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REPORT TO THE CONGRESS

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Opportunity For Savings In Space Programs By Reevaluating Needs Before Buying Facilities B-164027

Department of the Air Force

*BY THE COMPTROLLER GENERAL
OF THE UNITED STATES*

770356 / 087432

JULY 3, 1968



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B- 164027

To the President of the Senate and the
Speaker of the House of Representatives

The General Accounting Office has made a review of the acquisition by the Department of the Air Force of certain test, launch, and tracking facilities to support the TITAN III booster program and a classified satellite program.

The progress and requirements of space development programs can be influenced by many factors and are subject to adjustment in the light of rapidly changing events and conditions. Because of the interest of the Congress in the ensuring of prudent use of funds appropriated for these costly programs, we are reporting our finding that there is an opportunity for significant savings available to the Air Force through the reevaluation and updating of requirements for space system facilities.

It is the practice of the Air Force in acquiring a space system to develop, test, and procure the various components concurrently to place it into operation in as short a time as possible. Therefore, hangers, antennas, launch pads, silos, complexes, and other required items of support are planned and constructed early so that they will be ready at the same time as the booster or spacecraft.

We looked into the acquisition of certain test, launch, and tracking facilities for the TITAN III program, and a classified satellite program, to determine whether the initial plans for acquiring these facilities had been reevaluated and updated in view of changed circumstances affecting the programs. Although we found one instance in which savings had been realized because Air Force officials reevaluated and revised the requirements for support facilities, there were several instances in which opportunities for savings were not realized.

--Plans for the TITAN III launch complex at the Eastern Test Range included provision for rapid-launch, mobile facilities, which cost about \$23.8 million. Had the design been limited to meet firm requirements of the revised program. just prior to

DEPARTMENT OF THE AIR FORCE
WASHINGTON 20330

DEC 7 1967



OFFICE OF THE SECRETARY

MEMORANDUM FOR DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

SUBJECT: GAO Draft Report, Opportunity for Savings Through
Reevaluating and Updating Space System Facilities
Requirements Prior to Facilities Acquisition
(OSD Case #2683)

This is in response to **your** request of November 3, 1967
~~for~~ Air Force comments on the subject GAO report.

In their report, the GAO utilizes the outcome of certain actions taken in relation to specific space system facilities on the TITAN III and Program [REDACTED] to highlight an alleged deficiency within Air Force system program management review procedures, and recommends that a special review be undertaken just **prior** to releasing the construction contract **for** any major facility to insure that the planning basis has not sufficiently changed to cause the scope of the construction to be modified. ~~We~~ believe that the circumstances, described in the GAO review, are uniquely associated with the environment of these programs during the time in which the facility decisions **were** being made and that no new and unique review procedures **are** required. For **example**, while the GAO report is critical of the review process relating to the TITAN III PIL facility at ETR, they acknowledge that positive action was taken in reviewing the level of requirements for the TITAN III facilities at WTR.

The Air Force views on the conclusions and recommendations of the GAO report **are** summarized below and covered in detail in Attachment 1.

1. Sufficient regulatory mechanisms currently exist to provide continuous review of the total system under development.
2. Separate procedures **for** specific reviews of the system **prior** to acquisition of facilities create a special management practice for an individual functional area.
3. The Air Force management system must be and is **based** upon review and reevaluations of all factors impinging upon **the** total system.

GAO note: Attachment #2 withdrawn to remove classification
of letter,

4. Current Air Force efforts to develop and implement criteria specifications are considered a **major** management technique which will provide additional support to existing review procedures.

Detailed comments **with** specific attention to the TITAN III ITL **design** philosophy, **solid** rocket motor test complex requirements and Program **■** scheduling and support requirements have been covered in Attachment 2.



Alexander H. Flax
Assistant Secretary
Research & Development

2 Attachments



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

APPENDIX II
Page 1

Mr. William A. Newman, Jr.
Director, Defense Division
United States General Accounting Office
Washington, D. C. 20548

11 JAN 1968

Dear Mr. Newman:

This is in reply to your letter to the Secretary of Defense, dated November 3, 1967, with the enclosed preliminary draft report to the Congress on the opportunity for savings through reevaluation and updating space system facilities requirements prior to facilities acquisition by the Department of the Air Force. (OSD Case #2683)

I appreciate receiving the recommendations contained in your letter and the opportunity to comment on the report itself. This matter **has** been reviewed by officials of the Army, Navy, and Air Force, and their comments are attached for your information. You will note that the Air Force comments discuss the conclusions and recommendations of the report in some detail and also cover the TITAN III ITL design philosophy, the solid motor test complex requirements, and the Program [REDACTED] scheduling and support requirements.

I would like to comment briefly on these items. The TITAN III launch facilities procured since the initial Integrate-Transfer-Launch (ITL) complex at the Eastern Test Range (ETR) have all been designed to provide the minimum capability necessary to meet firm requirements. These facilities **are** the new launch complex at the Western Test Range (WTR) for TITAN IIIM (MOL) and the modification of two existing launch pads at WTR for the TITAN IIIB and the TITAN IIID programs. These launch facilities utilize a conventional assembly-on-pad design approach and do not include the rapid-launch, mobile features of the TITAN III ITL launch complex at ETR. Had the TITAN III ITL design been limited to meet firmly programmed requirements certain of the mobile features could have been eliminated. The cost of the facility would have been reduced, though not by the full \$23.8 million (15%) which you indicate, since some additional provisions would have been necessary for handling the TITAN III large solid motors.

GAO note: Satellite program designation blocked out to remove classification of letter. Approval of report release without classification obtained from Dr. Alexander H. Flax, Assistant Secretary of the Air Force (Research and Development).

The data recording instrumentation and storage buildings included in the design of the solid rocket motor test complex (1-36) at Edwards were considered necessary at the outset to meet the development and qualification test needs for the TITAN III program. Certain potential malfunctions planned for in the solid motor development were not encountered. In fact, the success of the program permitted the elimination of the solid motor qualification requirement and resulted in a substantial overall saving to the TITAN III program. This unusual success could not have been fully anticipated at the time of facility construction.

As pointed out in your report, the Program tracking and read-out facilities were constructed prior to the decision not to deploy the system operationally. Prior to that decision I do not believe a delay in constructing these facilities would have been proper. These facilities were used subsequently on Program as you know.

The Air Force comments provide a thorough discussion of existing pertinent Air Force regulations which do provide for reevaluation of requirements and schedules prior to acquisition. I believe that these Air Force regulations, if fully adhered to are adequate, and that additional revisions to meet the objectives cited in your letter are not necessary. The Air Force comments also note their efforts to develop and implement criteria specifications. This technique should provide additional support to existing review procedures.

Similarly I believe that the Army and Navy procedures provide adequate safeguards to insure that these Services do not acquire support facilities without first reevaluating their need in light of the then current status of a particular development program. However, you will note in the Navy comments attached that additional precautionary safeguards will be added to their current procedures.

Sincerely,



John S. Foster, Jr.

Attachments

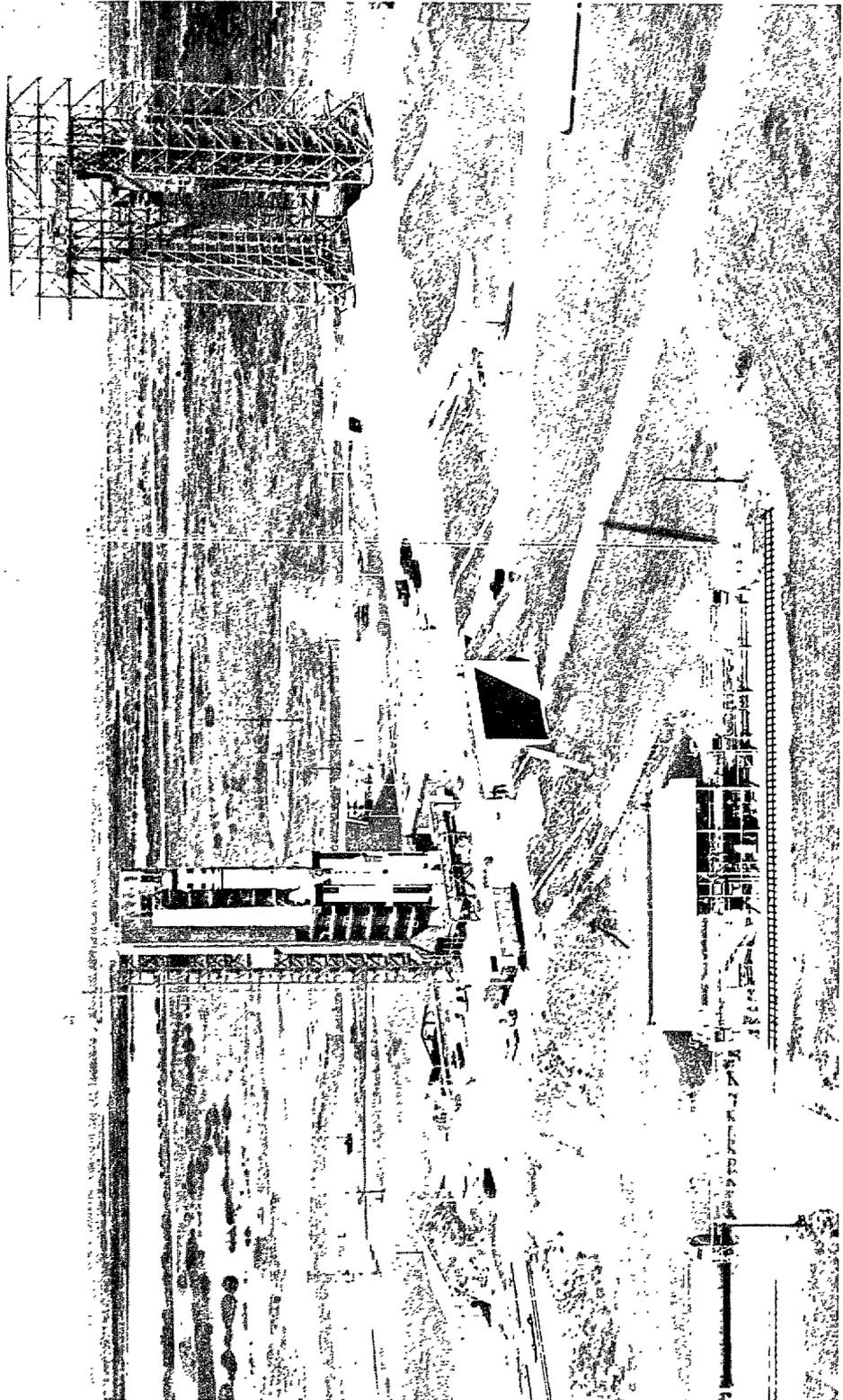
PRINCIPAL OFFICIALS OF
THE DEPARTMENT OF DEFENSE AND
DEPARTMENT OF THE AIR FORCE
RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES
DISCUSSED IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
<u>DEPARTMENT OF DEFENSE</u>		
SECRETARY OF DEFENSE:		
Clark M. Clifford	Mar. 1968	Present
Robert S. McNamara	Jan. 1961	Mar. 1968
DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING :		
John S. Foster, Jr.	Oct. 1965	Present
Harold Brown	May 1961	Oct. 1965
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS) (formerly Supply and Logistics):		
Thomas D. Morris	Sept. 1967	Present
Paul R. Ignatius	Dec. 1964	Sept. 1967
Thomas D. Morris	Jan. 1961	Dec. 1964
<u>DEPARTMENT OF THE AIR FORCE</u>		
SECRETARY OF THE AIR FORCE:		
Harold Brown	Oct. 1965	Present
Eugene M. Zuckert	Jan. 1961	Sept. 1965
UNDER SECRETARY OF THE AIR FORCE:		
Townsend Hoopes	Sept. 1967	Present
Norman S. Paul	Oct. 1965	Sept. 1967
Brockway McMillan	June 1963	Sept. 1965
Joseph V. Charyk	Jan. 1960	Mar. 1963

PRINCIPAL OFFICIALS OF
THE DEPARTMENT OF DEFENSE AND
DEPARTMENT OF THE AIR FORCE
RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES
DISCUSSED IN THIS REPORT (continued)

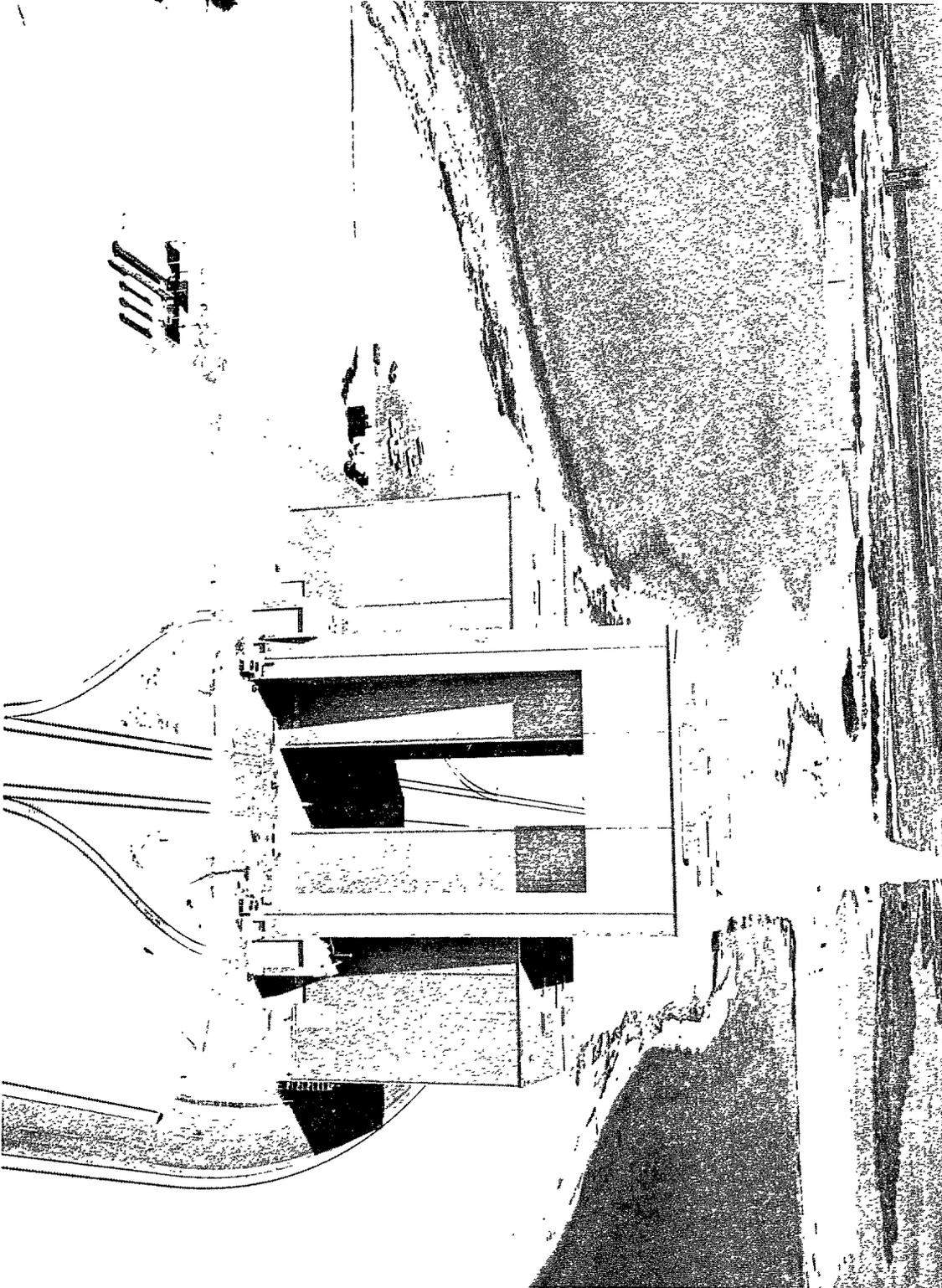
	Tenure of office	
	From	To
DEPARTMENT OF THE AIR FORCE (continued)		
ASSISTANT SECRETARY OF THE AIR FORCE (RESEARCH AND DEVELOPMENT):		
Alexander H. Flax	July 1963	Present
Brockway McMillan	June 1961	June 1963
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS) (formerly Materiel):		
Robert H. Charles	Nov. 1963	Present
Joseph S. Imirie	Apr. 1961	Sept. 1963
COMMANDER, AIR FORCE SYSTEMS COMMAND:		
Gen. James Ferguson	Sept. 1966	Present
Gen. Bernard A. Schriever	Apr. 1959	Sept. 1966
COMMANDER, SPACE AND MISSILE SYSTEMS ORGANIZATION (created July 1, 1967):		
Lt. Gen. John W. O'Neill	July 1967	Present
COMMANDER, SPACE SYSTEMS DIVISION (became a part of Space and Missile Systems Organization on July 1, 1967):		
Maj. Gen. Paul T. Cooper	Sept. 1966	July 1967
Maj. Gen. Ben I. Funk	Oct. 1962	Sept. 1966

APPENDIXES



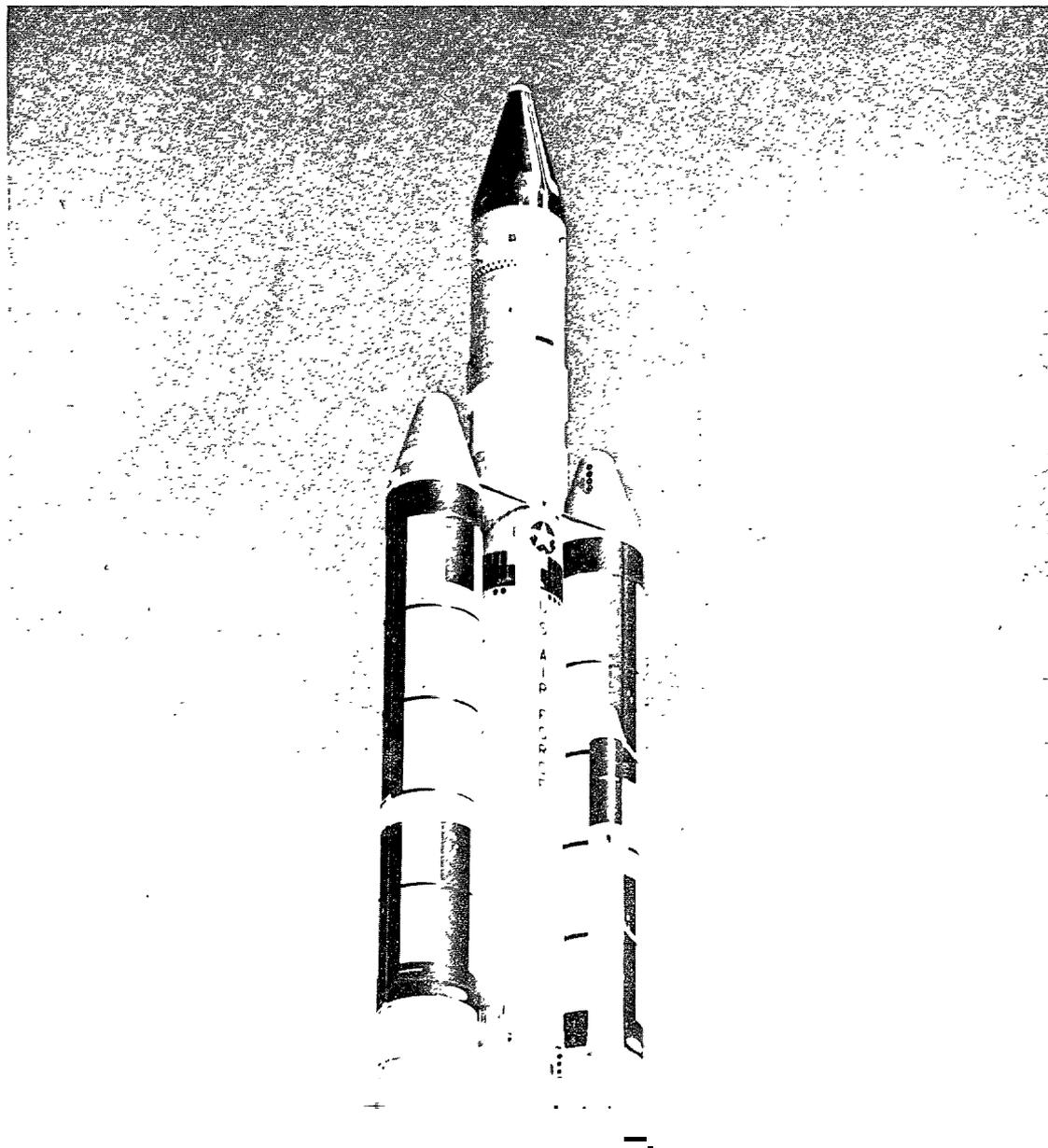
U.S. AIR FORCE PHOTOGRAPH
LAUNCH PAD AT ITL COMPLEX

SOLID MOTOR ASSEMBLY BUILDING AT ILL COMPLEX
U.S. AIR FORCE PHOTOGRAPH

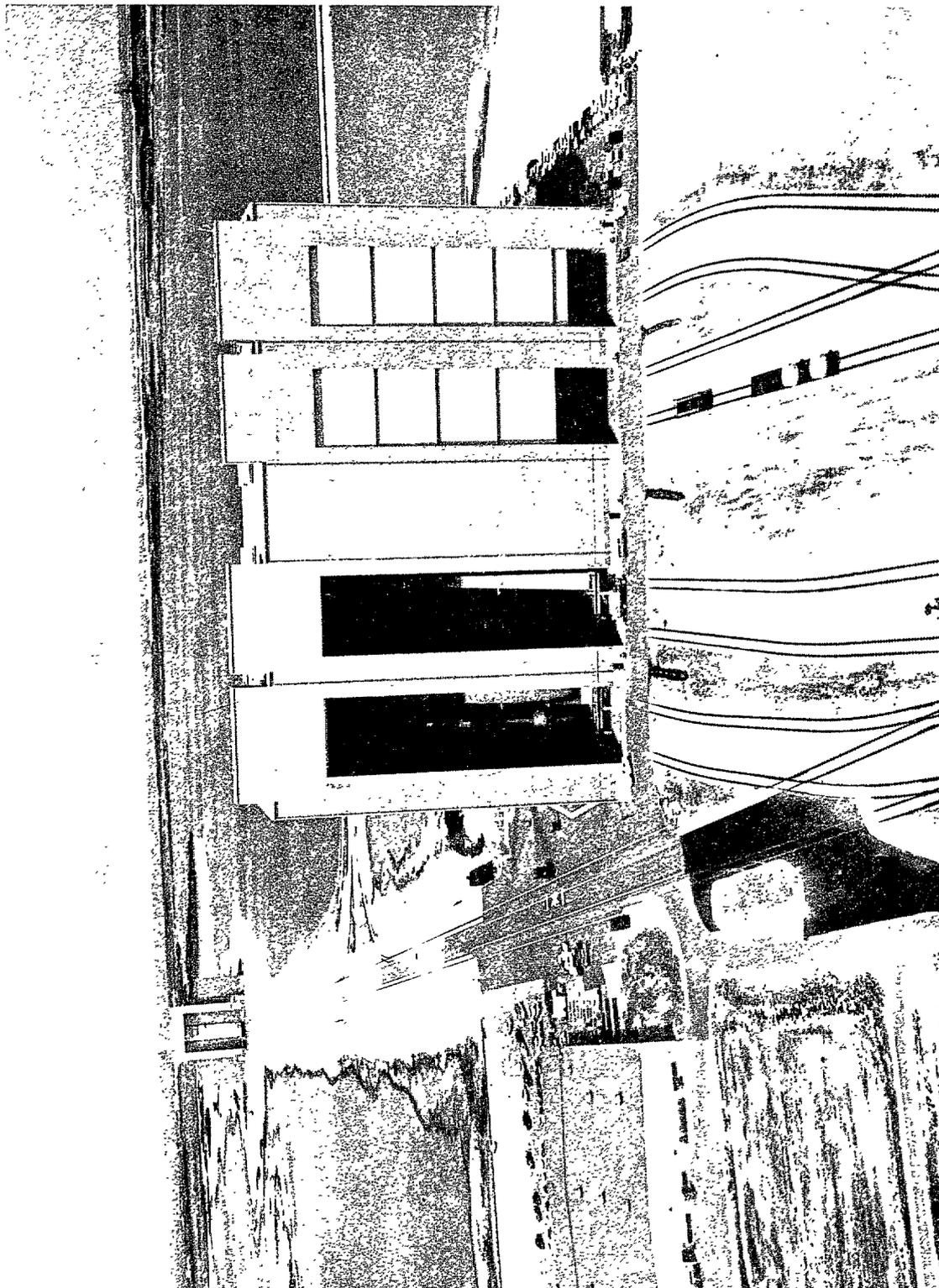


TITAN III ILL COMPLEX
U.S. AIR FORCE PHOTOGRAPH





U.S. AIR FORCE PHOTOGRAPH
TITAN III C



U.S. AIR FORCE PHOTOGRAPH
VERTICAL INTEGRATION BUILDING AT ITL COMPLEX

EXHIBITS

Conclusions

The progress and requirements of new and dynamic programs, such as the space programs, can be influenced by many factors and are subject to adjustment in the light of rapidly changing events and conditions. We believe that, for prudent use of program funds to be ensured, officials responsible for the management of such programs should be required to reevaluate program plans and program needs in consideration of changed events and conditions to determine whether costly support facilities actually are needed before action is taken to acquire them.

In our limited review of this matter, as discussed in the report, we found an instance in which savings were realized because Air Force officials did make reevaluations of changes affecting program development and consequently revised the requirements for support facilities. On the other hand, we found several instances in which opportunities for savings were not realized because initial plans for the acquisition of support facilities were not reevaluated and revised to meet changed conditions in the development program.

Under Air Force procedures construction of facilities commences early in the system development so that whatever facilities are required in the field will be ready concurrently with the mission hardware. Air Force regulations require that the system program control documents show the total facility requirements. Initially, the requirements for facilities may be based on original development launch schedules or anticipated operational requirements.

We believe that the cases described in this report indicate that Air Force procedures for systematically reevaluating and documenting the need for facilities at the System Program Office level warrant improvement. We also believe that the criteria under development should provide (1) verification of the need for facilities just prior to award of the construction contract or initiation of procurement and (2) development of alternative methods of acquiring the required facilities, including rescheduling of acquisition, so that only the facilities actually necessary, based on firm requirements, will be obtained or acquired. In our

opinion, such reevaluations, considering current needs and leadtime requirements, will provide the Air Force and DOD with the information needed to satisfy needs in the most economical manner.

Recommendations

We recommend to the Secretary of Defense that action be taken to ensure that the procedures of the services, including changes currently being made by the Air Force and Navy, provide (1) for reevaluation and updating of the approved plan for acquisition of facilities to be conducted by System Program Offices immediately prior to the procurement of costly facilities, emphasizing the need for the facilities and (2) that, where appropriate, acquisitions of costly facilities for support of a system be rescheduled in accordance with leadtimes necessary to have the facilities operational concurrently with the mission hardware. The reevaluation should include consideration of alternatives and recommendation of courses of action to the appropriate levels of command within the particular service and DOD.

Agencies' comments

We brought our findings to the attention of the Secretary of Defense in a draft report dated November 3, 1967.

We proposed that Air Force regulations be revised to provide that system development program proposals include requirements for (1) reevaluation and updating of the approved plan for acquisition of facilities immediately prior to procurement and (2) rescheduling of acquisition in accordance with leadtimes necessary to meet operational needs. We also proposed that the procedures of the Army and Navy be reviewed to ensure that these services do not acquire support facilities without first reevaluating their need in the light of the then current status of the development program.

In a letter dated January 11, 1968 (appendix II), the Director of Defense Research and Engineering (DDR&E) commented on our findings on behalf of the Secretary of Defense. The letter conveyed the Air Force comments relating to the particular facilities covered **by** our findings. These comments were discussed in previous sections of this report. The letter also commented on the procedures of the services for reevaluating requirements and schedules prior to acquisition.

The DDR&E comments did not disagree that it was necessary to reevaluate the need for facilities immediately prior to acquisition. Although the Director stated that he believed that the Air Force regulations, if fully adhered to, were adequate and additional revisions were not necessary, he referred to the Air Force's comments concerning its current efforts to develop and implement criteria specifications to provide additional support to existing review procedures.

The comments of the Air Force to DDR&E (appendix III) were attached to the letter received from DDR&E. Briefly, the Air Force stated that its management system should be based upon review and reevaluation of the total system; that current regulations provide continuous review of the total system under development; and that it is not necessary

to establish separate procedures for special reviews of an individual functional area, such as reviews prior to construction or acquisition of facilities. However, the Air Force comments stated also that, in addition to existing procedures, the Air Force has under development criteria specifications that will provide additional support to the existing review procedures.

We discussed the Air Force reply with the Assistant Secretary of the Air Force, Research and Development, on February 12, 1968. The Assistant Secretary assured us that the situations identified in our report signify the existence of a problem that the Air Force is recognizing in developing criteria specifications specifically oriented for application within the existing review system by the System Program Offices. The Air Force was not objecting to revising its procedures in order to ensure that the need for facilities is reevaluated, but was objecting to a specialized review in addition to its total system reviews currently required.

DDR&E informed us that the Army and Navy procedures had been reviewed and he believed that their procedures also provide adequate safeguards to ensure that these services do not acquire support facilities without first reevaluating the need for them in the light of the then current status of a particular development program. Again, however, the Director noted that the procedures will be strengthened. The Navy will modify its procedures to provide additional safeguards, including a stated requirement to verify facility needs as a milestone achievement prior to contract award.

We believe that the development of these additional safeguards should help to prevent the recurrence of situations similar to those described in this report. We intend to monitor the effectiveness of these management procedures to limit the acquisition of facilities to those actually needed to fulfill firm program requirements.

In July 1962 the station was placed in a caretaker status because of a sharp reduction in program funds. Although the station was nearing completion in July 1962, it had not contributed any support to the satellite program. Reactivation of the station to an operational status was begun in mid-1965, and, from June 1966 until September 1967, it participated in the satellite program.

Prior to initiation of the procurement of the 60-foot antenna, two development satellites were launched and both were failures; between the time of initiation of procurement and installation of the 60-foot antenna and other tracking and readout systems, another development satellite was launched, which also was unsuccessful.

Procurement of the 60-foot antenna was initiated in July 1960, about 2 years prior to the last scheduled development satellite test in the latest development plans that preceded initiation of the procurement, even though the total leadtime requirement was only 14-1/2 months. Installation of the tracking and readout systems, which required a leadtime of about 6-1/2 months, was started in September 1961, or about 9 months prior to the scheduled usage date. We found that consideration of data available in October 1961 would have shown that an even further delay was indicated.

We believe that the 60-foot antenna and other tracking and readout systems were procured prematurely. Also, we believe that, because of slippages in the development program, the installation of tracking and readout systems, required for the operational program, should have been deferred until there was reasonable assurance of success in the satellite development program.

We estimate that, from September 1961, when installation and checkout of the tracking equipment was begun, until July 1965, when work was started to reactivate the station, costs of about \$1.6 million were incurred which related to the unneeded equipment. These costs included contracts for phase down of the station equipment to caretaker status, including contract termination claims, and contracts for management and services to operate and maintain the equipment and facilities while in a caretaker status. In

addition, about \$170,000 was incurred during reactivation for repair and refurbishment of previously installed equipment.

In our opinion deferring installation of the tracking and readout systems, required for the operational program, until there was reasonable assurance of success in the satellite development program would have eliminated \$1.7 million of maintenance, caretaker, contract termination, and refurbishment costs.

We found no documented record of any review that questioned or reevaluated the detailed planning for procurement and installation of the tracking and readout systems at the station subsequent to the January 1959 development plan for the program.

Air Force comments

The Air Force informed us that the satellite program had been planned for a development phase and an operational phase, and because the Alaskan tracking station was planned to support the operational phase, a decision not to go ahead with the facility could not be made until the satellite operational program was terminated.

Our review was concerned with certain tracking and readout equipment that was installed at the station. This equipment had relatively short procurement and installation leadtime requirements, based on the satellite development test schedule. We believe that reconsideration of the slippage in the development schedule, even though station construction had been initiated, would have indicated that procurement of the equipment should be delayed.

The Air Force states that in retrospect it appears that a decision to delay the Alaskan facility could possibly have been made. We believe that any decision in such instances should be based on actual needs at the time of the decision. In our opinion, it is important to develop and consider alternatives, even though the final decision may be to still pursue the course originally planned,

Air Force comments

The Air Force informed us that, in the initial stages of the solid rocket motor test program, a testing schedule was established on the basis of turn-around times which required location of at least three motors at the facility concurrently during the testing program. Subsequent events resulted in a decision in early 1965 to delete qualification test firings. The Air Force stated, however, that, if the testing program had progressed as originally planned, all the storage buildings would have been utilized.

We believe that a review of UTC's test plan of September 1962, prior to initiation of construction, would have shown that requirements for storage buildings had been reduced. Also, we found that, had three motors been needed at Edwards at any one time, the additional motor could have been stored in the shipping containers. The motor segment shipping containers are capable of maintaining the motors at a constant temperature; therefore, any segment delivered to Edwards Air Force Base more than 2 months prior to its test firing date could have been stored in the shipping container until time for environmental conditioning. We found no evidence that this alternative was considered prior to construction of the storage buildings.

Satellite tracking and readout station

From our review of the acquisition of certain satellite tracking and readout equipment, we believe that a reevaluation of plans in consideration of program developments could have resulted in a reduction of costs for a classified program of about \$1.7 million.

A satellite tracking and readout station was constructed in Alaska to support a satellite program. Cost of construction was about \$25 million. This station includes a readout building and support facilities, a data acquisition and processing building, a 60-foot tracking antenna, a data acquisition system, and various other items of electronic equipment.

In January 1959 an Air Force contractor presented a development plan for the program, which included a number of satellite development test launches scheduled to begin in November 1959. The plan also included a requirement for a tracking station in Alaska, with readout and tracking capabilities for an operational program after completion of the satellite development test launches. The development plan showed that operational satellite launches were scheduled to begin 3 months after the Alaska readout station was scheduled to be ready for installation of the required instrumentation. The installation was scheduled to begin immediately prior to the last development launch.

We were advised by SSD officials that the station was not essential for program development flights since other existing tracking and readout stations could have and did provide the needed support.

It appears that the January 1959 development plan adequately provided for scheduling the acquisitions of the required facilities for the program. However, various development plans prepared by the Air Force contractor after January 1959 showed that the satellite development test flight schedule was slipping significantly. Nevertheless, with the exception of one of these plans dated March 29, 1962, the required completion date for the station was not postponed materially.

Instrumentation type	Number of basic data recording channels		
	<u>UTC</u>	<u>Edwards</u>	<u>Difference</u>
Analog-to-digital system	-	192	192
Wide-band FM system	84	84	-
72-channel narrow-band FM systems	<u>288</u>	<u>216</u>	<u>=72</u>
Total basic data re- cording capability	<u>372</u>	<u>492</u>	<u>120</u>

SSD acquired a basic data recording system of 492 instrumentation channels for the complex even though UTC, the prime contractor responsible for the testing at Edwards AFB, installed only 372 channels at its own test facility. We estimated that the additional 120 channels acquired at Edwards AFB cost the Air Force about \$683,000, as follows:

Estimated cost of 192 analog-to-digital system channels installed at Edwards AFB	\$1,358,000
Estimated cost of a 72-channel (note a) narrow-band FM system which could have been substituted at Edwards without degradation of data	<u>675,000</u>
Estimated savings if excess capacity of 120 channels had been eliminated and Edwards AFB capacity limited to 372 channels	\$ <u>683,000</u>

^aAs shown below, Aerospace Corporation found that the 192-channel system could be replaced with a 45-channel FM system, at an even greater saving.

Air Force comments

The Air Force advised us that the incorporation of additional channels of instrumentation into the Edwards facility was based on the fact that the 156-inch rocket motor program was in progress and, furthermore, the additional channels were utilized during test firings at Edwards. According to the Air Force, the extra capacity had afforded assurance that the data obtained would be more accurate and, had malfunctions occurred, additional instrumentation

would have been required on subsequent tests for complete analysis.

While excess capacity for possible use as backup may have been desirable, we noted that the Aerospace Corporation, which provides general systems engineering and technical direction to SSD, considered the instrumentation as fabricated to include excess capacity. About 3 months after award of the contract for fabrication, Aerospace advised SSD that the 192-channel analog-to-digital system could be replaced by 45 narrow-band FM channels without degradation of data.

Furthermore, we believe that a review of the need for instrumentation, as developed by UTC 2 months prior to construction, would have revealed that the only firm requirement was for the 120-inch rocket motor program and, consequently, the additional channels were not required.

Storage buildings

In our opinion, four of the 11 temperature-conditioned storage buildings constructed for complex 1-36 were in excess of needs for the 120-inch solid rocket motor program because the construction plan had not been based on actual requirements established in September 1962.

UTC's test plan, dated September 18, 1962, scheduled no more than one test firing a month at the complex, beginning in December 1963. Since each complete solid rocket motor used on the TITAN IIIC consists of seven parts and no more than one complete motor was to be test fired a month, only seven storage buildings would have been required to environmentally condition each complete motor for a 2-month period prior to test firing. Each of these storage buildings is capable of housing two 120-inch solid rocket motor segments or parts. No more than two complete solid rocket motors were at the complex at any one time during the actual test program.

On the basis of the cost to construct eleven storage buildings at Edwards AFB, we estimated that the Air Force could have saved \$137,000 by not acquiring the four buildings that were in excess of actual needs.

Support facilities at the solid rocket motor test complex

In our review of the need for the instrumentation and other facilities for testing solid rocket motors for the TITAN III booster program, we found no evidence that a re-evaluation was made from September 1962, immediately preceding construction, until fabrication of the instrumentation and construction of the other facilities had been started. We believe that reconsideration of the need for instrumentation and storage buildings prior to acquisition would have resulted in reducing the procurements to meet the requirements of the 120-inch solid rocket motor program at an estimated saving of about \$820,000.

A solid rocket motor test complex (complex 1-36) was constructed at Edwards AFB, California, at a cost of about \$12 million, in order to test the 120-inch diameter solid rocket motors in direct support of the TITAN III booster program. The design of complex 1-36 included flexibility as a prime feature so that with slight modifications the testing of 156-inch diameter solid rocket motors could also be carried out if such a program came into being. Construction of the complex began in December 1962. The major items included a vertical test stand, a horizontal test stand, an instrumentation and control system, and 11 solid rocket motor segment storage buildings.

The need for flexibility in design so that the facility's capability could be expanded to test 156-inch diameter motors appears questionable since the program was exploratory and the motor was not scheduled for use on any launch vehicle. Nevertheless, we did not find that an alternative design had been developed and presented to higher headquarters for consideration.

United Technology Corporation, now known as United Technology Center (UTC), a Division of United Aircraft Corporation, was selected in April 1962 as the contractor for development of the 120-inch solid rocket motor. UTC constructed its own test facilities at Coyote, California, as a full-scale backup for tests to be conducted at Edwards AFB.

UTC's Development Program Plan of September 18, 1962, for the 120-inch diameter solid rocket motor scheduled 33 test firings to be conducted at UTC's Coyote facility and at Edwards AFB complex 1-36. Only 17 test firings were actually conducted, 10 at UTC's facility and seven at the complex. Certain test firings scheduled for the complex were conducted instead at UTC's facility because the first test at the complex failed, extensively damaging the vertical stand.,

The complex was deactivated on June 30, 1965, and is being maintained in a standby status.

Instrumentation

On the basis of our review, we concluded that SSD had acquired about 120 basic data recording channels for complex 1-36 that were in excess of the requirements of the 120-inch solid rocket motor program. We estimated the cost of these excess channels to be about \$683,000. The original requirements for instrumentation provided flexibility for possible expansion to include testing of a 156-inch solid rocket motor program. At the time acquisition was initiated, a program for testing the 156-inch motor at complex 1-36 had not come into being. We found that the requirements were not reevaluated nor changed to correspond to actual needs.

The instrumentation system was designed by Aerojet-General Corporation's Aetron Division, in accordance with criteria established by SSD. On September 18, 1962, UTC's test plan for the 120-inch solid rocket motor indicated that a maximum of 370 instrumentation channels would be required for tests at the complex and a maximum of 361 channels would be required for tests at UTC's Coyote facility.

On November 5, 1962, UTC was assigned the responsibility for procurement, management, and installation of the instrumentation and control system for complex 1-36, and UTC subsequently awarded the subcontracts for fabrication of the system. Although the instrumentation requirements at both locations were about the same, the systems installed differed as shown in the following table:

We found that **SSD** also proposed construction of an ITL complex at the Western Test Range (WTR) for the TITAN III development program. However, DOD officials directed the Air Force to delete the ITL complex at WTR from the proposed TITAN III development program, indicating that, as the need for operational facilities became more evident in future years, they would be funded and justified as part of an operational program, not as part of the development program.

The opportunity for savings through reevaluation and updating of support facilities acquisition plans in consideration of revised development requirements was realized by the Air Force in a more current program. We made a limited review of the planning for acquisition of launch facilities for the Manned Orbiting Laboratory (MOL) to ascertain present Air Force practices.

We noted that, about 2 years after the ITL complex at WTR was deleted from the TITAN III development program, the Secretary of Defense directed the Air Force to proceed with a detailed design of a fully operational TITAN III launch pad at WTR. SSD proceeded to design a single TITAN III pad, called an initial launch capability (ILC), with provisions for later expansion to a complete ITL complex. When the MOL program was approved and a decision was made to launch the vehicle from the ILC site at WTR, the plan to expand to an ITL was abandoned. A launch pad and supporting facilities are to be constructed to accommodate only MOL launches. Consequently, the new facilities will be a "special purpose" complex.

In this instance, plans for acquisition of facilities to support the MOL program were revised after reviews were made by Air Force officials to reconcile differences in design objectives between the MOL and the TITAN III program directorates.

Air Force comments

The Air Force, in commenting on our finding, agreed that, had the design of the TITAN III ITL launch complex been limited to meet firm requirements just prior to actual start of construction, certain of the mobile features

could have been eliminated and costs would have been reduced. The Air Force pointed out, however, that additional provisions would have been necessary for handling TITAN III motors and, consequently, the savings would not have amounted to the full \$23.8 million.

These comments, relative to the need for additional provisions to convert the ITL to a conventional two-pad launch site, had been similarly expressed by officials at SSD. Upon inquiry, however, we could not ascertain from the Air Force what the cost of the additional provisions would have been. In our opinion, a substantial portion of the \$23.8 million could have been realized as savings.

We were informed that an estimate of cost of the alternative approach had not been developed by the Air Force for consideration immediately prior to the award of the construction contract. In our opinion, had such an estimate been made, consideration could then have been given to whether the additional cost involved in continuing with the original plan was warranted in view of the changed circumstances.

Also, the Air Force stated that retention of the mobile launch features provided a flexibility to support tentative program plans requiring increased quantities of boosters at a relatively modest additional cost and could conceivably result in future cost savings if future construction would be required to add this capability. We believe that tentative plans should not be considered a sound basis for planning the acquisition of costly support facilities, since such plans may never materialize. If the need for mobile facilities should become evident in the future, expansion could be considered at that time and funded as part of the ongoing program, if justified.

the TITAN III would be required. However, the **SPP** provided for a development program of 17 launches over a 43-month period ending in June 1966, indicating a capability for a high rate of launches would not be needed until after June 1966.

On March 27, 1963, about 4 months before construction of the mobile features of the ITL complex began, AFSC reported the results of a review performed by the TITAN III Task Group to resolve eight questions asked by the Secretary of Defense on December 3, 1962. The review, which included a payload study, indicated that expected TITAN III payloads would not require an ITL capability of 24 launches a year at ETR until 1967. This study was performed, and the results were known, prior to the start of construction of the mobile launch facilities at ETR in August 1963. Construction records and information obtained from **SSD** officials indicated that an 18-month leadtime was needed to construct the mobile launch features of the ITL. The ITL requirement in 1967 could have been met even if the start of construction of the facilities required for a mobile launch capability had been deferred until July 1965.

Other events occurring prior to July 1965 indicated that an ITL capability was not required at ETR and, therefore, construction could have been further deferred.

Cancellation of the DYNA *SOAR* program on December 10, 1963, shortly after construction of the mobile features of the ITL had begun, reduced the number of expected TITAN launches at the ITL facility from that estimated in the March 27, 1963, payload study to less than 24 a year through 1970. Extension of the TITAN III development program on December 28, 1964, deferred completion of the 17-launch test program until June 1967 to allow the availability of the payloads to catch up with the availability of the boosters.

Only three TITAN IIIC boosters were launched from the ITL complex at ETR in 1965 under the development program, and three more were launched in 1966. In August 1966 the anticipated number of TITAN III launches from the ITL complex averaged about four a year through 1972.

Although the TITAN III development program had changed, we found no indication that the Air Force revised its construction plans or considered a facilities construction program for two launch pads with supporting facilities but without the mobile features of an ITL complex.

SSD officials informed us that (1) after approval of the TITAN III development program, the need for an ITL capability at ETR was not reconsidered because SSD had been directed by DOD to build a complete ITL complex and (2) reviews of program requirements were conducted monthly by SSD, but the need for the ITL capability was not questioned in these reviews. Approval of an ITL to meet basic needs was originally supported by payload studies demonstrating a need for a rapid-launch capability. At the time of construction, however, the basic need had been reduced to a conventional two-pad launch facility.

We were advised by SSD officials that the ITL was justified, not only on the basis of estimated launches, but also on the basis of wanting to match the capability of a foreign power and demonstrating the feasibility of the ITL concept of rapid-launch capability, including rail transfer of the vertically integrated booster to the launch pad. However, the development boosters had never been scheduled for rapid launch. The Air Force contractor concluded in its study that the ITL concept was feasible and practical if launch rates were high enough to justify its use. Thus, it appears questionable that the need to demonstrate the ITL concept warranted constructing a complete ITL complex for the TITAN III development program, since there were insufficient launches to prove its capability.

Officials at SSD stated that the performance of the Air Force and its contractors in the development, production, test, and launch phases of the TITAN III in its various configurations was generally considered to have been successful and that significant cost reductions had been accomplished in certain aspects of the program. In our opinion substantial additional savings could have been realized had the need for the ITL capability been directly related to the availability of payloads to be launched.

that cost about \$23.8 million. Reevaluation of revised program requirements before acquisition of these facilities could have shown that these facilities might not be needed.

The TITAN III booster was developed in two configurations, referred to as IIIA and IIIC. The TITAN IIIA has a 3-stage core with a diameter of 10 feet and a height of 124 feet, and has liquid propellant propulsion systems. The TITAN IIIC is essentially the same as the TITAN IIIA except for two solid rocket motors attached on the sides of the core. Each solid rocket motor has five 120-inch diameter center segments, a forward closure, and an aft closure with a motor exhaust nozzle, (See exhibit A.)

The cost of the integrate-transfer-launch (ITL) complex, constructed at the Eastern Test Range (ETR) to launch the TITAN IIIC booster, was about \$154.4 million, including aerospace ground equipment. This complex includes a Vertical Integration Building in which the complete vehicle core is erected and vertically integrated with the payload. The building has a series of high bays used for assembly and contains the launch control center and supporting shops and equipment. (See exhibit B.)

After systems integration and checkout in the Vertical Integration Building, the vehicle core and spacecraft are moved in a vertical position on a rail transporter to the Solid Motor Assembly Building for attachment of the solid motors. (See exhibit C.) After attachment of the motors, the vehicle is transported to the launch complex, where the transporter, when locked in place, acts as a launch pedestal. The vehicle is checked thoroughly, fueled, and launched at the launch complex. (See exhibit D.)

The ITL complex constructed at ETR includes two fixed pads. It is capable of handling 40 launches a year and, if need be, may be expanded to three pads to achieve a rate of 60 launches a year. (See exhibit E.)

A chronology of events related to the progress of the TITAN III program, summarized below, indicates that it might not have been necessary to acquire some of the support facilities that were procured. On the basis of information obtained at SSD, it appears to us that the Air Force

could have built the **ITL** facilities at **ETR** on an as-needed basis, giving consideration to required leadtimes. To illustrate, the fixed-pad feature, consisting of the two launch pads, two mobile service towers, and a launch control center, could have been constructed for **TITAN III** development launches and subsequently expanded to an **ITL** complex by adding the mobile features if sufficient launch requirements materialized to justify the expansion. The mobile features include the **Vertical Integration Building**, the **Solid Motor Assembly Building**, and the transport facilities.

An **ITL Feasibility Study** prepared by an Air Force contractor in January 1962 indicated that the need for an **ITL** complex would be questionable if as few as 24 launches a year were required.

The **TITAN III** proposed system package plan, dated April 16, 1962, identified the facilities required under the basic program plans as well as under alternative program plans and provided for a development program that included 17 launches over a 43-month period.

In a memorandum report to the Secretary of Defense on August 10, 1962, the Deputy Director, Defense Research and Engineering, recommended that the development of the **TITAN III** booster be a program providing for basic needs and that the program include construction of a two-pad **ITL** facility at Cape Kennedy on the **ETR**. This facility was designed to provide capability for a high rate of launches and for vertical integration and rail transfer of the booster and payload to the launch pad. The report indicated that 50 launches a year, beginning in 1965, would be required for various **DOD** and National Aeronautics and Space Administration satellites or payloads. The program was approved by the Secretary of Defense on August 11, 1962,

The system package program (**SPP**), dated October 15, 1962, provided for a two-pad **ITL** facility at **ETR**, and had no provision for considering alternative programs. The **SPP** indicated that the only payload designated to use the **TITAN III** was the **DYNA SOAR**, but that other space programs would probably also use the **TITAN III**. Several payload studies by various agencies indicated that an **ITL** capability for

The principal officials of the Department of Defense (DOD) and the Department of the Air Force responsible for administration of activities discussed in this report are shown as appendix I.

FINDINGS AND RECOMMENDATIONS

OPPORTUNITY FOR SAVINGS THROUGH IMPROVED PROCEDURES FOR THE ACQUISITION OF SUPPORT FACILITIES

Our review showed that reevaluation and updating of initial Air Force plans for acquiring certain support facilities--immediately prior to the procurement action, in order to buy only what was actually needed in the light of revised program requirements--could have resulted in significant savings to the Government.

We found that the Air Force acquired test, launch, and tracking facilities for the TITAN III booster program and a classified satellite program in accordance with initial plans that had not been reevaluated and updated despite rapidly changing circumstances that affected these programs. These circumstances had indicated that requirements for test facilities were substantially less than those originally estimated. We believe that a substantial portion of the estimated costs of about \$26.3 million incurred for these facilities could have been saved. The facilities involved are listed below and discussed in detail in this report.

1. Rapid-launch, mobile features of the TITAN III launch complex at Cape Kennedy, Florida. Estimated construction cost, about \$23.8 million.
2. Basic data recording instrumentation and four storage buildings at Edwards Air Force Base (AFB), California, Estimated procurement and construction cost, about \$820,000.
3. Tracking and readout equipment installed in a tracking station in Alaska. Estimated maintenance and refurbishment cost, about \$1.7 million.

TITAN IIIC integrate-transfer- launch facility

Plans for the TITAN III launch complex for the Eastern Test Range provided for rapid-launch, mobile facilities,

OPPORTUNITY FOR SAVINGS IN

SPACE PROGRAMS BY

REEVALUATING NEEDS BEFORE

BUYING FACILITIES

INTRODUCTION

The General Accounting Office has made a review of the acquisition by the Department of the Air Force of certain test, launch, and tracking facilities to support the TITAN III booster program and a classified satellite program. The review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), the Accounting and Auditing Act of 1950 (31 U.S.C. 67), and the contract clauses prescribed by 10 U.S.C. 2313(b).

During the course of a survey of Air Force management of satellite and booster programs, we noted the existence of inactive and standby facilities. We therefore undertook an examination of the procedures and practices of the Air Force in its determination of the requirements for facilities and updating of the requirements prior to acquisition. We examined pertinent hearings and legislation relating to the development of boosters, examined certain files and records of the TITAN III booster program and the satellite program, and held discussions with responsible Air Force officials. This report is limited to these aspects of the Air Force management of space programs.

The review was conducted primarily at Headquarters, Space Systems Division (now known as Space and Missile Systems Organization), Air Force Systems Command, El Segundo, California; Cape Kennedy Air Force Station, Cape Kennedy, Florida; and United Aircraft Corporation, Sunnyvale, California.

BACKGROUND

The Space Systems Division (SSD) of the Air Force Systems Command (AFSC) is responsible for the management of military space system programs. Its major mission is to plan, program, develop, acquire, and test space systems. The Air Force manages space system development programs through System Program Offices established in SSD. In July 1967 SSD became part of the Air Force Space and Missile Systems Organization.

In the acquisition of space systems, SSD's practice is to concurrently develop, test, and procure the various components. According to the Air Force, under this method of acquisition, referred to as the concept of concurrency, it became possible to place a system into operation in a relatively short time. Under the previous method of procurement, it took almost 10 years to advance certain systems from the point of design to entry into the Air Force inventory as operational weapon systems. Most of this time was needed to design, develop, and test the system before placing it into production.

Under application of the concept of concurrency to space programs, construction of facilities commences early so that hangars, antennas, launch pads, silos, complexes, and other required items will be ready at the same time as the booster and/or spacecraft (hardware). Under this concept a system goes through a 4-phase cycle--conception, definition, acquisition, and operation. During the definition phase a proposed system package plan, defining the system's program, is prepared. Upon approval of the program, a system package program is prepared and the system enters the acquisition phase, which includes hardware development, testing, and production. The acquisition and operational phases of a system overlap.

The concept of concurrency had been applied in the TITAN III booster program and the satellite program that we reviewed. Air Force regulations require that the total facility requirements needed to support a system be included in the system package program.

Appendix Page

Memorandum dated December 7, 1967, from
the Department of the Air Force to the
Director of Defense Research and
Engineering

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We are recommending that the Secretary of Defense take action to ensure that these procedures, including changes currently in **process**, will limit the acquisition of facilities to those actually needed to fulfill firm program requirements. We intend to monitor the effectiveness of these procedures and their implementation in future programs.

Copies of this report are being sent to the Director, Bureau of the Budget, the Secretary of Defense, and the Secretary of the **Air** Force.

A handwritten signature in black ink, appearing to read "James P. Stets". The signature is written in a cursive style with a large initial "J".

Comptroller General
of the United States

the actual start of construction, these mobile features could have been eliminated. Although the Air Force stated that some additional provisions would have been necessary, we believe that a substantial portion of the \$23.8 million could have been realized as savings,

- Basic data recording instrumentation and storage buildings for testing solid rocket motors for the TITAN III booster program were acquired in accordance with original plans. We believe that, if the need had been reconsidered prior to acquisition, procurements would have been reduced by about \$820,000.
- Reevaluation of plans for the acquisition of satellite tracking and readout equipment in consideration of program developments could have resulted in a reduction of costs of the satellite program of about \$1.7 million.

We proposed that the Air Force revise its regulations to provide that system development program proposals include requirements for (1) reevaluating and updating the approved plan for facilities acquisition immediately prior to procurement, and (2) rescheduling acquisitions in accordance with leadtimes necessary to meet operational needs. We also proposed that the procedures of the Army and Navy be reviewed to ensure that they do not acquire support facilities without first reevaluating their need in the light of the then current status of the development program.

The Assistant Secretary of the Air Force, Research and Development, informed us that the situations identified by our review signify the existence of a problem which the Air Force is recognizing in developing criteria specifications for application within its existing review system.

The Director of Defense Research and Engineering advised us that the Army and Navy have reviewed their regulations and the Navy will modify its existing procedures to provide additional safeguards, including a stated requirement to verify facility needs as a milestone achievement prior to contract award,