Nov-67

TALKING PAPER

MOL/AAP CONSIDERATIONS

INDEX

I. INTRODUCTION

Severe budget limitations in FY 69 plus general Congressional/public criticism of the parallel and apparently duplicative MOL and Orbital Workshop Programs have required that DoD and NASA again assure that the continuation of separate programs is still valid and that the two efforts are as correlated, coordinated, and cost-effective as possible. This paper examines the two programs in that general atmosphere.

The sections which follow describe the MOL and AAP (Orbital Workshop portion only) Programs; discuss the possible use of MOL hardware by NASA and the possible use of Apollo/AAP hardware for MOL purposes; propose a gradual "unification" and closer correlation of the MOL and AAP Programs; and discuss various management considerations and other aspects.

II. MANNED ORBITING LABORATORY PROGRAM

A. MOL Baseline Technical Objectives:

The principal objective of the MOL Program is to secure [redacted] resolution photography of significant targets in denied areas for technical, strategic, and tactical purposes and, at the same time, to determine the extent of man's capability to operate, adjust, maintain, and process the output of complex military equipment in space. The objective is to be reached through the development of the necessary high resolution optical technology and flight vehicles for either manned or unmanned use.

B. Flight Hardware and Mission Profile:

1. The Manned System:

The major elements of the manned space vehicle include: the GEMINI B; a LABORATORY MODULE consisting of a pressurized compartment and an unpressurized service section housing oxygen, helium, hydrogen, fuel cells, and attitude control and auxiliary propulsion systems; and a MISSION MODULE which houses the optical assembly.

The GEMINI B, LABORATORY MODULE, and MISSION MODULE will be launched as an integral unit by a TITAN IIIM booster and carry sufficient expendables to function on-orbit for at least 30 days. This vehicle will weigh approximately 29,500 pounds at injection into the normal 80 x 180 nautical mile, elliptical, 90^{o}-inclination polar orbit.

The two MOL astronauts will ride in the GEMINI B during launch; transfer through the tunnel to the pressurized laboratory after injection into orbit and work in a "shirtsleeve" two-gas (oxygen and helium at 5 psi) atmosphere during the 30-day reconnaissance mission; transfer back to the GEMINI B along with the exposed film at the end of the mission; detach from the LABORATORY/MISSION MODULE and reenter the earth's atmosphere for landing in a predesignated recovery area in either the Pacific or Atlantic Oceans. The LABORATORY/MISSION MODULE will then be de-orbited into the South Pacific area, burning up during reentry.

2. <u>The Unmanned System</u>:

The major elements of the unmanned space vehicle include: the SUPPORT MODULE housing six film reentry vehicles; MODIFIED LABORATORY MODULE without life support equipment and manual controls; and the MISSION MODULE housing the optical assembly.

The SUPPORT MODULE, MODIFIED LABORATORY MODULE, and MISSION MODULE will be launched as an integral unit by a TITAN-IIIM booster and carry sufficient expendables to function on orbit for approximately 56 days. This vehicle will weigh approximately 27,400 pounds at injection into the normal 80 x 180 nautical mile, elliptical, 90°-inclination polar orbit.

Upon completion of photography, film will be transferred sequentially to the reentry capsules, one of which will be returned to earth approximately once each 7-10 days (depending on the operational situation or "health" of the vehicle) and retrieved in the air near Hawaii. After recovery of the sixth reentry vehicle, the MODIFIED LABORATORY/MISSION MODULE will be de-orbited into the South Pacific area, burning up during reentry.

C. Ground Environment:

1. Government/Industrial Base:

The MOL Program has both open and covert management channels, under the joint executive management of the Secretary of the Air Force and the Director of the National Reconnaissance Office (DNRO).

Other participating government agencies include the: Air Force Satellite Control Facility; 6595th Aerospace Test Wing; Western Test Range; Pacific Missile Range; 1st Strategic Aerospace Division; National Range Division; and the Department of Defense Manager for Manned Space Flight Support Operations.

The design, development, manufacture and test of the MOL system is on contract with five principal Associate Contractors, who as of June 1, 1968 had approximately 12,000 direct and indirect personnel assigned to the MOL Program. A peak of approximately 18,000 will be reached in late FY 69 or FY 70 (depending on FY 69 funding). The contractors and their responsibilities are:

a. The Douglas Division of the McDonnell-Douglas Corporation who provides the Orbiting Laboratory and the external structure of the Mission Module which houses the photographic system.

b. The McDonnell Division of the McDonnell-Douglas Corporation who builds the Gemini B, used as the ascent vehicle for the crew, and the return vehicle for both crew and film.

c. The General Electric Company who provides the control system and mounting structure for the large tracking mirror in the Mission Module, most of the photographic mission-related control equipment in the Orbiting Laboratory, software for mission accomplishment, system integration functions for the photographic payload, and data return capsules for the unmanned system.

d. The Eastman Kodak Company who is responsible for the optical and camera elements. Included in the Eastman Kodak contract is provision for approximately $30 million of industrial facilities built and equipped specifically for the MOL Program.

e. The Martin-Marietta Corporation and its TITAN-III associates (Aerojet General, AC Electronics, United Technology Corporation, and Spacecraft Incorporated) who are providing the TITAN-IIIM launch vehicle and booster launch services.

2. Launch Facility:

SLC-6 at Vandenberg AFB.

3. Command, Control and Communication:

Satellite Control Facility.

4. Recovery:

Department of Defense Manager for Manned Space Flight Support Operations, and recovery aircraft of Satellite Control Facility (for unmanned operations).

D. Schedule

Booster/Gemini Qualification Flights	Nov '70 April '71
Manned All Up Flights	Aug '71 Jan '72 May '72
Unmanned All Up	Sept '72 Jan '73

E. Funds

Baseline MOL Fund Requirements for the Engineering Phase which began September 1966 are as follows:

FY 68 & Prior	FY 69	Total Program
$722 Million	$600 Million	$2.84 Billion

F. Realigned Program

Because less than optimum funds apparently will be available in FY 69, a proposal has been made to defer all development effort on the unmanned system from FY 69 to FY 70. A fourth manned flight would be added to the program and inserted into the flight schedule prior to the two unmanned flights. By concentrating on the manned effort in FY 69, the maximum return could be obtained from the available funds and the effects of fiscal restraints lessened. The schedule and fund requirements that might result from such a realignment of the program are covered below:

1. <u>Schedule</u>

Booster/Gemini Qualification Flights	Feb '71 July '71
Manned All Up Flights	Dec '71 May '72 Oct '72 Mar '73

Unmanned Flights - first to be scheduled in July or August 1973 if work is reinitiated in FY 1970.

2. <u>Funds</u>

Fund requirements for the realigned program are estimated as follows (These cover only the scheduled six launches. If the unmanned effort is reinitiated in FY 70, appropriate "delta" increments are required in FY 70 and beyond, and the total cost increases to approximately $3.1 billion):

FY 68 & Prior	FY 69	Total Program
$722 Million	$530 Million	$2.71 Billion

III. APOLLO APPLICATIONS PROGRAM

A. Technical Objectives:

The stated objectives of the Apollo Applications Program (AAP) are:

1. Obtaining information on how best to sustain or improve the effectiveness of man in space in terms of biomedical considerations, living conditions, mobility, and work station designs.

2. The achievement of long-duration operations.

3. The conduct of scientific, technical, and applications tasks with the aim of assessing, experimenting with, and increasing man's capabilities for performing these tasks as well as the acquisition of useful data and results.

The Apollo Applications Program includes three separate elements:

1. The low earth orbital phase using the empty hydrogen tank of the S-IVB stage as an orbital workshop;

2. Lunar exploration missions; and

3. A large ground outfitted workshop employing a Saturn V as the launch vehicle.

The latter two elements, lunar exploration and the Saturn V "dry" workshop, are not discussed in this paper since they are not pertinent to the current MOL/Orbital Workshop considerations in FY 69.

B. Mission Profile:

The basic AAP mission concepts are to:

1. Use launch vehicles and spacecraft developed for Apollo.
2. Accomplish space revisit, resupply, reuse.
3. Use an open-ended mission philosophy.
4. Minimize development of major new hardware.

In the low earth orbital element, the program can be described in two categories. The first category includes five Saturn-IB launches for which contractual action is in progress. The second includes three additional Apollo CSM launches to revisit the orbital workshop (these presently are only in the planning stage).

In the first category, the initial mission consists of the AAP-1 and AAP-2 launches which together are designed to place the orbital workshop in operation. AAP-2 is an unmanned vehicle which will precede AAP-1. AAP-2 will be launched on an inclination of 28.9 degrees into a circular orbit at an altitude of 230 n.m. Following the successful orbit of AAP-2, the manned

AAP-1 will be launched into orbit at a time and azimuth to facilitate rendezvous with AAP-2, the orbital workshop. The orbital workshop will use the empty hydrogen tank of the S-IVB stage (after its use as a launch vehicle stage). The manned AAP-1 (an Apollo Command and Service Module (CSM) modified for extended mission duration) will then rendezvous with the orbital workshop. The three man crew will outfit the workshop for living and working and initiate the experimental phase of the mission. The duration of the mission will be "open-ended" for up to four weeks. At the completion of this period, the workshop will be stored in orbit for reactivation and reuse on subsequent missions.

The next mission (AAP-3A) will be a revisit to the orbital workshop by a three man crew launched on a Saturn IB and employing the Apollo and the CSM. The purpose of this mission is to flight test the concept of reusing a habitable space structure after a period of several months of unattended operation in orbit. The planned duration of this mission is 56 days, with the objective of progressively extending mission length, to systematically test and evaluate the ability of both man and his spacecraft to function effectively for long periods of time in space.

The third mission involves the orbiting of AAP-3 and AAP-4 for a solar astronomy mission. This mission uses the S-IVB Orbital Workshop as a base of operations for the manned Apollo Telescope Mount (ATM) solar observatory. One Saturn IB (AAP-3) will launch a three man Apollo CSM configured for a 56 day mission and a second Saturn IB (AAP-4) will launch the ATM (on a modified LEM) with its payload of solar instruments. After the CSM and the LEM rendezvous and dock with the orbital workshop, the crew reactivates the workshop and begins the in-orbit phase of the mission. This mission will be a test of equipment and operating concepts for future manned and unmanned astronomical observatories.

In addition to the above, a series of three more launches is being planned for subsequent revisits to the orbital workshop. These missions will employ the Apollo/CSM configuration, with a maximum mission duration of 56 days.

C. Flight Hardware

1. AAP-1 is a manned vehicle consisting of an uprated Saturn 1 launch vehicle and a Block II Apollo Command and Service Module (CSM). It will be launched after AAP-2 from launch complex 34 at Kennedy Space Center.

2. AAP-2 is an unmanned vehicle consisting of an uprated Saturn I launch vehicle, an airlock, a multiple docking adapter and a nose fairing. It will be launched before AAP-1 from launch complex 37B at KSC into a 230 n.m. circular orbit at an inclination of 28.9°.

3. AAP-3A is a manned vehicle composed of a Saturn IB launch vehicle, a modified Apollo Block II CSM and resupply provisions as needed to sustain a 56-day mission.

4. AAP-3 will have the same vehicle configuration as AAP-3A.

5. AAP-4 is an unmanned vehicle composed of a Saturn IB launch vehicle, the ascent stage of an Apollo Lunar Module and the Astronomical Telescope Mount (ATM). It will be launched at a time and azimuth to facilitate rendezvous with the CSM from AAP-3.

6. It is important to understand that a very large proportion of the AAP flight hardware for the low earth orbit mission is already available or is being fabricated at this time. Based on data presented to Congress this year by NASA in support of the FY-69 Budget Hearings and NASA reports dated May 68, the following is a summary status:

a. Saturn IB. Twelve of these vehicles have been procured. Four have been launched. Vehicle 205 is scheduled for launch late this year as part of the Apollo qualification program. Vehicle 206 is in checkout. Vehicles 207 through 212 are in storage or completing fabrication. Two additional vehicles, 213 and 214, will be in manufacturing by the end of FY 68, with the long lead items for 215 and 216 ordered, and a future planned production rate of two vehicles per year.

b. Command and Service Modules, Block II. Twenty CSMs are on order (Flight Vehicles 101-119). Vehicles 101 through 105 are substantially complete with the remaining vehicles in various stages of completion. Vehicle 101 is scheduled for launch late this year as part of the Apollo qualification program on Saturn IB number 205. At the present, six CSMs are allocated to the AAP program for modification for long duration (56 days) missions.

D. Ground Environment:

1. Government/Contractor Industrial Base:

North American Rockwell - Command Service Module.

Grumman Aircraft Engineering Corp - Lunar Module.

Lockheed Aircraft Corp - Astronomical Telescope Mount.

Chrysler Space Division - Saturn IB Launch Vehicle at Michoud.

McDonnell Douglas - (Douglas Division) SIVB stage and Orbital Workshop. (McDonnell Division) Air Lock.

Martin Marietta - Systems Integration.

Boeing Co - Saturn V at Michoud.

Marshall Space Flight Center - Launch Vehicle Test, Multiple Docking Adapter.

Kennedy Space Center - Launch Operations, Launch Support.

Manned Spacecraft Center - Spacecraft Crew Training, Mission Operations.

Office of Manned Space Flight - Total Program Management

2. Launch Facility:

Kennedy Space Center.

3. Command, Control and Communication:

Manned Spacecraft Center for Mission control.

Goddard Space Flight Center for Computer Center.

World-Wide NASA Manned Flight Ground Control Network.

4. Recovery:

Department of Defense Manager for Manned Space Flight Support.

E. Schedule AAP (Approved)

Flight Mission #1

AAP-1/AAP-2 CY 1970

Flight Mission #2

AAP-3A CY 1970

Flight Mission #3

AAP-3/AAP-4 CY 1971

f. Funding - AAP

	FY67	FY68	FY69	FY70-Beyond
Research & Development	80.0	253.2	395.0	Unknown
Facilities	1.2*	2.3*	2.0	"
Administrative Opns	8.7*	28.2*	35.0	"
Total	89.9	283.7	432.0	

*Represent proportionate share of MSF budget estimates based on AAP percentage of all MSF R&D (Source: Dr. Mueller statement before the Committee on Aeronautical and Space Sciences of the U.S. Senate). The totals do not include Saturns, Apollos, LEM's, etc. funded in the basic Apollo Program.

IV. MOL HARDWARE FOR AAP PURPOSES

The MOL System can be viewed in three general configurations (and time frames) when evaluating its potential usefulness for fulfilling AAP objectives. These are:

a. the present 30-day manned space vehicle, less the camera system;

b. the present 30-day manned space vehicle, less the camera system, but modified for 40-60 day on-orbit durations; and

c. the basic MOL hardware, reengineered and modified for very long durations on-orbit (up to one year) using a space rendezvous/resupply technique.

A. PRESENT MOL SPACE/VEHICLE

The present MOL system would be taxed in terms of weight, power, pressurized volume, crew-time availability, etc., to accomplish anything more than the very high resolution photographic reconnaissance mission. Thus, unless the camera system were removed, all that NASA will (or could) learn from MOL flights is physiological information on the effects of 30 days weightlessness, and the performance of astronauts in a complex and demanding task (the latter is unique to MOL, and will constitute a significant contribution to the national space program).

However, the MOL camera system could be removed from the vehicle and either a vehicle diverted from the present MOL program or one or more additional MOL booster/space vehicle(s) produced for NASA use. In this regard, either Flight Vehicle 5 (third manned launch in present MOL Program) might be diverted for NASA use or an FV-5A (FV-6A, etc.) might be built exclusively for NASA. If the present MOL Program is stretched-out, as now being considered in conjunction with the FY 69 budget, FV-5 will be launched in about September 1972. An additional vehicle for NASA (FV-5A) could be launched about two months later without interfering with the basic MOL Program. NASA should be able to "buy" a launched, basic MOL system (not included are NASA experiments and their integration costs) for about $80 million. First NASA funding would be required in FY 70.

If the camera system were removed from the present MOL manned system, approximately 11,500 pounds of discretionary payload would be available for the Mission Module structure (10 ft. diameter and up to 36 feet long) and NASA experiments.

Virtually all NASA experiments contemplated for the Orbital Workshop except for the 56 day mission duration, rendezvous/ resupply operations, and the Advanced Telescope Mount could be accommodated in a Block I MOL space vehicle. No information is available as a basis for estimating the development and integration costs of these experiments.

In April 1968, Douglas completed an in-house assessment of the "Utilization of MOL for Astronomy in Space". Douglas concluded that most of the emphasis for astronomy from spacecraft in low orbits should be at the short wavelengths (UV, X-ray, and V-ray), and studied specific payloads in this area. This study is available in the MOL Program office.

The preceding generally contemplates NASA/MOL launches from the WTR; if ETR launches were made, the T-IIIC ITL at Cape Kennedy could be modified to accommodate MOL (Cost estimated to be as much as $75 million, including MCP and MOL AGE). Modifications to MOL for operation within the NASA Manned Space Flight Net (e.g., not using SGLS) would add additional non-recurring costs. However, discretionary payload for the MOL Mission Module and NASA experiments, at the inclination planned by NASA from the ETR, would increase from 11,500 pounds to approximately 17,500 pounds.

B. MODIFIED PRESENT MOL HARDWARE

Relatively straightforward modifications to the present MOL space vehicle for increased on-orbit duration and/or increased pressurized volume are possible in approximately the same time frame as present hardware could be made available to NASA.

The extension of the unpressurized expendables compartment now planned for the unmanned MOL system (to give it a 56 day on-orbit capability) is also being designed for inclusion in any MOL Block II manned vehicles (to increase on-orbit duration to 40-45 days). This could be included in a Flight Vehicle-5A, if desired. The non-recurring costs are estimated at about $25 million and the recurring costs approximately $5-10 million per vehicle. However, the added expendables would reduce the discretionary payload for the Mission Module structure and NASA experiments from the previously noted 11,500 pounds to about 9,500 pounds.

Another possibility for increasing the on-orbit duration of the MOL vehicle as well as the pressurized volume is to pressurize all or part of the Mission Module section, incorporating a separate Environmental Control System for this purpose. Up to about 2500 additional cubic feet of pressurized volume could be made available in this manner and the on-orbit duration increased to 60 days or more. There are many possible variations of this configuration; including combinations of some with the "stretched" expendables compartment described above. Discretionary payload for experiments would be reduced to 2-3000 pounds. Non-recurring costs could run as high as $200 million, and recurring launched costs (less experiments) could exceed $100 million per mission.

The above possible modifications all contemplate WTR launches. Non-recurring costs should be adjusted properly for ETR launches; however, discretionary payload would be increased by about 6,000 pounds.

The configurations described in this sub-section would accomplish essentially all of the AAP objectives except the rendezvous/resupply operations and the ATM experiment (as the mount, as presently designed, is too large).

C. GROWTH VERSIONS OF MOL

In late 1967, Douglas completed a NASA-funded study of a one-year duration MOL vehicle (which employed space rendezvous/resupply. The basic concept is to first launch an RIV (Rendezvous Initial Vehicle) consisting of a Gemini, MOL pressurized laboratory, and lengthened unpressurized expendables compartment, with a TITAN IIIM into a low earth orbit. This is to be followed by an RRV (Rendezvous Resupply Vehicle) launch -- generally similar to the RIV -- and rendezvous of the two vehicles in orbit. Four men would then be on orbit for 60 days, at the end of which, another RRV would be launched, two of the first four astronauts would return to earth, the initial RRV discarded, and the process repeated at 60 day intervals.

Douglas envisaged the RIV as lasting one year, and being resupplied six times by RRVs. Douglas estimated the non-recurring and recurring costs of a three-year on-orbit program (three RIVs, eighteen RRVs) at $2.2 billion, with three years of development prior to the first launch. These cost estimates appear to be quite low, even though a great deal of basic MOL hardware would be used.

Nevertheless, such a configuration is technically quite feasible, and probably could be developed for launch in the 1973-1974 time period without undue interference to the basic MOL Program. Such a configuration would meet all of the AAP objectives (except to utilize Apollo hardware) as currently stated.

V. USE OF AAP HARDWARE FOR MOL

A. Background:

As a part of the effort to accomplish a manned lunar landing in this decade, NASA has developed a very large hardware, and an in-house and contractor manpower capability which might be applicable to other uses. The underlying motivation for the Apollo Applications Program is the utilization of Saturn/Apollo hardware. Thus, the AAP missions are a consequence of this situation rather than an original requirement.

On the other hand, MOL does fulfill a requirement of National urgency and, therefore, this gives rise to the obvious thought of using Apollo hardware for the MOL missions. The Apollo program production plan required a procurement of Saturn IB and Saturn V launch vehicles as well as Apollo spacecraft (Command Modules, Service Modules, and Lunar Modules) in such quantities as to insure with great confidence the successful accomplishment of the lunar landing goal. Presently it is becoming increasingly obvious that there may be many surplus articles available which will have been procured with lunar landing funds.

At the time the MOL program was being conceived and approved (1965), it was not clear how much of the basic Apollo hardware would become excess, and, therefore, in any considerations for MOL the full cost of Apollo spacecraft and launch vehicles has to be assumed. On that basis, the Gemini-MOL-Titan III combination specifically designed for the military mission proved to be significantly less expensive. Reevaluation of the use of Apollo and/or AAP hardware for MOL purposes reconfirms the earlier findings. For example, it is not feasible to install the MOL payload inside the S-IVB Orbital Workshop since it is being launched with the hydrogen propellant, and the delicate payload would not be able to withstand the cryogenic environment.

It is conceivable to place the MOL Mission Module in the Apollo Spacecraft Launch Adapter and use the CSM as the crew vehicle instead of the Gemini B. However, this approach still doesn't appear to be desirable since it would require the development of a pressurized compartment to carry the MOL payload controls and displays as well as some means of permitting crew access to the area. The Airlock Module currently under development for AAP could not serve this purpose.

The development of a new pressurized module would be at least comparable to the current development of the MOL Laboratory Module.

B. Use of the Saturn IB:

The alternative of using the Saturn IB only, without the Apollo Spacecraft, however, may be worthy of reconsideration. The basic Apollo program has used four Saturn IB vehicles to date, and one more launch is planned in support of the manned lunar-landing effort. The Apollo Program plan is to employ Saturn V vehicles after this last Saturn IB launch. Thus, if everything goes well, there will be at least seven Saturn IBs available which will have been fabricated. In addition to this, NASA has ordered the long lead items and began assembly of four additional Saturn IBs. Thus, if the earth orbital portion of the Apollo Applications Program were cancelled, seven to eleven "free" Saturn IB launch vehicles could possibly be made available to the MOL Program. As a parallel action to this, the Titan IIIM would be cancelled. Such a cancellation would avoid the expenditure of about $300 million in MOL funds.

Since MOL requires polar orbits, a Saturn IB launch facility would have to be constructed at or near the current MOL launch complex. Most of the MOL supporting buildings and facilities could be utilized, but Saturn IB AGE and other launch vehicle supporting equipment would have to be transferred from ETR or newly acquired. It is estimated that a new Saturn IB facility at WTR might cost as much as $150 million, although at least half of this amount could be saved if ETR equipment could be utilized. In addition to this, $50 - $75 million more probably would have to be expended to integrate the MOL Orbiting Vehicle with the Saturn IB. The MOL vehicle qualification program would have to be redefined for the new environment, a new spacecraft-to-launch-vehicle adapter constructed to mate the 22 ft. S-IVB to the 10 ft. MOL, and possibly a launch escape tower added to the Gemini because of the more explosive character of the hydrogen/oxygen propellant in S-IVB.

It appears that if the NASA surplus Saturn IB vehicles could be made available at no expense to the DoD, some initial savings might accrue to the MOL program. Once these vehicles are expended, however, any additional MOL launches would have to utilize newly produced Saturn IBs with an approximately $15 - $20 million cost difference per flight as compared to the projected Titan IIIM recurring costs.

Thus, in summary, if the Orbital Workshop portion of AAP were terminated and Saturn IB's diverted to MOL, some initial savings probably would accrue from termination of the Titan IIIM effort. If there were a follow-on MOL program, however, the higher costs of the Saturn IB would soon offset this advantage. If the AAP Program continues as planned, however, the Titan IIIM booster is cost advantageous for MOL.

C. <u>Other Considerations</u>:

The current Apollo program contracts may also produce excess spacecraft for possible use other than the MOL reconnaissance mission. For example, the Lunar Module represents an attractive space maneuvering capability with possibly as much as 10,000 ft/sec velocity change available. A Lunar Module combined with a Gemini B re-entry spacecraft when launched on a Saturn IB represents an interesting possibility for [redacted]

[redacted]

VI. "UNIFIED" MOL/AAP PROGRAMS

Neither of the two possibilities discussed in Sections IV and V are attractive. Total termination of the earth orbital portion of AAP is not realistic since much of the hardware has been or is being produced for either Apollo or AAP use; a large Government/contractor team is at work, etc.; and further, MOL could not fulfill all of the major AAP objectives without entering a major engineering/development program. On the other hand, virtually none of the Apollo or earth-orbital AAP Program hardware except the Saturn IB booster could be useful to the present MOL Program. The use of the S-IB in lieu of the T-IIIM might only be cost-attractive from the short term view if the S-IB's could be provided "free" to MOL by NASA; the S-IB would not be cost-competitive with the T-IIIM if there were a follow-on MOL buy. Further, if MOL should "grow" to 40-45,000 pounds on-orbit weight for longer manned missions, it appears that the T-IIIM could be uprated at less cost than the S-IB.

As an alternative, the possibility of "unifying" or semi-merging the MOL and earth-orbital AAP Programs toward coordinated national objectives and to reduce total DoD and NASA space expenditures in FY 69 and subsequent years has also been examined.

MOL objectives toward very high resolution photography, the development of both manned and unmanned reconnaissance systems, and the collection of data on man's ability to perform complex military functions in space are "hard" and have adequate Executive and Legislative support. In comparison, the AAP earth orbital objectives of extending the duration of manned space missions and conducting scientific and earth resources applications experiments are relatively "soft" and have questionable Legislative support in the present environment. For the short term, it does not appear sensible to either terminate or combine the two programs; however, a closer merging of current objectives, efforts, and mid-term follow-on plans should serve to make the earth orbital portion of AAP more technically useful, more palatable to the Congress, and insure that future NASA/DoD space station efforts are coordinated and economical.

Reasonable "unified" objectives of the two programs appear to be military missions in earth orbit (MOL), general manned operations (both), very long duration manned operations, including rendezvous and resupply (AAP), and manned applications experiments in orbit, including earth resources (both), and astronomy (AAP). One possible approach toward these objectives is discussed in the following paragraphs.

Specifically, it is envisaged that the MOL Program would be approved at present for six launches (2 unmanned, 4 manned, deferring development of unique unmanned items in FY 69, as now being considered for the program), and AAP be limited to a maximum of six launches (2 to assemble workshop; 1 resupply for 56 day mission; 2 for ATM assembly and resupply; and 1 as a backup or for a subsequent revisit), while the future courses of action for both programs were studied and coordinated between now and the submittals of the FY 70 and 71 Budget Estimates. The objectives and configuration of the present MOL would be unchanged; however, the AAP, aside from its primary objectives of rendezvous/resupply, 56 day earth orbital missions, and astronomy and earth resources experiments, would be reoriented somewhat. Certain of the additional experiments now planned (many of which are short term and/or could be accomplished in unmanned vehicles) would be replaced by tests of specific subsystems and/or components (generally non-camera related) for application to any future 60-90 day MOL Block II/III vehicles.

A joint DoD/NASA group of appropriate officials would be established to study future objectives and meshing of the two programs. The first few months should be spent on reorienting lower priority Orbital Workshop experiments to direct support of the 60-plus day MOL. Then, the next step in the earth orbital portion of AAP should be evaluated. One possible solution would be to conclude the present Orbital Workshop Program after the first three missions (5 launches) and have NASA then use basic MOL and/or available Apollo/CSM hardware for further earth resources or astronomy experiments pending possible development of a Saturn V-sized space station.

A cursory examination of this concept indicates a possible "savings" of perhaps $200 million in MOL and AAP in FY 69 (from program goals and dollar needs as set forth in the

FY 69 Budget Estimate) without seriously damaging either program. This potential $200 million comes from a reduced/stretched MOL Program (70), deferral of Saturn V workshop studies (20), reduced Saturn IB launches to six (20), reduced or closed excess NASA launch vehicle facilities, AAP integration contracts, and Houston AAP effort (potential $100 million).

Additionally, the Michoud facility might eventually be phased out, and Saturn V fabrication transferred to the Marshall Space Flight Center. There Nasa, employing the "arsenal" concept, could utilize NASA personnel for production of the limited number of Saturn Vs required for further lunar exploration, deep space exploration, and/or the large earth orbiting station under study by NASA.

VII. MANAGEMENT CONSIDERATIONS

If NASA were to use MOL Block I hardware, less the camera system, the most straightforward management arrangments probably would be for NASA to: contract through the AF for the basic MOL hardware; collocate a NASA management group with the MOL Systems Office to look after NASA interests in this regard; and contract separately with Douglas for experiment integration, providing the experiments as NASA-furnished equipment. Alternatively, NASA could ship the Mission Modules to MSC or MFSC and install the experimental equipments there. Another task of the NASA Management Group in LA would be to work out launch, on-orbit control, and recovery plan details with the Systems Office. Undoubtedly, a joint Washington-level DoD/NASA group should also be established to oversee and provide policy guidance for the entire operation.

If NASA, rather than using basic Block I MOL hardware, were to elect to proceed directly to a longer-than-30 day duration MOL, the extent of the changes would probably determine the revisions necessary to the above management arrangements. For example, the preceding arrangement could handle the 40-45 day MOL (incorporating the unmanned system expendable "wafer" for increased on-orbit durations). However, a 60-90 day MOL, or continuous on-orbit operation, at an early date would undoubtedly require considerable revision in the above contracting approach, with NASA probably contracting directly with DAC for the major effort, and the AF providing various subsystems (Gemini B, T-IIIM, ECS, etc.) as GFE items added on to existing AF contracts.

Were the DoD to decide to use the Saturn IB booster in lieu of the T-IIIM, the most straightforward management arrangement probably would be for the AF to "contract" with NASA to provide the S-IB's and the launch services, and for NASA and the AF to establish joint offices at both MSC and Los Angeles to coordinate and monitor details of spacecraft/booster integration, changes to the SLC-VI at VAFB, etc.

If the DoD and NASA were to elect, however, to pursue the "unified" approach discussed in Section VI, the first step should be an ad hoc effort by appropriate DoD and NASA officials (perhaps, the MSFPC would be appropriate for this task) to define and agree on the scope and objectives of the MOL Block I/II Programs and the earth orbital portion of the

AAP, and to prepare a charter for a DoD/NASA MOL/AAP Planning and Coordination Group. The short term objectives of the latter should be to first reorient some of the Orbital Workshop experiments toward technology for longer-duration MOL and Saturn V-sized space stations, and next to study AAP earth orbital objectives and hardware approaches for the period between the completion of the present OWS program and any Saturn V-sized space station. The efforts of the P and C Group would, of course, have to be closely coordinated with the booster studies now beginning.

VIII. DISCUSSION

The various possibilities discussed in this paper range in scope from immediate NASA involvement in MOL to questions of long term national space policy. There are apparent advantages and disadvantages in each for the DoD and NASA and, in some cases, to both. Any serious consideration of any of these proposals will require in depth analysis and examination of alternatives. At the present time, MOL seems to enjoy a fairly solid position in Congress, with the exception of some not thoroughly briefed congressmen who continuously raise the MOL/AAP duplication question. Some joint venture might be useful to appease those MOL critics. The key problem, however, is NASA's dilemma in the Apollo Applications Program and the long-term Apollo/Saturn V future. The latter is a national problem of major proportions. This paper has confined itself largely to the MOL/AAP interaction.

The "unified" program discussed in Section VI appears to have appeal for a variety of very useful reasons, provided certain restrictive ground rules are observed and inforced. These ground rules can be summarized as:

a. The MOL in any military vehicular version must operate exclusively within the authority and constraints of the NRO and NRP security.

b. The MOL must continue to emphasize the primary purpose of the program which is an operational reconnaissance mission.

c. In no case will any plan consider the flying, on a NASA spacecraft, of reconnaissance equipments or reconnaissance related equipments as a major or principle experiment.

Within these specific constraints, a number of technically significant and nationally important advantages can be realized. Some of these are:

To the DoD -

a. Assists in keeping DoD space development efforts oriented to military applications while advanced space technology developments are properly carried out by NASA.

b. Insures the development of the technology, common spacecrafts and boosters for defense and civil applications outside of the DoD budget.

c. Enhances the DoD ability to influence and guide, NASA in the achievement of common goals and national economies.

To NASA -

a. Strengthens the NASA justification for the present earth orbital portion of AAP by giving AAP a mission in support of Block II/III MOL.

b. Provides a medium to plan for a future large space station on a national basis.

c. Provides a means for NASA in cooperation with DoD to guide the AAP program to make best use of the hardware bought for and/or already under development for AAP, MOL, and, to some extent, future Apollo activities.

For both DoD and NASA - Will improve the congressional and public image of both agencies from the viewpoint of DoD/NASA cooperation. Additionally, real benefits should be derived by both in close coordination of objectives, hardware, plans, and products.