Program 632A

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SECRET SPECIAL HANDLING

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Objective: To provide the United States with photographic intelligence information pertaining to activities/developments within the Sino-Soviet and other denied areas. [redacted] resolution.

SAFSL Responsibility: Complete systems management including system planning and management of engineering, procurement, test planning, launch, on-orbit testing and recovery of the MOL system.

Technical Description: The MOL system consists of a Titan IIIM booster and an orbiting vehicle which includes a Gemini B re-entry vehicle, Laboratory Vehicle and Mission Module. The orbiting vehicle, weighting 32,000 lbs., will support two men in a shirtsleeve environment for 30 days. The MOL system will have a capability to obtain [redacted] ground resolution photography primarily for technical intelligence purposes.

Present Aerospace Role: General Systems Engineering and Technical Direction.

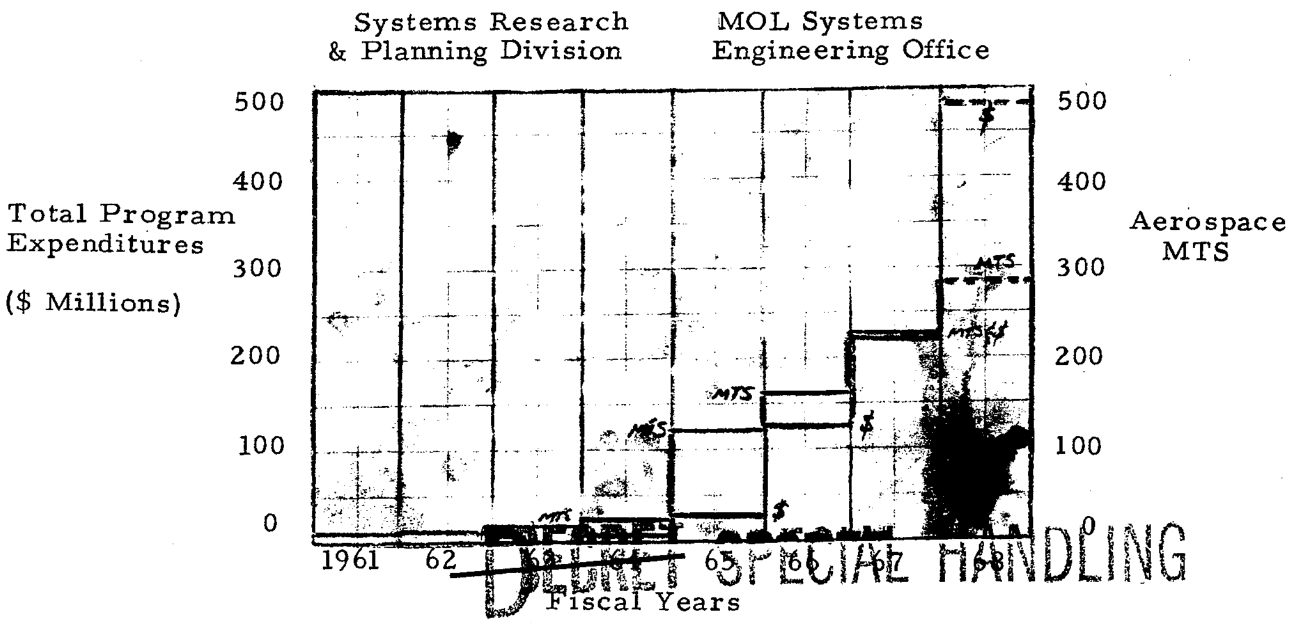
Contractor Responsibilities: T-IIIM booster - Martin Company; Gemini B - McDonnell Aircraft Company; Laboratory Vehicle, Mission Module structure and systems integration - Douglas Aircraft Company; Mission Module equipment and experiment integration - General Electric Co.; photographic equipment - Eastman Kodak; pressure suit - Hamilton Standard.

Program History: Pre-Phase I cost effectiveness and preliminary system design studies were initiated in 1960. Presidential approval to enter Phase I (Program Definition) was given in August 1965. In December 1965, direction was received to provide a capability for automatic unmanned operation. Definitive contracts were signed in May 1967 initiating the Engineering Development Phase (Phase II).

Launches: November 3, 1966 - Successful Gemini B heat shield qualification demonstration. There are seven MOL flights planned, two unmanned test, three manned and two with automatic operation, starting in early 1970 and concluding in mid 1972.

Status: The Program is currently in Phase II, Engineering Development.

Aerospace Participation: In mid 1960, Aerospace initiated studies of manned military space system concepts. Cost and effectiveness of a wide range of possible manned military missions were investigated leading to the conclusion that the reconnaissance area presented the most attractive possibility for a manned system. Subsequently, Aerospace technically directed industry studies defining the necessary booster and reconnaissance space payload combinations. Aerospace then wrote the technical portions of the Program Plan. Following Program approval, Aerospace has provided GSE/TD during the selection of associate contractors and the Program definition. Currently, GSE/TD is being provided on all aspects of the Program including continuing studies of alternate equipment use and growth capabilities.



SECRET SPECIAL HANDLING

MOL/DORIAN PROGRAM

I Importance of the Program to the United States

The United States has a vital need for intelligence information pertaining to activities/developments within the Sino-Soviet and other denied areas. For various intelligence purposes, the types, quality, and quantity of information to be collected vary considerably, and therefore, a multiplicity of programs are contributing toward the fulfillment of the overall objective. Of significant importance to the total intelligence picture is the need for very high-resolution photographic coverage primarily for technical intelligence purposes, and it is to this purpose that the MOL/DORIAN Program is oriented. This program will provide the United States with a capability to obtain [redacted] ground resolution photography, imagery of a quality far surpassing that associated with our present base of photographic intelligence.

II Contributions of Aerospace to the Program

For the first three years following its inception in mid-1960, Aerospace Corporation personnel were engaged in studies of manned military space system technologies, vehicle and system concepts, costs and effectiveness. These studies were performed for a wide range of possible manned military missions. It became clear, as a result of these activities, that a justifiable manned program could only be defined in the context of a mission area fulfilling a vital national need, and that, furthermore, the presence of the man must demonstrably enhance the mission effectiveness.

The results of the mission studies indicated that the reconnaissance area presented the most attractive possibility for a manned system definition consistent with the foregoing thinking, and in the fall of 1963, Aerospace Corporation initiated intensive efforts in analyzing all aspects of the reconnaissance mission area to determine where the presence of man would permit the realization of performance capabilities unattainable in unmanned approaches. While these studies were not limited to photographic reconnaissance only, primary emphasis was placed on this area.

It soon became clear that field-of-view limitations, precise image-motion-compensation requirements, and across-the-format (geometric) smears associated with optical systems designed to achieve very high ground resolution [redacted] presented technological limitations which could be circumvented by using man to perform acquisition, target centering and tracking functions. Detailed analysis of man's ability to perform these functions and the equipments necessary to permit this were then initiated

Concurrently with the foregoing, conceptual studies were accomplished by Aerospace Corporation to define an overall flight vehicle and system. These studies resulted in selection of an orbiting vehicle comprised of a modified Gemini spacecraft, a laboratory module, and a large-aperture optical system, with a Titan III vehicle in the integral launch mode.

In late 1963, the direction of these activities underwent a major change based on instructions received from Washington. It was then the opinion of DOD leadership that the first step should be of a more limited nature. Rather than working toward the development of an operational reconnaissance system, an experimental approach was thought more appropriate to assess the ability of man to perform critical mission-oriented functions.

For the next year, planning activities were oriented toward that goal. Considerable efforts were expended in detailed analysis of potential manned contributions to militaty space missions, again primarily in the reconnaissance area, and resulted in the definition of a group of primary experiments for the MOL Program.

During this period Aerospace defined and technically directed industry studies pertaining to the definitions of the necessary experiments payloads and major vehicle subsystems. Simultaneously, vehicle systems and operations studies were continued toward this newly defined program objective. These efforts resulted in generation of a Preliminary Technical Development Plan, a System Performance/Design Requirements specification and formal definition of the program Phase Zero industry efforts. The Aerospace effort was also aimed at narrowing down the approaches requiring consideration by industry, and assuring a high caliber RFP input and efficient contractor effort. In order to accomplish this it was necessary to establish a sound system configuration with growth potential; establish the preferable subsystems as to type, characteristics, and requirements to limit scope of contractor's investigations; identify potential critical problem areas requiring detailed investigation; establish long lead time and development items; define the major trade-off considerations required to be investigated by the contractors; delineate the environmental criteria to be utilized by the contractors in their studies; develop probable contractor cost estimates for Air Force budgeting/planning considerations; and assist in establishing system segment definitions and associate contractor roles and responsibilities. Additionally, continual system planning activity assured that necessary flexibility for growth for an effective operational capability was maintained in the design.

The necessity for an experiments-oriented program and the ability to justify the large dollar expenditures necessary for its conduct was again questioned by Aerospace Corporation in late 1964. Analysis of man's ability to perform the defined critical mission functions, plus the results of simulations conducted as part of the industry studies leading to the definition of the experimental payloads, engendered a high degree of confidence that these functions could in fact be performed, and that little additional confidence in this premise could be obtained via actual space flight. Aerospace again argued that the dollar expenditure necessary to realize a manned system could only be supported if it resulted in an operational high-resolution photographic reconnaissance system, and toward the end of 1964 this position prevailed.

From then through the summer of 1965, Aerospace Corporation was heavily engaged in design and systems analysis studies leading to the definition of the MOL/DORIAN Program. Utilizing parametric data on optical payload characteristics, developed through Eastman-Kodak and Aerospace Corporation analyses, systems analyses were conducted to optimize, within the launch vehicle constraints, the performance attainable as measured by resolution; mission duration and quantity of photographic take; and to demonstrate the advantages attainable via a manned approach. These studies resulted in the definition of the MOL/DORIAN flight vehicle concept and in the quantitative definition of the primary program objective of achieving [redacted] ground resolution photography. Furthermore, the baseline system, as defined in the system spec, incorporated sufficient flexibility for possible growth to improve mission economics and performance through a variety of potential alternative approaches. In response to questions raised at a national level, major technical and economic studies were completed which fully substantiated the baseline flight vehicle and launch site selection. These studies considered Saturn I and Titan III launch vehicles, Apollo and Gemini/MOL spacecraft, and operations from ETR and WTR. Briefings summarizing these efforts, presented at high levels of government during the summer of 1965, led to approval of the program by the President in August 1965.

Following program approval, Aerospace Corporation personnel contributed heavily to the detailed definition of the Phase I program and supported the Air Force System Program Office in establishing the necessary activities at the selected associate contractors. Detailed reviews of the contractor approaches and designs have been conducted on a continuing basis and technical direction provided to all aspects of the program to ensure the development of an overall system compatible with mission objectives. The MOL Program utilizes Technical Working Groups, Interface Control Working Groups, and Technical Direction/ Program Review Meetings in accomplishing technical management. The Aerospace Corporation provides chairmanship of the Technical Working Groups and Technical Direction Meetings. Many of the Technical Working Groups are functionally oriented and serve to integrate activities across the multiple contractor structure.

In late 1965, Washington requested that the feasibility and practicality of a parallel effort to develop an unmanned DORIAN system be investigated to ensure that the Country could retain this intelligence capability in the event that the use of the man was denied for any reason. Aerospace performed an in-depth appraisal of the technical feasibility of an unmanned DORIAN system, and during this study it was demonstrated that recent advances in navigation, pointing and image-motion control devices could result in an unmanned system providing comparable resolution performance. These devices were therefore included in both the manned and newly-defined unmanned configurations in the MOL/DORIAN program.

At this point, the need for a manned program again came under close scrutiny. If the resolution performance could be attained unmanned, then could the manned program be justified solely on the basis of earlier maturity of the unmanned system? Aerospace personnel therefore initiated a complete review of all aspects of the photographic reconnaissance operation to determine if there were primary mission functions other than acquisition and tracking, now automatable, that the man could perform which would result in a significant effectiveness advantage over the unmanned approach. Questions of increased total take due to man's performance of weather avoidance and target verification functions were subjected to rigorous statistical analyses, and while they could improve the mission effectiveness, the improvement was disappointingly low.

The basic field-of-view limitation, it was then realized, had implications other than just a severe navigation and pointing requirement.

In effect, it results in the ability to contain but a single target within the field-of-view, as opposed to the multiplicity of targets containable within a single frame of lower-resolution, but wider field, photography. How then could photography of the right target at the right time be assured, considering that the presence of things or activities at the target which could yield vital technical intelligence information are highly transitory events? This thinking led Aerospace to the definition of the active indicator concept, wherein the astronauts utilizing high-power acquisition telescopes could access targets other than those pre-programmed for the main camera. If activity was detected, they could redirect the main camera to these alternate targets thus enhancing the value of the technical intelligence information contained in the imagery. Analyses of the effectiveness of this mode have indicated that for an overall mission two to three times the number of active targets could be imaged by a manned system, and in the case of certain important, high-density, target clusters as many as six times.

This concept was received by Dr. Flax and PSAC, with considerable interest and has since been subjected to considerable analysis in terms of the targeting programming problem and the nature of the necessary improved acquisition system. Additionally, simulators were fabricated and extensive exploratory simulations, using flight crew members as subjects, were conducted at Aerospace, and these tests have confirmed man's ability to perform the necessary visual target inspections. As a result, the improved acquisition system has been incorporated into the baseline system and the mission planning software is being defined to include the capability for alternate target selection and programming.

Early in 1966 it was apparent that program financial constraints and schedule considerations were such that significant changes in technical approach would be necessary. Accordingly, Aerospace identified areas which would enable reductions in program costs and which would have the least impact in reducing potential attainment of system objectives. In addition to many hardware and test deletions, consideration was given to flight development schedules in terms of alternative sequencing and deletions of flights. These efforts contributed to changes including deletion of one mission simulator, reduction in complexity of development and test fixtures and devices, deletion of the laboratory environmental control system suit loop, simplification of the monitor and alarm system, deletion of two flights, and an adjustment in the launch schedule.

More recently, Aerospace was asked to reinvestigate the possibility of using the MOL/DORIAN payload [redacted] under the constraint that no modifications to the hardware be made to achieve these capabilities. The results of Aerospace analyses indicated that these capabilities were attainable under this constraint, and based upon briefings presented to Major General Stewart in April 1967, the program received directions to insure the ability to incorporate these capabilities into the baseline, and define in depth the necessary software changes.

Today the MOL/DORIAN Program is in Phase II engineering development, proceeding toward a date of December 1970 for the first manned flight. Aerospace Corporation is continuing in its role of providing general system engineering and technical direction of all aspects of the baseline program to ensure on-schedule and in-cost realization of program objectives. Studies of possible program growth avenues for enhancement of the primary mission objectives, as well as the possible utilization of MOL hardware for other military or NASA objectives, are underway on a continuous basis to provide overall longer-term direction to the program.