasadena Office                              | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| NPO - Pasadena, California                        | ---            | ---              | ---                             | ---                    | ---              | ---                     | ---                      | ---              |
| <b>OTHER</b>                                      | <b>---</b>     | <b>---</b>       | <b>---</b>                      | <b>---</b>             | <b>---</b>       | <b>---</b>              | <b>---</b>               | <b>---</b>       |
| NASA Headquarters                                 | ---            | ---              | ---                             | ---                    | ---              | 32,077                  | ---                      | 32,077           |
| Washington, D.C.                                  | ---            | ---              | ---                             | ---                    | ---              | 5,561                   | ---                      | 5,561            |
| Various Locations <sup>1/</sup>                   | ---            | ---              | ---                             | ---                    | ---              | 26,516                  | ---                      | 26,516           |
| <b>GRAND TOTAL</b>                                | <b>123,245</b> | <b>1,424,610</b> | <b>1,104,616</b>                | <b>863</b>             | <b>2,653,134</b> | <b>2,298,512</b>        | <b>84,858</b>            | <b>5,036,504</b> |

<sup>1/</sup> Includes Capital Type Property in Possession of Contractors at Various Locations.

<sup>2/</sup> Disestablished June 30, 1970.

<sup>3/</sup> Includes Contractor-Held Special Test Equipment.

<sup>4/</sup> DSNS - Deep Space Network Stations.

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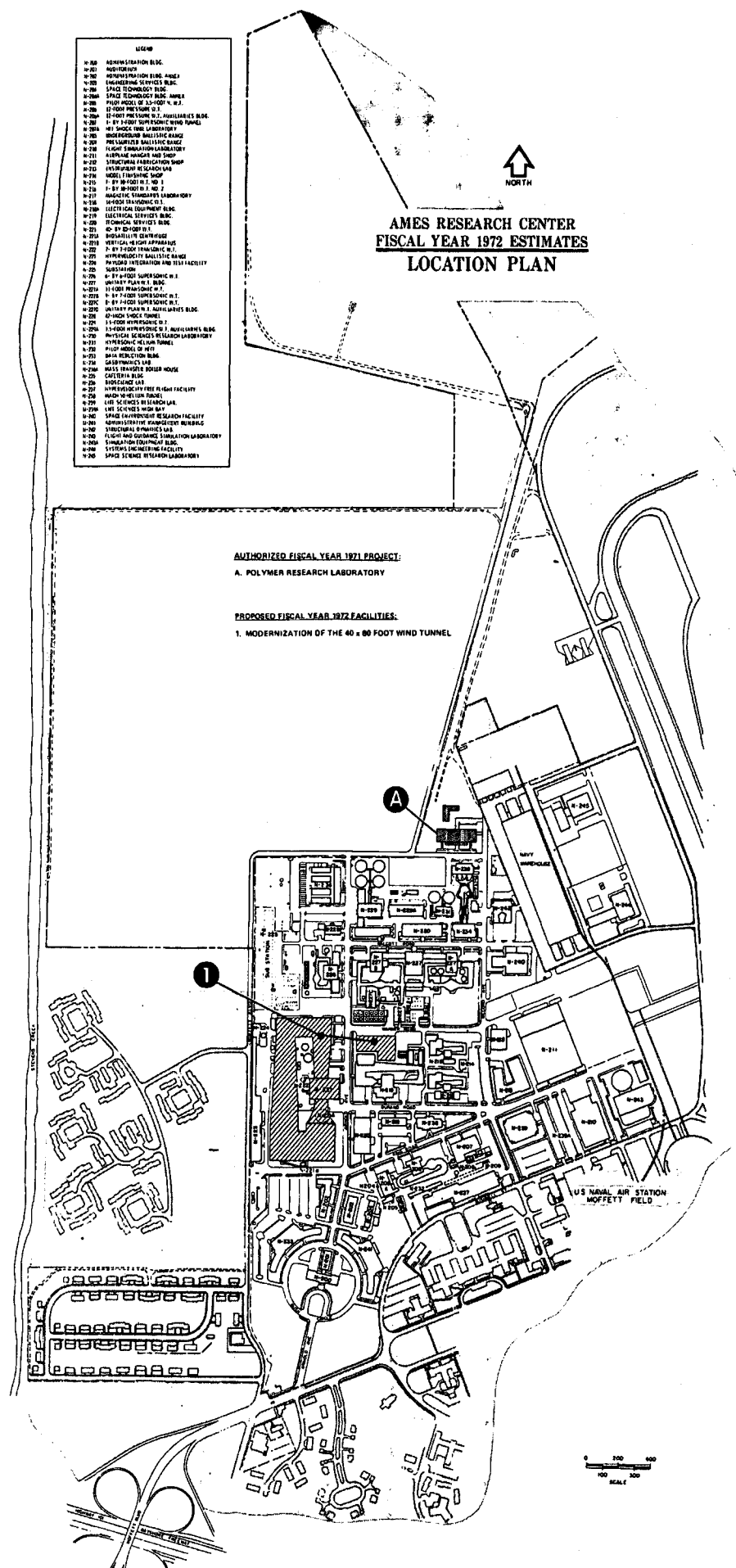
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AMES RESEARCH CENTER

|                                                     | <u>Page No.</u> |
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| Location plan.....                                  | CF 1-1          |
| Summary.....                                        | CF 1-2          |
| Office of Advanced Research and Technology Project: |                 |
| Modernization of the 40X80-foot wind tunnel.....    | CF 1-3          |



## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# **INSTALLATION SUMMARY** **CONSTRUCTION OF FACILITIES** **FISCAL YEAR 19 72 BUDGET ESTIMATES**

(Dollars in thousands)

|                                                              |                              |                                                                                                |  |
|--------------------------------------------------------------|------------------------------|------------------------------------------------------------------------------------------------|--|
| NASA INSTALLATION<br><b>Ames Research Center</b>             |                              | COGNIZANT PROGRAM OFFICE FOR INSTALLATION<br><b>Office of Advanced Research and Technology</b> |  |
| LOCATION OF INSTALLATION<br><b>Moffett Field, California</b> | COUNTY<br><b>Santa Clara</b> | NEAREST CITY<br><b>Mountain View, California</b>                                               |  |

## INSTALLATION MISSION

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

| PROJECT LINE ITEM                           | COGNIZANT OFFICE | FY 1959 THRU CURRENT YR | FY 19 <u>72</u> (Estimated) | FUTURE YEARS (Estimated) | TOTAL ALL YEARS (Estimated) |
|---------------------------------------------|------------------|-------------------------|-----------------------------|--------------------------|-----------------------------|
| Modernization of the 40x80-foot Wind Tunnel | OART             | 294                     | 6,500                       | -0-                      | 6,794                       |
| <b>TOTAL</b>                                |                  |                         | <b>6,500</b>                |                          |                             |

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Ames Research Center

PROJECT TITLE: Modernization of the 40 x 80-foot Wind Tunnel

FY 1972 CoF ESTIMATE: \$6,500,000

COGNIZANT INSTALLATION: Ames Research Center

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

COGNIZANT PROGRAM OFFICE: Office of Advanced Research and Technology

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                               |                  |
|-------------------------------|------------------|
| Planning and Design           | \$294,000        |
| Construction                  | ---              |
| Total FY 1971 and Prior Years | <u>\$294,000</u> |

SUMMARY PURPOSE AND SCOPE:

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

PROJECT JUSTIFICATION:

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

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

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

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

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

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

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

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

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

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

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

#### PROJECT DESCRIPTION:

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

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

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

PROJECT COST ESTIMATE:

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

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

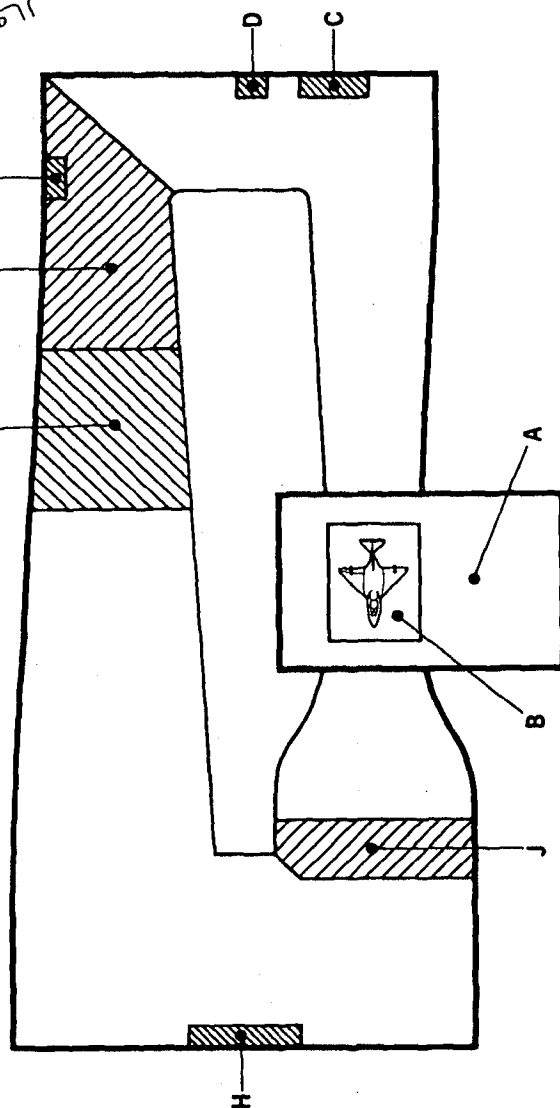
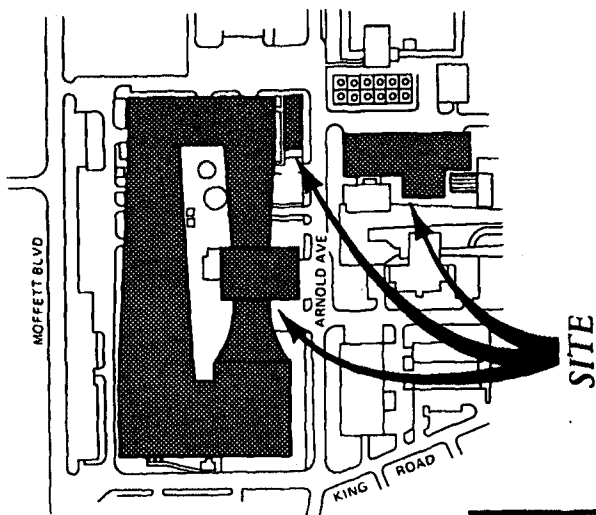
# AMES RESEARCH CENTER FISCAL YEAR 1972 ESTIMATES

## MODERNIZATION OF THE 40x80 WIND TUNNEL

### PROPOSED CONSTRUCTION PROGRAM

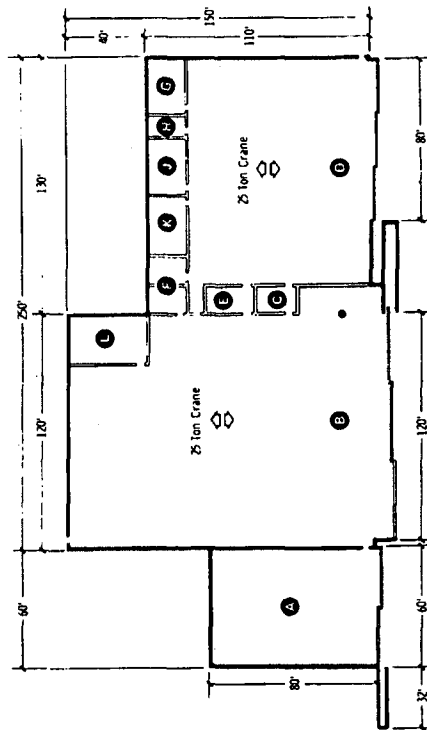
- A. New Test Chamber Crane 35T New Heavy Duty Elevator to Test Section (3rd Level) 5000# Capacity.
- B. Extend Armor Plate in Test Section New Sound Proof-Vibration Free Tunnel Operators Room. Two Model Observation Stations, One Each Side Test Section.
- C. Provide a Large, 50 Ft. Wide by 20 Ft. High Model Access Door to Model Modification Area.
- D. Remove Wall Steel Siding, Etc., to Provide a 22 Ft. Wide by 20 Ft. High Roll Door.
- E. Replace Tunnel Skin Fasteners - Remove Wall Steel and Siding.
- F. Provide 24 Ft. Wide by 20 Ft. High Roll Door.
- G. New Skin Stiffeners Motor Entrance & Exit Cones and Nacelles - New Motor Support Fairings - Canopy Over the Motor Section - Overhaul all Electrical Equipment.
- H. Motorized purge doors.
- J. Replace tunnel skin fasteners.

### PLOT PLAN



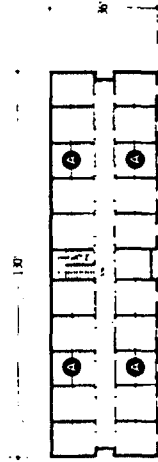
# AMES RESEARCH CENTER FISCAL YEAR 1972 ESTIMATES

## MODERNIZATION OF THE 40x80 WIND TUNNEL

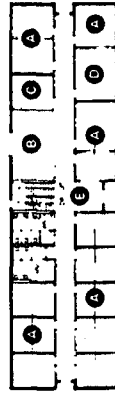


PLAN

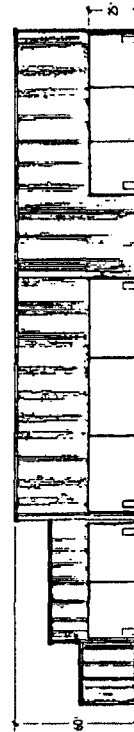
- A Research Scientists Offices
- B Mechanical Room
- C Computer Room
- D Conference Room
- E Entry and Delivery



SECOND FLOOR PLAN

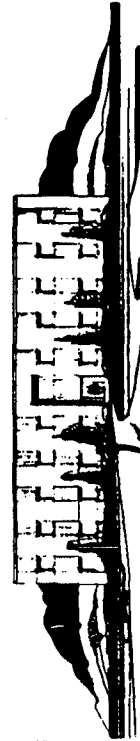


FIRST FLOOR PLAN



ELEVATION

MODEL PREPARATION BUILDING



ELEVATION

OFFICE BUILDING

5

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

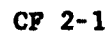
CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

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

# LOCATION PLAN



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
**INSTALLATION SUMMARY**  
**CONSTRUCTION OF FACILITIES**  
**FISCAL YEAR 19 72 BUDGET ESTIMATES**

(Dollars in thousands)

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

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

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

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center

PROJECT TITLE: Centaur Modifications to Titan III Launch Area

FY 1972 CoF ESTIMATE: \$10,700,000

COGNIZANT INSTALLATION: John F. Kennedy Space Center

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

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                               |                  |
|-------------------------------|------------------|
| Planning and Design           | \$255,000        |
| Construction                  | ---              |
| Total FY 1971 and Prior Years | <u>\$255,000</u> |

SUMMARY PURPOSE AND SCOPE:

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

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

#### PROJECT JUSTIFICATION:

The Titan Centaur addition to the National Launch Vehicle capability will provide the high energy (H<sub>2</sub>-O<sub>2</sub>) final stage and, consequently, the escape velocity needed for heavier planetary exploration missions now planned for the mid-1970's. Adoption of this combination of stages will enable NASA to use the existing Air Force Launch Complex 41 to service, check out and launch the Titan Centaur vehicle. Because the Centaur stage is new to Complex 41, additions and modifications will be necessary to service the Centaur stage and the spacecraft-related ground support equipment.

#### PROJECT DESCRIPTION:

The alterations and additions to the Titan Launch Complex include:

##### Mobile Service and Umbilical Towers

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

##### Aerospace Ground Equipment Enclosure

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

##### Guidance Optical Alignment Shelter (GOAS)

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

### Facility Electric Power

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

### Vehicle/Spacecraft Air Conditioning System

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

### Liquid Hydrogen System

A 28,000 gallon LH<sub>2</sub> storage tank including roads, barricades, supporting structures, piping and control equipment will be provided.

### Liquid Oxygen System

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

### Gaseous/Liquid Nitrogen System

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

### Gaseous/Liquid Helium

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

### Vertical Integration Building

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

### Solid Motor Assembly Building (SMAB)

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

### Transporters and Vans

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

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

### PROJECT COST ESTIMATE:

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

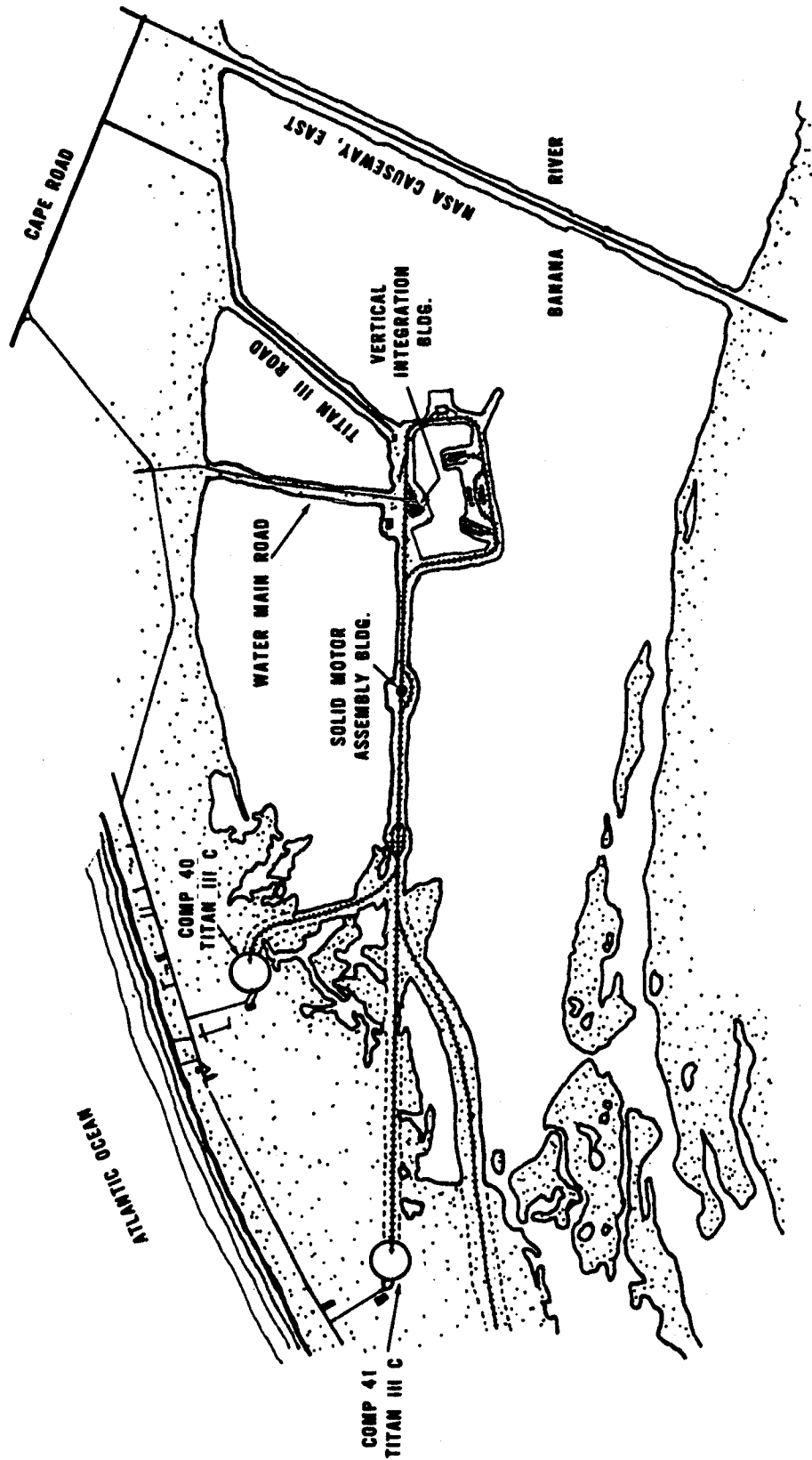
|                                               | <u>Unit of Measure</u> | <u>Quantity</u> | <u>Unit Cost</u> | <u>Total Cost</u>          |
|-----------------------------------------------|------------------------|-----------------|------------------|----------------------------|
| <u>Equipment</u>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

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

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

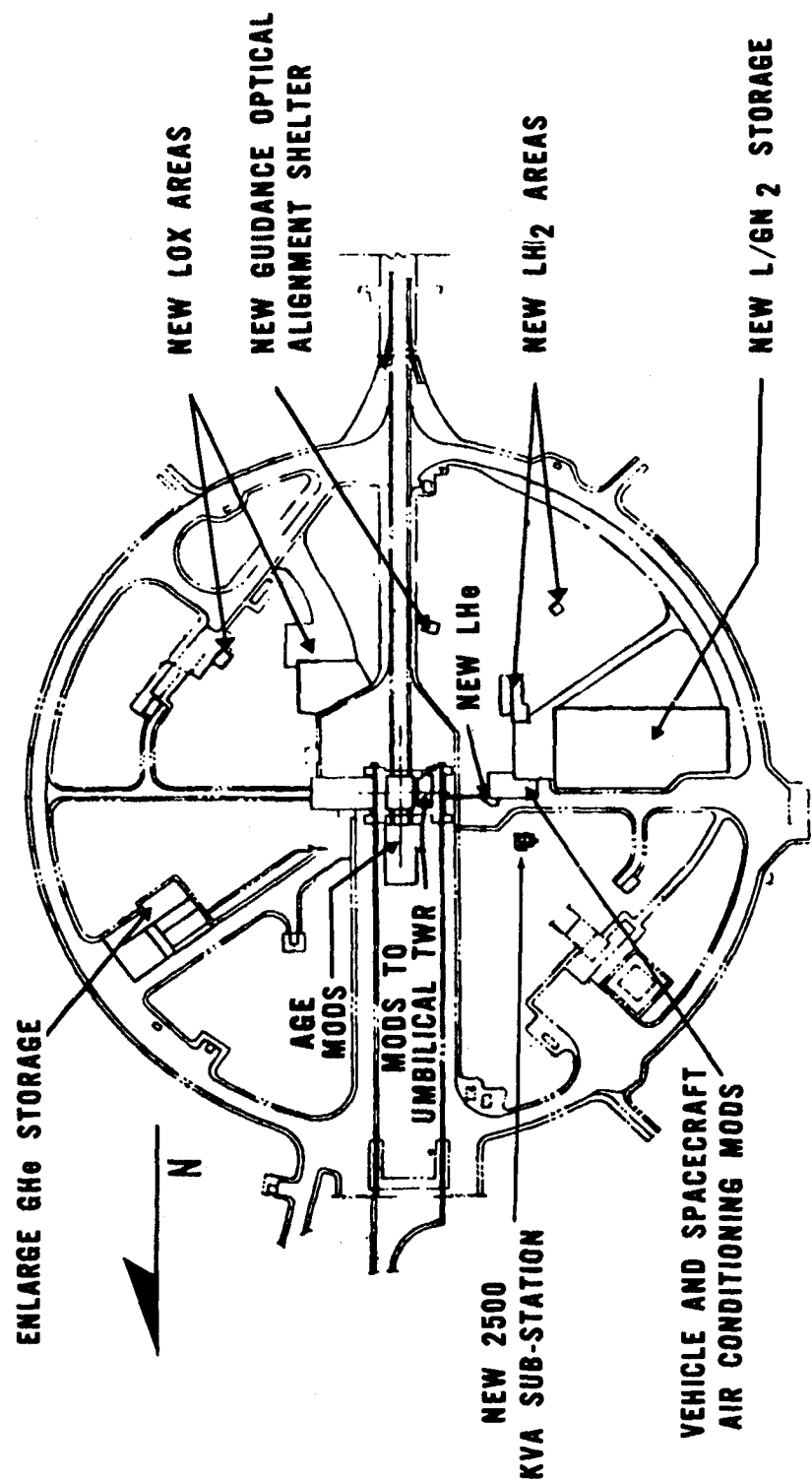
This project will complete the modification for the presently planned Titan Centaur program; future requirements will be dependent upon future launch vehicle configurations and spacecraft unique prelaunch checkout requirements.

JOHN F. KENNEDY SPACE CENTER  
FISCAL YEAR 1972 ESTIMATES  
CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



SITE PLAN FOR TITAN III LAUNCH AREA

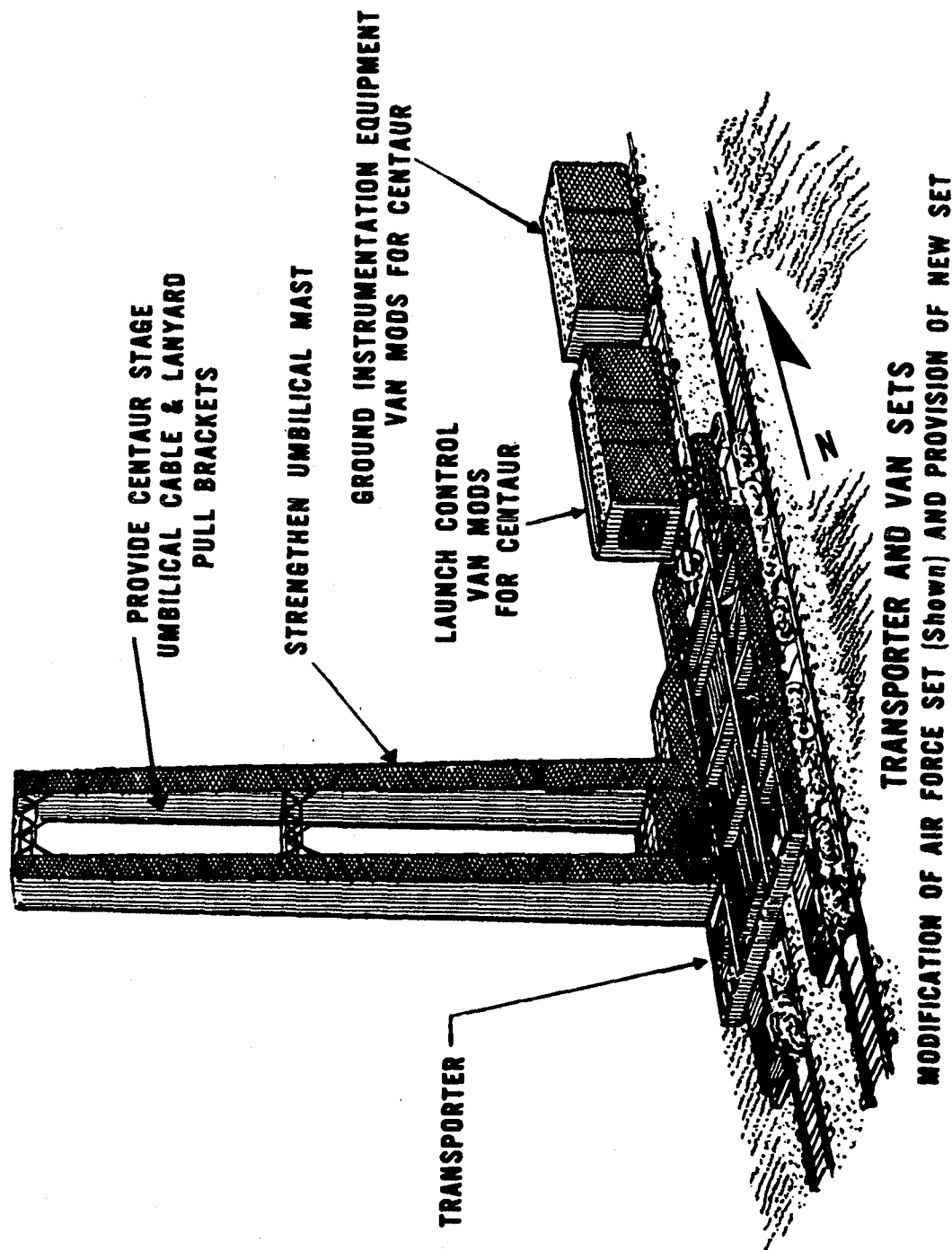
JOHN F. KENNEDY SPACE CENTER  
 FISCAL YEAR 1972 ESTIMATES  
 CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



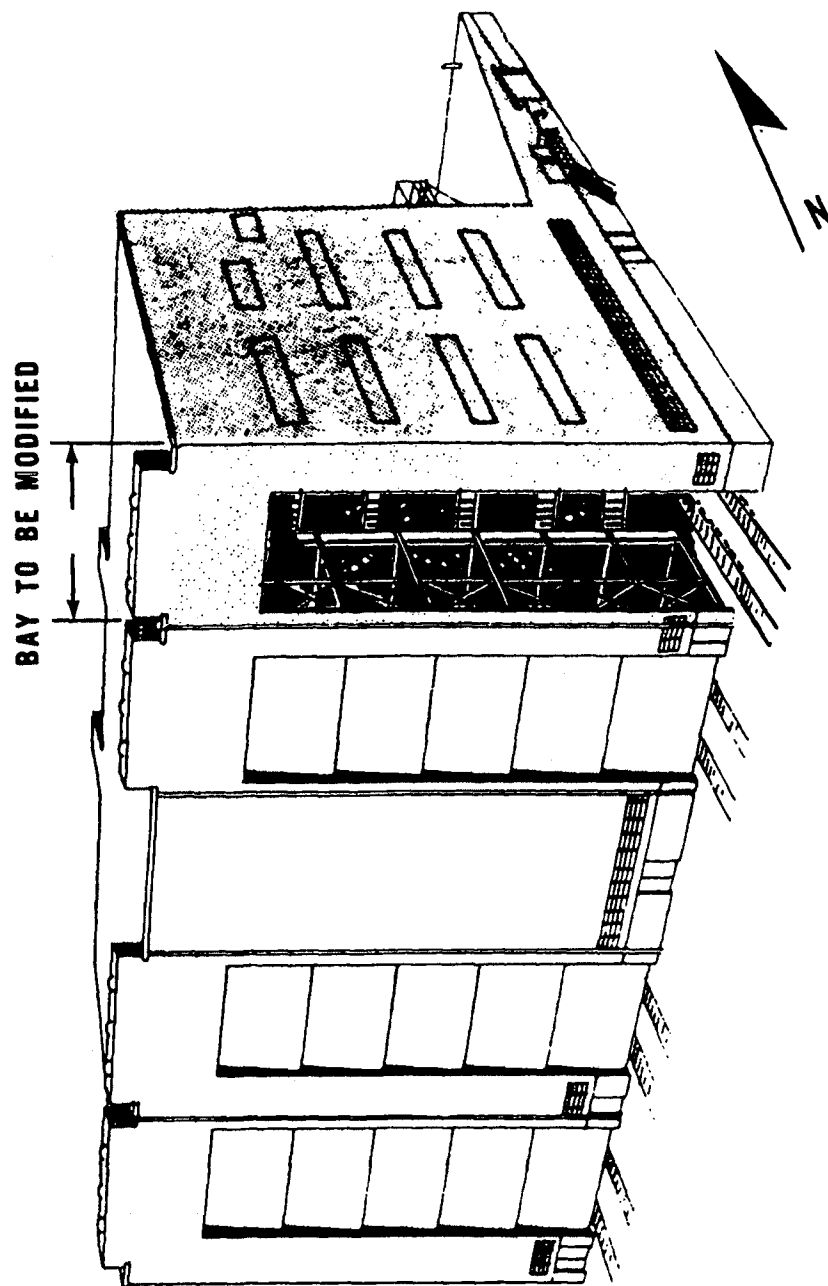
SITE PLAN FOR COMPLEX 41

JOHN F. KENNEDY SPACE CENTER  
FISCAL YEAR 1972 ESTIMATES

## CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



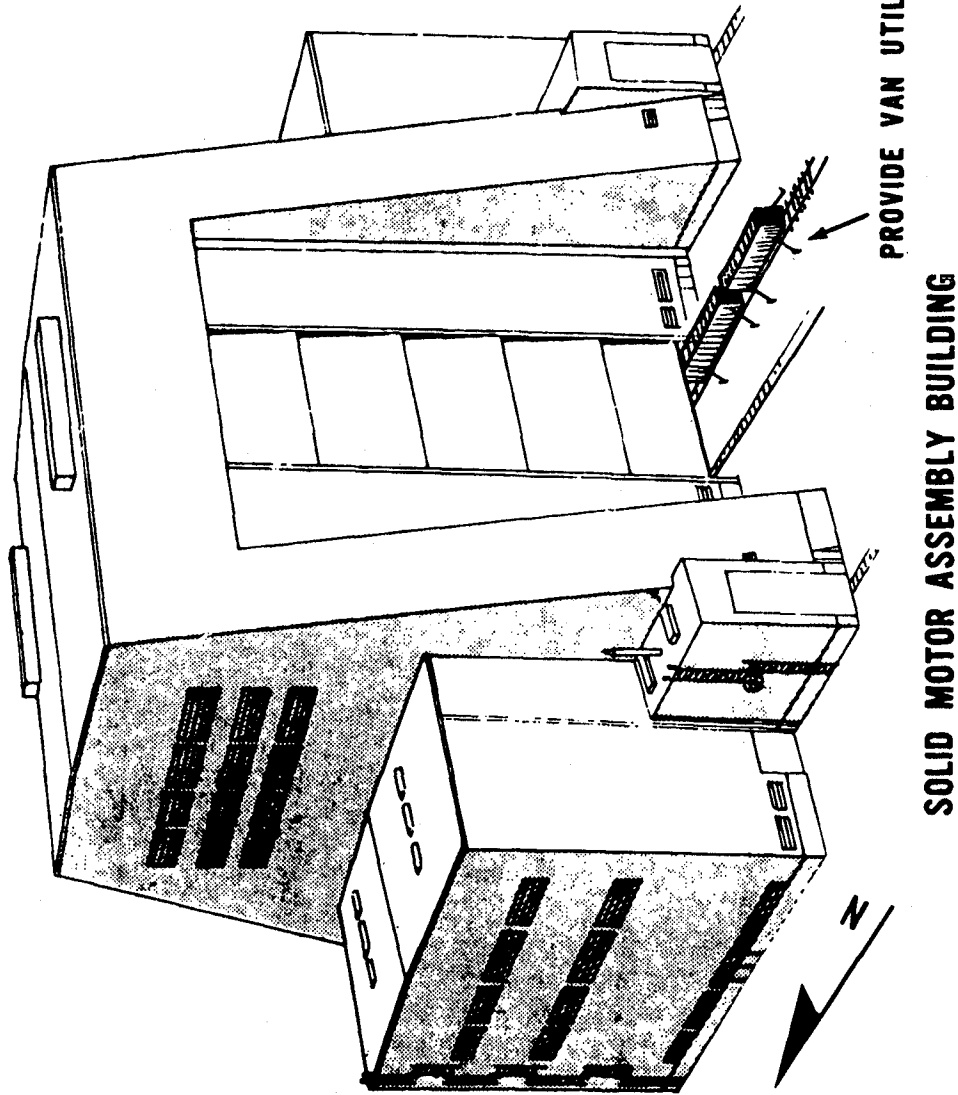
JOHN F. KENNEDY SPACE CENTER  
FISCAL YEAR 1972 ESTIMATES  
CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



VERTICAL INTEGRATION BUILDING

JOHN F. KENNEDY SPACE CENTER  
FISCAL YEAR 1972 ESTIMATES

CENTAUR MODIFICATIONS TO TITAN III LAUNCH AREA



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center

PROJECT TITLE: Alterations to Launch Complex 17

FY 1972 CoF ESTIMATE: \$4,500,000

COGNIZANT INSTALLATION: John F. Kennedy Space Center

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

COGNIZANT PROGRAM OFFICE: Office of Space Science and Applications

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                     |                  |
|---------------------|------------------|
| Planning and Design | \$808,919        |
| Construction        | <u>7,377,063</u> |

Total FY 1971 and Prior Years \$8,185,982

SUMMARY PURPOSE AND SCOPE:

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

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

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

#### PROJECT JUSTIFICATION:

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

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

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

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

#### PROJECT DESCRIPTION:

This project provides the following alterations and additions:

##### Mobile Service Structure

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

### Umbilical Tower

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

### Launch Deck

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

### Service Structure Clean Room

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

### Theodolite and Prism Station

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

### Air-Conditioning Systems for LC 17A and B

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

### Equipment Additions and Modifications

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

**PROJECT COST ESTIMATE:**

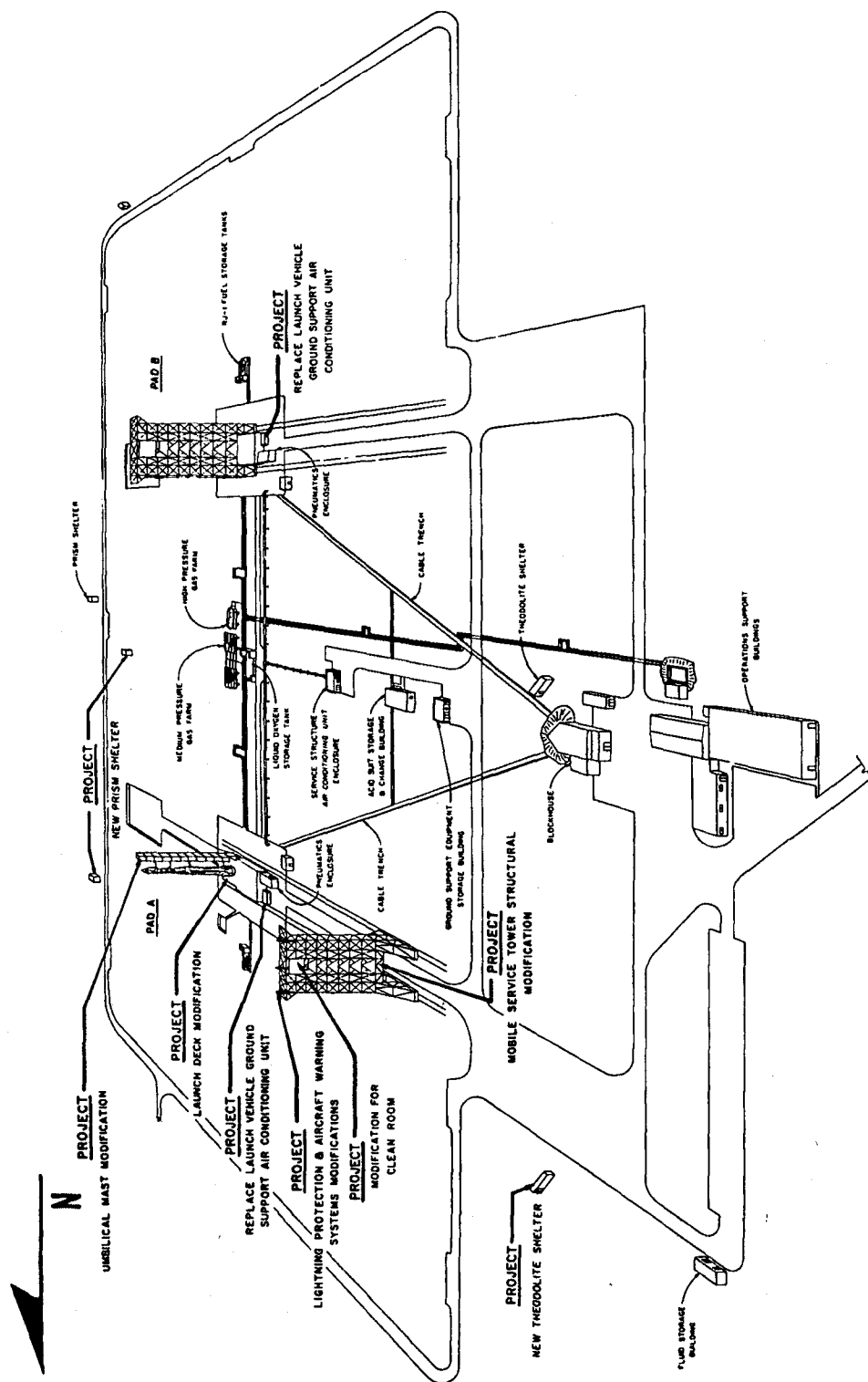
|                                                                             | <u>Unit of Measure</u> | <u>Quantity</u> | <u>Unit Cost</u> | <u>Total Cost</u>  |
|-----------------------------------------------------------------------------|------------------------|-----------------|------------------|--------------------|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

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

# JOHN F. KENNEDY SPACE CENTER FISCAL YEAR 1972 ESTIMATES

## ALTERATIONS TO LAUNCH COMPLEX 17



PERSPECTIVE

6

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

VARIOUS LOCATIONS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
**INSTALLATION SUMMARY**  
**CONSTRUCTION OF FACILITIES**  
**FISCAL YEAR 19 72 BUDGET ESTIMATES**

(Dollars in thousands)

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

| PROJECT LINE ITEM                              | COGNIZANT OFFICE | FY 1959 THRU CURRENT YR | FY 19 <u>72</u> (Estimated) | FUTURE YEARS (Estimated) | TOTAL ALL YEARS (Estimated) |
|------------------------------------------------|------------------|-------------------------|-----------------------------|--------------------------|-----------------------------|
| Rehabilitation and Modification of Facilities  | O&M              | 23,017                  | 10,000                      |                          | 33,017                      |
| Space Shuttle Facilities                       | (OMSF<br>(OART   | 630                     | 20,000                      | 10,000                   | 30,630                      |
| Power Plant Replacements                       | OTDA             | 54                      | 600                         | -0-                      | 654                         |
| Relocation of ATS Transportable Ground Station | OTDA             | 60                      | 500                         | -0-                      | 560                         |
| <b>TOTAL</b>                                   |                  |                         | <b>31,100</b>               |                          |                             |

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Various Locations

PROJECT TITLE: Rehabilitation and Modification of Facilities

FY 1972 CoF ESTIMATE: \$ 10,000,000

COGNIZANT INSTALLATION: Various Locations

LOCATION OF PROJECT: Various Locations

COGNIZANT PROGRAM OFFICE: Office of Organization and Management

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                     |                   |
|---------------------|-------------------|
| Planning and Design | \$2,092,320       |
| Construction        | <u>20,925,000</u> |

Total FY 1971 and Prior Years \$23,017,320

SUMMARY PURPOSE AND SCOPE:

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

PROJECT JUSTIFICATION:

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

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

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

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

#### PROJECT DESCRIPTION:

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

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

PROJECT COST ESTIMATE:

Rehabilitation and Modification - General

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

|                                                                                               |                    |
|-----------------------------------------------------------------------------------------------|--------------------|
| III. OFFICE OF SPACE SCIENCE AND APPLICATIONS                                                 | <u>\$1,435,000</u> |
| A. <u>Goddard Space Flight Center</u>                                                         | <u>395,000</u>     |
| (1) Modification of fire protection systems                                                   | 395,000            |
| B. <u>Wallops Station</u>                                                                     | <u>790,000</u>     |
| (1) Building fire protection systems                                                          | 350,000            |
| (2) Rehabilitation of runway and taxiway                                                      | 440,000            |
| C. <u>Jet Propulsion Laboratory</u>                                                           | <u>250,000</u>     |
| (1) Rehabilitation of procurement offices and the<br>development laboratory                   | 250,000            |
| IV. OFFICE OF TRACKING AND DATA ACQUISITION                                                   | <u>2,573,000</u>   |
| A. <u>Various Locations</u>                                                                   | <u>2,573,000</u>   |
| (1) Modification of electrical utilities systems<br>(8 locations)                             | 690,000            |
| (2) Rehabilitation of communications duct system, Hawaii                                      | 360,000            |
| (3) Rehabilitation of air conditioning systems<br>(5 locations)                               | 280,000            |
| (4) Modification of fire protection/safety systems                                            | 1,243,000          |
| (a) Space Tracking and Data Acquisition Network                                               | (438,000)          |
| (b) Manned Space Flight Network                                                               | (585,000)          |
| (c) Deep Space Network                                                                        | (220,000)          |
| Subtotal (rehabilitation and modification - general)                                          | <u>\$7,000,000</u> |
| <u>Rehabilitation and Modification - Pollution</u>                                            |                    |
| 1. OFFICE OF MANNED SPACE FLIGHT                                                              | <u>\$1,418,000</u> |
| A. <u>Kennedy Space Center</u>                                                                | <u>290,000</u>     |
| (1) Modification of water pollution control<br>facilities (water)                             | 200,000            |
| (2) Replacement of treatment facilities (water)                                               | 28,000             |
| (3) Modification of waste disposal system at the GSA<br>motor pool (water)                    | 9,000              |
| (4) Modification of propellant treatment facilities<br>services components laboratory (water) | 20,000             |

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

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

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

|                          |                                           |
|--------------------------|-------------------------------------------|
| AUTHORIZATION LINE ITEM: | <u>Various Locations</u>                  |
| PROJECT TITLE:           | <u>Space Shuttle Facilities</u>           |
|                          | FY 1972 CoF ESTIMATE: <u>\$20,000,000</u> |

COGNIZANT INSTALLATION: Various Locations

LOCATION OF PROJECT: Various Locations

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

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                               |            |
|-------------------------------|------------|
| Planning and Design           | \$630,000  |
| Construction                  | <u>-0-</u> |
| Total FY 1971 and Prior Years | \$630,000  |

SUMMARY PURPOSE AND SCOPE:

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

PROJECT JUSTIFICATION:

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

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

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

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

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

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

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

## PROJECT DESCRIPTION:

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

### MAIN ENGINE TEST FACILITIES

#### SUMMARY PURPOSE AND SCOPE:

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

#### JUSTIFICATION:

The space shuttle planning is based upon achieving operational capability in the late 1970's. The intervening period will require the development of a suitable vehicle which will require a minimum of refurbishment, have a short ground turn-around capability, and be designed to operate at low levels of acceleration during launch and reentry. A key element in the development is a new high pressure, throttleable LOX-LH<sub>2</sub> rocket engine which will be used in both the booster and the orbiter. The orbiter engine will have a translatable skirt to provide a higher expansion ratio in the space environment.

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

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

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

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

#### DESCRIPTION:

This project provides for the procurement, modification, and activation of test facilities for testing the space shuttle engine. The engine test requirements will be met by two sea level (ambient) test stands and one altitude simulation test facility. The modifications will consist of structural changes, addition of LOX and LH<sub>2</sub> run tanks and storage tanks, new thrust measuring systems, and changes to the mechanical, electrical, control, instrumentation, propellants and pressurant systems. Modifications of the firex and deflector cooling water systems will be required. The altitude system will include an altitude simulation chamber, diffuser, steam ejectors and a steam supply system. The facilities will provide for vehicle suction duct dynamics and launch acceleration simulator.

#### PROJECT COST ESTIMATE:

##### Engine Test Facilities

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

##### AUXILIARY PROPULSION SYSTEM TEST FACILITIES

#### SUMMARY PURPOSE AND SCOPE:

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

#### JUSTIFICATION:

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

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

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

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

#### DESCRIPTION:

This project provides for the procurement, modification, and activation of test facilities for testing of auxiliary propulsion systems and orbital maneuvering system for the space shuttle. The modification will consist of structural changes, addition of LOX and LH<sub>2</sub> run tanks and storage tanks, gaseous oxygen and hydrogen storage, high pressure plumbing, and other changes to the mechanical, electrical, control, instrumentation, propellants and pressurant systems.

#### COST ESTIMATE:

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

## THERMAL PROTECTION SYSTEMS

### SUMMARY PURPOSE AND SCOPE:

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

### JUSTIFICATION:

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

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

### DESCRIPTION:

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

1. Ames Research Center, California - Interaction-Heating Shuttle Panel Test Facility will increase the existing 20 megawatt arc facility to 60 megawatts. A low subsonic arc heater and a hypersonic arc heater will also be provided. This upgrading will allow the generation of large scale hot flows for long durations as required to evaluate the effect of interaction heating over joints and discontinuities.
2. Ames Research Center, California - Combustion Facility Modification for Shuttle Thermal Protection Testing provides for modification to the combustion chamber and nozzle system of the existing gas-dynamic laser facility. A water-cooled test section with the capability of mounting 2 foot by 2 foot test panels will also be installed to permit the evaluation of various panel design concepts.

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

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

COST ESTIMATE:

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

SUMMARY PROJECT COST ESTIMATE:

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

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

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

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

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Various Locations

PROJECT TITLE: Power Plant Replacements

FY 1972 CoF ESTIMATE: \$ 600,000

COGNIZANT INSTALLATION: Goddard Space Flight Center

LOCATION OF PROJECT: Goldstone, California/Santiago, Chile

COGNIZANT PROGRAM OFFICE: Office of Tracking and Data Acquisition

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                               |                 |
|-------------------------------|-----------------|
| Planning and Design           | \$54,000        |
| Construction                  | ---             |
| Total FY 1971 and Prior Years | <u>\$54,000</u> |

SUMMARY PURPOSE AND SCOPE:

It is the purpose of this project to replace the obsolete and inadequate temporary power plant building at the Echo Deep Space Station (DSS-12) site at Goldstone, California (cognizant installation Jet Propulsion Laboratory) and the Space Tracking and Data Acquisition Network (STADAN) Station at Santiago, Chile (cognizant installation Goddard Space Flight Center). These power plants are the prime source of power during mission operations.

PROJECT JUSTIFICATION:

The existing engine-generator sets (two 200 KW and three 150 KW) at Goldstone are worn out, undersized, and must be replaced with larger units. The existing temporary building is not large enough to accommodate the larger capacity engine generator sets and it is not feasible to add to the temporary structure. This project provides for a new power plant building and the installation therein of generators and switch gear which are now on hand.

At Santiago, reliable operational electrical power for the entire STADAN station must be provided. In order to ensure reliability and quality of power, the onstation powerhouse must be fully adequate to permit efficient operations. The existing power generating facility was constructed in 1963 and has had several subsequent temporary modifications and additions. The basic structure is a prefabricated and uninsulated building, which is inadequate to function as a primary power plant facility.

PROJECT DESCRIPTION:

At Goldstone, a 5,300 square foot concrete block power plant building will be constructed to house three rebuilt 500 KW engine generators, and one rebuilt 350 KW engine generator. Existing station switch gear will be installed in the new building.

At Santiago, a 5,000 square foot concrete block power plant building will be constructed to house four 350 KW and one 500 KW motor generators and the switch gear presently installed at the site.

PROJECT COST ESTIMATE:

|                                                           | <u>Unit of Measure</u> | <u>Quantity</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|-----------------------------------------------------------|------------------------|-----------------|------------------|-------------------|
| A. Goldstone, California                                  |                        |                 |                  |                   |
| <u>Land Acquisition</u>                                   | ---                    | ---             | ---              | ---               |
| <u>Construction</u>                                       |                        |                 |                  | <u>\$370,000</u>  |
| Power plant building                                      | SF                     | 5,300           | \$30.19          | 160,000           |
| Mechanical distribution system                            | LS                     | ---             | ---              | 70,000            |
| Electrical distribution system*                           | LS                     | ---             | ---              | 100,000           |
| Utilities                                                 | LS                     | ---             | ---              | 30,000            |
| Site development                                          | LS                     | ---             | ---              | 10,000            |
| *Includes relocation/installation of existing generators. |                        |                 |                  |                   |
| <u>Equipment</u>                                          | ---                    | ---             | ---              | ---               |
| <u>Fallout Shelter</u> (Not Feasible)                     | ---                    | ---             | ---              | ---               |
|                                                           |                        | Subtotal        |                  | <u>\$370,000</u>  |

Existing government-owned engine generator sets (3-500 KW) (1-350 KW) and switch gear will be used at no cost to this project.

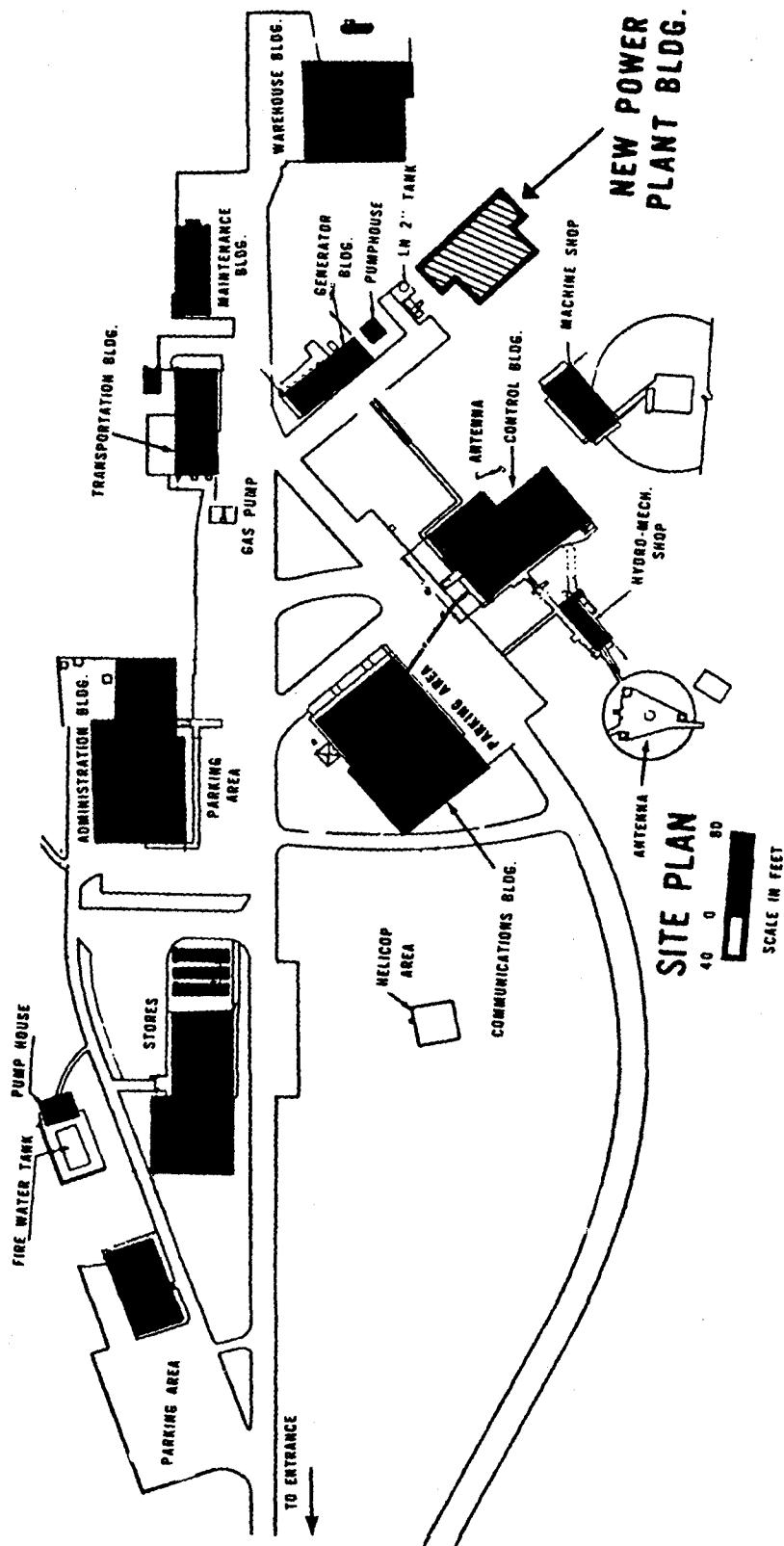
|                                                          | <u>Unit of Measure</u> | <u>Quantity</u> | <u>Unit Cost</u> | <u>Total Cost</u> |
|----------------------------------------------------------|------------------------|-----------------|------------------|-------------------|
| B. Santiago,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

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

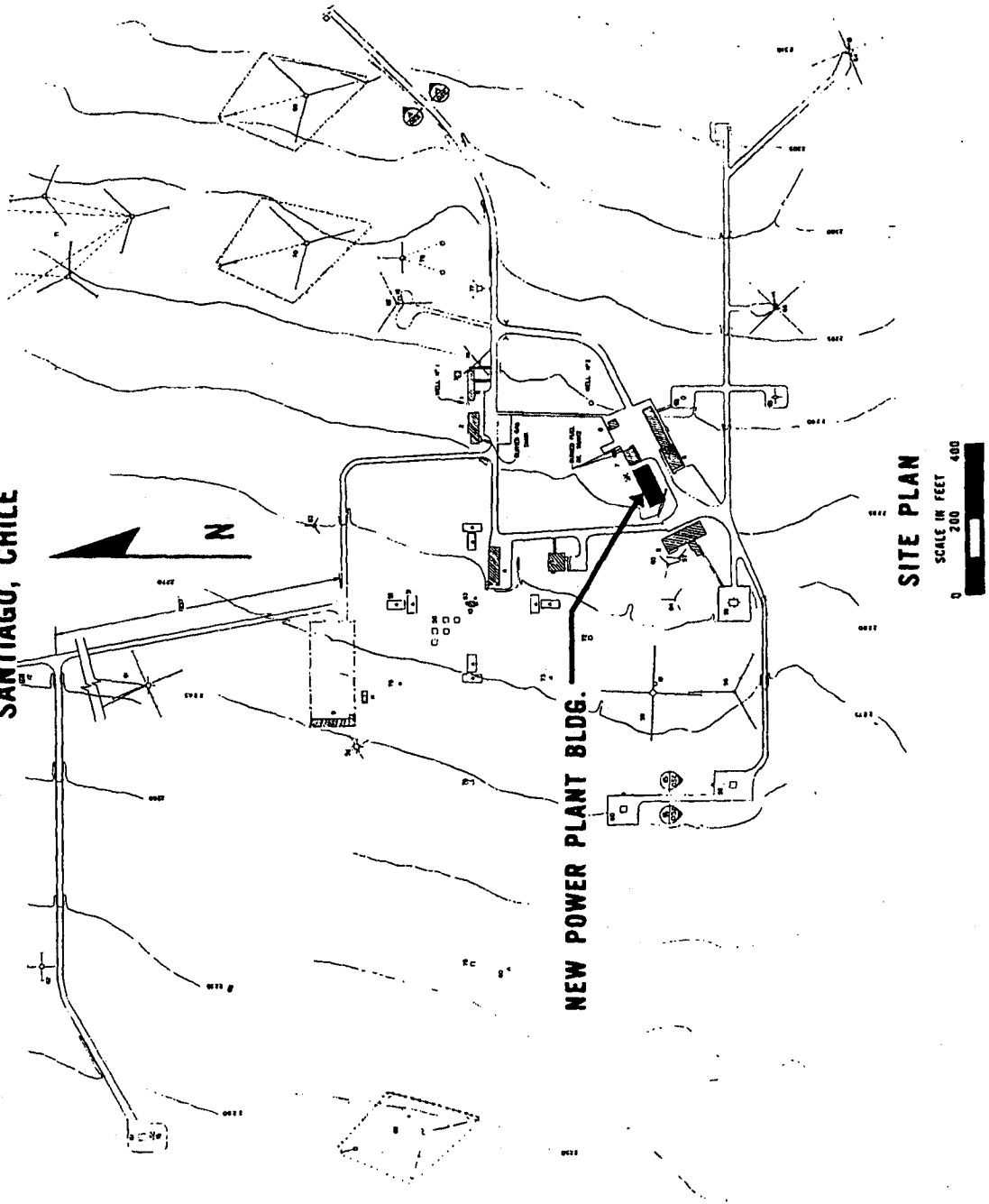
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

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



VARIOUS LOCATIONS  
FISCAL YEAR 1972 ESTIMATES  
POWER PLANT REPLACEMENTS  
SANTIAGO, CHILE



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

AUTHORIZATION LINE ITEM: Various Locations

PROJECT TITLE: Relocation of ATS Transportable Ground Station

FY 1972 CoF ESTIMATE: \$ 500,000

COGNIZANT INSTALLATION: Goddard Space Flight Center

LOCATION OF PROJECT: Europe

COGNIZANT PROGRAM OFFICE: Office of Tracking and Data Acquisition

FY 1971 AND PRIOR YEARS CoF FUNDING:

|                               |                 |
|-------------------------------|-----------------|
| Planning and Design           | \$60,000        |
| Construction                  | ---             |
| Total FY 1971 and Prior Years | <u>\$60,000</u> |

SUMMARY PURPOSE AND SCOPE:

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

PROJECT JUSTIFICATION:

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

PROJECT DESCRIPTION:

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

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

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

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

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

PROJECT COST ESTIMATE:

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

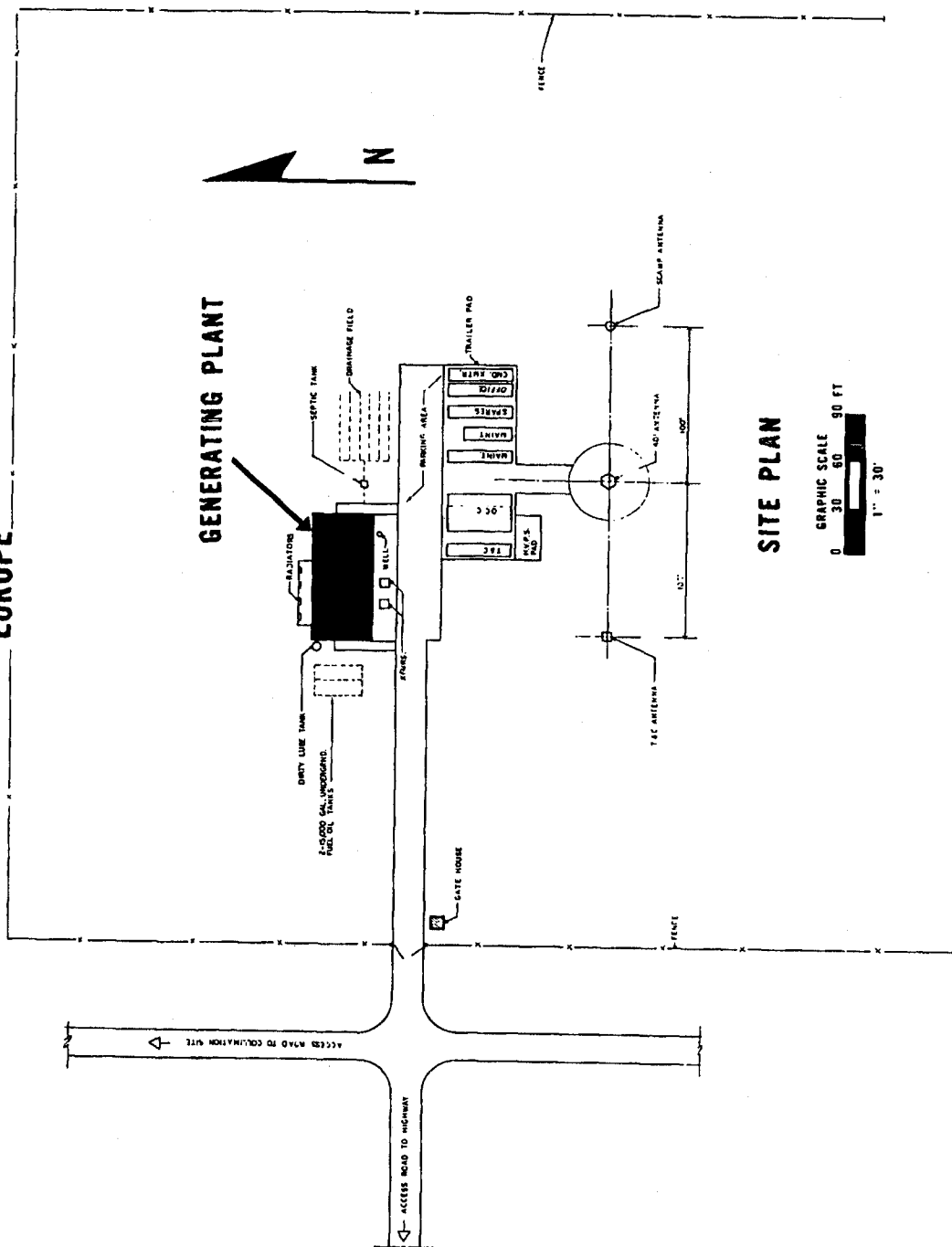
Existing government owned engine generator sets (2-250 KW) (2-200KW) and switch gear will be used at no cost to this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

None

\*Includes engine-generator installation

VARIOUS LOCATIONS  
FISCAL YEAR 1972 ESTIMATES  
RELOCATION OF TRANSPORTABLE GROUND STATION  
EUROPE





NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

FACILITY PLANNING AND DESIGN

Page No.

Summary..... CF 4-1

Office of Organization and Management

Facility planning and design..... CF 4-2

## (Dollars in thousands)

|                                 |               |                                                                                           |  |
|---------------------------------|---------------|-------------------------------------------------------------------------------------------|--|
| NASA INSTALLATION<br><b>All</b> |               | COGNIZANT PROGRAM OFFICE FOR INSTALLATION<br><b>Office of Organization and Management</b> |  |
| LOCATION OF INSTALLATION<br>--- | COUNTY<br>--- | NEAREST CITY<br>---                                                                       |  |
| INSTALLATION MISSION            |               |                                                                                           |  |

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

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1972 ESTIMATES

Facility Planning And Design

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

- a. Preliminary engineering reports, cost estimates, and design and construction schedules.
- b. Preliminary plans and specifications as well as final construction contract plans, specifications and associated cost estimates and schedules.
- c. Necessary development and master planning for field installations.
- d. Special facilities siting and other investigations, facilities methodology and other studies, and facilities reports.

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

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

- c. The amount requested will provide for the preparation of final design, plans, drawings and specifications necessary for the accomplishment of the subsequent FY 1973 Construction of Facilities program.

\$1,700,000

TOTAL

\$3,500,000