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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON 25, D.C.

AFSHRC MAXWELL

REPLY TO ATTN OF: AFDSD-MS

5 OCT 1960

SUBJECT: Request by House Committee on Science and Astronautics for Information on Briefing Held at AFBMD

TO: SAFLL-2 (Maj James M. Brower)

1. The following information is furnished in response to your letter, subject as above, dated 22 September 1960.

a. A copy of the presentation made to industry. A summary of AFBMD's presentation made to aerospace industry executives on 14 Sep 1960 is attached. It should be noted that this briefing was given from notes. Although the attached summary does not contain technical details presented during the briefing, it does include sufficient data without impairing the intent or substance of the briefing itself.

b. Were the space systems presented to industry approved programs or systems under study and consideration? The briefing included discussions of both approved space systems and systems under study and analysis, many of which have been previously discussed with the Congress. The status of the systems discussed at this briefing is as follows:

Positive Control Bombardment System	-Study to determine feasibility
Operational Communication Satellite System	-R&D Component Development
Satellite Maintenance and Repair Techniques	-Study
Military Launching Vehicle Systems	-Study and Applied Research
Defense Systems	
SAINT	-Development to demonstrate rendezvous capability
Orbital Interceptor	-Study & development of Components & techniques to define concept & determine feasibility
Weapons Test Surveillance	-Development Plan recommended to D.O.D.
Study Requirements	-Studies

REVIEW ON 10/21/90

18 DEC 1985

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c. Any additional comments we might have as to purpose of this briefing. Objectives of the briefing were: (1) to provide guidance to industry regarding future space systems, concepts and requirements, (2) to provide directions for industry supported study and research, and (3) to increase the quality of contractor proposals by informing them as early as practical about the systems and research in which ARDC is interested.

d. A list of the industry representatives and the agenda for the meeting. See Attachment #2.

W. B. KEESE
Major General, USAF
Acting DCS/Development

3 Atch
1. Summary of AFBMD Presentation to Industry 14 Sep 60
2. ~~List of Attendees~~
3. ~~Agenda~~

SECRET

D.S.
Please file for
SAFLL -
DJ.

SUMMARY OF AFBMD

PRESENTATION TO INDUSTRY

14 September 1960

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SUMMARY OF AFBMD

PRESENTATION TO INDUSTRY

14 September 1960

I. INTRODUCTION

II. PLANNING APPROACH

III. DEVELOPMENT PHILOSOPHY

IV. SPACE SYSTEMS

A. Positive Control Bombardment System (PCBS)

B. Operational Communication Satellite (FLAG)

C. Satellite Maintenance and Repair Techniques (SMART)

D. Military Launching Vehicle System (PHOENIX)

E. Defense Systems

F. Weapons Test Surveillance (VELA)

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V. SUMMARY

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SUMMARY OF BRIEFING TO INDUSTRY

14 September 1960

Colonel Ray E. Soper, Assistant Deputy Chief of Staff for Plans and Operations, AFBMD, chaired the meeting which opened with introductory remarks by General Powell, Vice Commander, AFBMD; and Mr. Ivan Getting, President, The Aerospace Corporation.

I. INTRODUCTION

General Powell, Vice Commander, AFBMD

Traditionally, industry has pieced together random bits of information in an effort to predict the Air Force research and development future. I'm sure you agree that it is far more practical, economical, and timely for us to tell you what we are thinking about rather than have you guess. The objectives of today's briefing are:

1. To provide adequate guidance to industry for placement of corporate effort.

2. To provide direction to you for industry supported study and research.

3. To increase the quality of contractor proposals.

As a background for today's presentation, the history of BMD was outlined and the scope of our present effort summarized.

Superimposed on this complex program is the fact that production capability has been replaced by technical capability. To meet this

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problem ARDC has reorganized and now has three development divisions. Management, as well as the rate of advance of technology, has become a pacing factor for development. These facts have caused a transition from the prime contractor concept to the present associate contractor concept. Single contractors simply can no longer be the best qualified in all technical areas. To shorten weapon systems development time, we have adopted the method called concurrency. To be successful, this method required people well qualified in systems integration. We solved this problem initially by contracting with STL to provide this integration capability. Recently the Aerospace Corporation was created to continue providing the elite technical assistance required to develop future Space systems.

To manage this effort, ARDC has a nucleus of highly technically qualified officers who, as decision-making managers, are responsible for the success of our development program. The AFBMD/Aerospace Corporation team will be calling on industry for the maximum in technical competence and look forward to working with you in solving the intricate problems of military Space systems development.

Dr. Ivan Getting, President, The Aerospace Corporation

Within the principles of free enterprise and competition, I am sure we will be able to work with the most efficient and effective means of combining our intellectual scientific engineering skills in support of our government and, particularly in this case, the Air Force

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Ballistic Missile Division. It is certainly the intention of the Aerospace Corporation to seek the most intelligent and effective means of being of help. As a young organization, we would like to ask your assistance, your advice and the guidance you feel we should have so that we can serve not only the Air Force directly, but industry as well. At the present time, we are only partially staffed, however, I am fully confident that the Aerospace Corporation will provide the functions its originators hoped it would. I am also proud of the fact that the momentum gained from our predecessor, STL, has permitted us to participate in today's presentation.

II. PLANNING APPROACH

Lt Colonel Carter, Deputy Director Advanced Systems Plans & Analysis Directorate

The early potential of space as a medium of operation has gained increasing acceptance and support. This has resulted in part from recognition of the relationship between space systems and our present deterrent force. Both SAMOS and MIDAS provide information we can not get in any other way. There are many ways in which space can contribute to our military posture and deterrent. Possibilities range from weapon delivery by satellites to the possible eventual use of the moon as a military base. Our purpose here today is to discuss these possibilities and to indicate what our thoughts are in regard to their feasibility, usefulness, and desireability to the Air Force. I would like now to

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outline the steps we follow and the criteria we consider important in selecting and initiating the development of a new system.

Mission catagories we find useful in our planning effort are: offense, defense, surveillance, and communications.

There are no offensive space systems under active development today. Ballistic missiles are under development and several future ballistic missiles and space systems are under consideration. We will discuss one possible space system in the offensive catagory with you later in the program.

Defense is a catagory where immediate exploitation of space is possible. MIDAS is an example. Another possible defensive system is an orbital defense system. If it can be attained (and we don't know yet whether it can) a space system for active defense against ballistic missiles could be a most important deterrent system.

Surveillance and communication are also catagories where we are now exploiting space for military use. SAMOS and ADVENT are examples.

In addition, various test and support missions are necessary to extend knowledge and prove important techniques. Examples of systems for test support are DISCOVERER, Test System 609A and the present DYNA-SOAR program. DISCOVERER supports both the SAMOS and MIDAS systems by testing the hardware and investigating techniques. TS 609A, an Air Force modification of NASA SCOUT, will become a work-horse test bed for space research. The DYNA-SOAR program will develop and demonstrate the oper-

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ation of a manned hyper-sonic glider at orbital speeds and conditions.

New systems are evaluated in terms of meeting specific operational requirements. A conceptual design is often necessary to define all the technical requirements for system development.

New technology may be required. The increased cost for new systems, in both man-power and dollars, places the highest premium on selecting the proper system for development from the many possibilities that exist.

Elements of selectivity are based on the threat, technical feasibility, cost, relative operational capabilities and timeliness.

After system selection a development plan must be prepared. This plan includes all the aspects of the program necessary to achieve the end objective—system description, technical feasibility, cost, schedules, facilities, and even the development personnel requirements. When the development plan is complete, approval must be obtained throughout the chain of command. When the system is approved, it is transferred to one of the development organizations and the familiar process of RFP's, work statements, evaluation of proposals, and contract award begins.

III. DEVELOPMENT PHILOSOPHY

Mr. Donovan, Vice President, Technical, The Aerospace Corporation

THE RISE AND DECLINE OF THE U.S. MONOPLY ON DETERRENCE

As we enter the era of fully operational ICBM's, it is essential that we assess the manner in which the development of these weapons by the Soviet

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Union has eroded away our superiority in deterrence. Clearly in the period from 1945 into the early 1950's when only the United States had a significant nuclear capability we had an effective monolopy on the ability to deter major wars. This monolopy began to erode with the first Soviet nuclear tests, but we still maintained an overwhelming margin of strength for deterrence. This was achieved through the combination of a superior delivery capability with an improving Air Defense system. With the development by the Soviets, however, of the world's first long-range ballistic missile, and their clear demonstration of this capability by their orbiting of the world's first artificial satellite, our superiority in deterrence dropped sharply.

In particular it is essential to recognize the enormous possibilities that the development of the ICBM opens to an aggressively-minded nation. Never before in history has a weapon been developed which offers such potential to a would-be world dictator. Let us examine briefly the manner in which an aggressor might plan to use ICBM's. Quantities of ICBM's that would require an effort small by comparison with that Hitler expended on his Air Force could deliver multi-megaton warheads on every important target in the United States within thirty minutes. While the Soviets have not officially announced an aggressive policy in the use of their ICBM's they did in 1958 state their pre-emptive war philosophy; a concept under which they would propose to shoot first on the basis of supposed intelligence information on our intentions used as an "excuse" for an aggressive attack. It is apparent that the United States should try to regain superiority in a new deterrent approach. It would be desireable,

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for example, through a combination of revolutionary new weapon systems to get back at least part of the monopoly in deterrence we had from approximately 1945 into the early '50's. This is a very ambitious objective, and even with our enormous resources, and scientific skills,may be unattainable. Nevertheless, the possiblity should be explored. We should look for military means of stabilizing peace by introducing systems which would make it unattractive to an aggressor to initiate provocative acts, especially extreme ones. In particular the possibilities of using space for preserving peace should be implemented. Mr. Donovan's discussion is continued in outline form on next page. Technical details which begin here in the talk arc [illegible]ted or summarized without impairing the substance of the contents.

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THE UNIQUE ADVANTAGES OF SPACE FLIGHT

Extremely high speed (Nuclear weapon delivery, i.e., ICBM, etc.)

Extreme altitude: gives "line of sight" to large areas.

Reconnaissance

Optical - intelligence and weather

Infra-red early warning

Electromagnetic surveillance

Communications relay

Navigation aids

Space based defense against ICBM's

"Infinite" duration (Eliminates sustaining propulsion requirements).

THE PRIMARY ADDITIONAL SPACE FORCE NEEDS 1960-1970

Means for obtaining adequate target location and surveillance data.

High resolution reconnaissance satellite systems

Benchmark mapping satellite systems

Electromagnetic surevillance satellite systems

Methods for locating enemy missile launching submarines

Means for countering an aggressor's pre-emptive ICBM launch.

Super-hard ICBM bases

Concealed strategic force

Recallable ICBM's (or equivalent)

Means for deterring limited war.

Accurate, low cost, low yield, clean tactical inter-continental limited war missiles

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THE HOSTILE ENVIRONMENT OF SPACE

- Penetrating Radiation
- Absence of Oxygen
  - Needed to support life
  - Useful for generating power
- Absence of Atmosphere
  - Makes disposal of waste heat difficult
  - Makes maneuvering by aerodynamic reaction impossible
  - Confines flight nominally to highly predictable orbits
  - Makes return to earth difficult
- Presence of Meteorites

THE SPECIAL REQUIREMENTS OF MILITARY SPACE SYSTEMS

- Continuous satellite system operation essential
- Large numbers of satellites needed
- Qualifications for operational use essential
  - Simplicity of operation
  - High reliability
  - Very low cost per launch

PRESENT OBSTACLES TO THE FULL MILITARY USE OF SPACE

- Space launching costs are too high
- The life of space payloads is too short
- Means for returning from orbit are inadequate
- Adequate space power supplies are not available

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THE PRINCIPAL TECHNOLOGICAL OBJECTIVES 1960-1970

Cut space launching costs by one to two orders of magnitude.

Provide solution to reliability problems of large, complicated space payloads.

Provide controlled, maneuvering flight path return from orbital speeds.

Provide suitable space power supplies.

Provide militarily effective space maneuvering capability.

PROBLEMS OF PLANNING THE AIR FORCE SPACE AND MISSILE PROGRAM-1960-1970

The problems of planning of weapon systems of the past indicate:

We expect too much progress in a short time

We underestimate greatly the progress occurring over the long term.

Why?

Short term progress is limited primarily by the technical decision process, authorizations, money, manpower, strikes, natural interferences.

Progress over a long term is advanced by unexpected technological advances. These result from:

Unanticipated advances in basic science

Unanticipated applications of available knowledge

Correction of previous erroneous data on a problem

Proper planning will enable us to achieve better systems in a timely manner.

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The exploitation of the airplane capability and potential could have been substantially accelerated by earlier recognition and adequate planning

The Airplane

1903: 1 pilot and passenger, 42 mph for 1 hour, cost per passenger mile, $25.00 (equivalent 1959 dollars - approximately $80.00.)

Logical prediction:

Airplanes are impractically expensive

Payloads are inevitably small

Uses, even military, will be severly limited

Commerical air transportation is economically impracticable

The Airplane - 50 Years Later - 1959

Speed has increased more than one order of magnitude

More important, useful life has increased by three orders of magnitude

Results

Direct operating costs for a jet are about $0.03/ passenger mile

EXAMPLES OF FORCEFUL PLANNING

The Ballistic Missile

In 1945 the objectives and advantages of the Ballistic Missile were scarecely recognized.

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In 1954 the Von Neuman committee established goals that were met by 1960 - in all cases the goals were equalled, in most substantially improved.

POSSIBILITIES IF TECHNOLOGICAL OBJECTIVES ARE ACHIEVED

Launches into space become very much cheaper.

Reliability reaches levels where complicated space missions can be accomplished.

Payload return from space in usable condition becomes routine.

Permits new weapon system concepts and cost reductions.

Large power levels needed for military space missions become feasible.

Maneuvering of satellites in militarily useful manner becomes feasible.

NEW WEAPON SYSTEMS MADE PRACTICAL BY ACHIEVEMENT OF THE TECHNOLOGICAL OBJECTIVES.

PRIMARY SYSTEMS (Assuming adequate satellite warning systems)

Strategic offensive

- Recallable or positive control ICBM system
- High resolution, high capacity, strategic surveillance system defensive
- Space based anti-ICBM system
- Satellite inspection system

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SUPPORTING SPACE SYSTEMS

Communication satellites

Mapping satellites

Weather satellites

Navigation satellites

Satellite maintenance and resupply

Rescue

Satellite tracking and cataloguing

SOME APPROACHES TO ATTAINING THE TECHNOLOGICAL OBJECTIVES

REDUCTION OF SPACE LAUNCHING COSTS

What should be done

Make the hardware reusable

Make the vehicles simpler

Thereby, make them cheaper to develop, more reliable after development, easier to check out and launch.

HOW?

Simplified, low cost, ruggedized stages

Booster recovery systems

Maneuvering payload recovery systems

Recoverable second stages

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SIMPLIFIED, LOW COST REUSABLE BOOSTER

One Possible Approach to Cheap Reusable Booster Stage

Ablative surface spike nozzle

Annular segmented combustion chambers

Pressure fed (250 psi) manifold

Thick tank for liquid oxygen-hydrogen pressure facilities re-entry and recovery

BOOSTER RECOVERY

Desired Recovery System Characteristics

Small penalty to booster performance should decrease delivered impulse less than 10%.

Recover in condition for immediate checkout and reuse. Minor rework, at most, acceptable.

Recovery at least 90% reliable

Recovery cost less than 10% booster cost

Booster back on stand within one week

CONCEPT FOR FUTURE MILITARY OPERATIONAL SPACE LAUNCHING VEHICLES

Vehicles for transition from Ballistic Missiles to Military Space Launching System Concepts

Initial ICBM adaption

Recoverable ICBM booster

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Conventional second stage

Simplified, low cost, throw away high energy final stage

Advanced ICBM adaption

Recoverable ICBM booster

Recoverable ruggedized second stage

Simplified low cost throw-away high energy final stage

True Military Operational Space Launching Vehicle Concept (PHOENIX concept vehicle)

Recoverable, low cost, booster stage

Low cost, simplified, throw-away, high energy, final stage

Recoverable, low cost, second stage

BALLISTIC MISSILE BOOSTERS

Boosters useful for limited military capabilities

ATLAS CENTAUR

Boosters that are too expensive for true operational military use

SATURN

F-1 Engine Stage System

NOVA

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RELIABILITY

A three way state-of-the-art constraint between direction for improvement of reliability, direction for improvement of performance, and direction for reduction of cost. Any improvement in one will degrade the other two.

APPROACH TO SPACE PAYLOAD RELIABILITY

Work on basic component development and qualification.

- Transistors and other semi-conductors
- Tubes
- Other components

Obtain data on space environment and means for environmental control.

Study of approached to design simplification.

Provide redundancy where advantageous.

Qualify payloads and ground test carefully before use.

Consider providing for servicing payloads.

- Manned intermittent service.
- Payload recovery, ground service and re-installation in orbit.
- Automatic replacement of defective subsystems from smaller maintenance vehicle.

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PROGRAM FOR SPACE PAYLOAD RELIABILITY

Simplify to maximum practicable extent.

Recognize that there are no magic roads to reliability, only the route of hard work.

Major emphasis is needed on the technical areas discussed.

As problems solved:

Novel new weapon systems can be created.

A significantly superior military capability may be achieved.

The probability of major war can be greatly reduced.

THE PROBLEMS OF POWER SUPPLIES MANEUVERING RETURN FROM ORBIT AND RECOVERY OF PAYLOADS WERE ALSO DISCUSSED

CONCLUSION

Initial Military space is "near" space.

Military space payloads will be "small" until:

- Launch cost is greatly reduced
- Payload reliability is substantially improved
- Recovery from orbit becomes standard procedure

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IV. SPACE SYSTEMS

A. Positive Control Bombardment System (PCBS) - Mr. Warren Amster, The Aerospace Corporation

I would like to discuss the results of a preliminary study on the recoverable ICBM or Positive Control Bombardment System (PCBS). This study was conducted for BMD and results have been encouraging in terms of ideas which can contribute to insuring the survivability of ballistic missiles and the requirement for verification of attack before they can be launched. BMD has requested industry to look further into this type of system under Study Requirement 199A.

The primary objective is to analyze the technical problems and advantages of launch on receipt of early warning. Once the vehicles are launched, there is then an additional time for the attack command signal. The vehicle would be launched into an 100 n.m. orbit trajectory and if no signal is transmitted to the vehicle, it is programmed to impact harmlessly in an innocuous area with the warhead unarmed and unfuzed. The trajectory would be clearly distinguishable from an ICBM trajectory.

The vehicle would proceed in orbit for approximately 18 minutes before receiving an attack command. The command could be sent through a satellite communications system if such a system exists at the time. Alternative means of communication with the satellite are through a rocket containing a radio-repeater launched on a very high trajectory, or through use of BMEWS which could be coded to provide the attack-enabling signal.

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Alternative trajectories are possible by launching the long-way-around the earth. With this type of trajectory, 26 minutes decision delay time is possible. If an attack signal is transmitted, the vehicle proceeds on to attack the target. If no attack-enabling signal is sent, the vehicle automatically de-boosts short of the target, and is disposed of harmlessly avoiding over-flight.

A possible launch vehicle would be about 2300 pounds and the re-entry vehicle would be about 1500 pounds. The concept of PCBS would permit use of soft surface sites.

The accuracy of the system is estimated to be 1.1 n.m. CEP for a 5400 n.m. range and about 2.5 n.m. CEP for the long-way-around. It is desirable to conduct an operational study to determine the contribution to deterrence which would be provided by a PCBS. There is need to determine force level with relationship to other ballistic missiles and manned aircraft, and the vulnerability of the PCBS force to countermeasures must be investigated.

A. Operational Communications Satellite (FLAG) - Major Jack Albert

There are two fundamental ways in which we can use space for communications: active and passive. Active communications satellites are those having both transmitting and receiving equipment, while the passive satellites are basically reflectors, with all electronic equipment on the ground. Examples of an active satellite are COURIER, a delayed repeater, and an example of a passive satellite is ECHO, which we have all had an opportunity to see recently.

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The satellite which I will discuss is called FLAG, and is active in nature. Requirements within DOD as well as the Air Force call for an early, quick-acting means of communications for rapid, long-line transmission. The R & D program leading to an operational communications satellite is called ADVENT.

In the FLAG program, we could place an active satellite in a 24-hour synchronous equatorial orbit. By having a large satellite we can provide a communication link at the proper mico-wave frequency, and through a spread-spectrum technique make it virtually immune to communication black-out. With the spread-spectrum technique, we use approximately 10 megacycles of bandwidth to transmit only 10 kilocycles of voice information - in essence then, we are using valuable bandwidth for protection.

Since the satellite is stationary with respect to the earth, we can avoid having a tracking mechanism and can therefore have a hardened ground station. Our design study indicates a vehicle approximately 26 feet long and 6 feet in diameter, using solar cells for power. Total satellite weight would be of the order of 4000 pounds, with approximately 1200 pounds of communications equipment. In peace time service, 432 voice duplex or 4320 teletype channels would be available. In a national emergency, we would have 7 jam-resistant duplex voice channels.

Much of the R & D accomplished on ADVENT could be used by the FLAG program. ADVENT is R & D oriented, while the FLAG program would be operationally oriented. Some of the primary technical developments necessary for the success of FLAG are (1) increased life for power amplifier tubes

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and (2) the development of anti-jam techniques and current effort is in applied research on such problems.

By proceeding concurrently with ADVENT, we feel that FLAG could become operational in the 1965 time period.

C. Satellite Maintenance and Repair Techniques (SMART) - Dr. Leonard, The Aerospace Corporation

In this study, attention is directed primarily toward manned maintenance of space systems rather than manned operations. The primary obejctives of the study has been to define quantitatively the conditions under which various forms of manned maintenance may be economically preferable to total payload replacement as the means of maintaining an operational system in space. This objective has been accomplished in several steps:

First, estimates were made of the mean-time-to-failure of space payloads based on present experience and projected technology for electronic components.

Next, several methods of maintaining satellite systems were outlined and concepts for the manned vehicles required were defined. The methods described are: (1) total replacement, (2) surface-based maintenance, (3) continuously manned payload, (4) multiple mission station, and (5) central space maintenance station. For each of these methods, logistics equations are derived to express the total cumulative weight which must be placed in orbit over a given period of time.

The vehicle concepts to support these methods range from a

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one-man Mercury-type capsule, weighing about 5,000 pounds for minimum surface-based maintenance, to a three-man central maintenance station weighing about 50,000 pounds. Personnel shielding requirements and a shielding philosophy consistent with the mission were defined and included in the vehicle weight estimates.

Finally, the relative advantages of the several support methods are compared on the basis of cumulative weight in orbit. From this comparison it can be concluded that (1) it will be economically preferable to use surface-based manned maintenance whenever the payload weight exceeds the 5,000 to 10,000 pounds weight of the maintenance capsule, regardless of mean-time-to- failure and mission time, (2) it will be economically preferable to use continuously manned maintenance for payloads weighing more than the maintenance capsule when the mean-times-to-failure are less than 1 to 3 months and when missions exceed 1 year, and (3) for payload weights less than the 5000 to 10,000 pounds weight of the maintenance capsule, it will be economically preferable to use total replacement except for very short mean-times-to-failure (of the order of a few days to several weeks) in which cases continuous manning may again be economically advantageous.

The study work to date has not been exhaustive in nature; many interrelated factors were not included in the basic analysis. Further detailed analysis is required to confirm the validity of this concept and to define more precisely the terms of economic preferences in terms of specific future orbital systems. This follow-on study is being undertaken on a priority basis.

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