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1 2 FEB 1958

ORDAB-CL 471.9

Major General August Schomburg
Office, Chief of Ordnance
Department of the Army
Washington 25, D. C.

Dear Augie:

I am inclosing a preliminary outline for a proposal for Project "Man Very High" which we intend to prepare in the near future.

The purpose of this limited experimental project will be two-fold. It will provide valuable information for the space medicine field on the effects of rocket propulsion, upper altitude environment, and re-entry into the atmosphere, on living beings; and it will demonstrate a U. S. capability for manned missile transport.

Although the details are not firm, we contemplate a three to four missile program, using the JUPITER-C booster to carry a capsule containing instrumentation and a living passenger to an altitude between 100 and 200 miles. The capsule will then be returned to earth with a recovery system similar to our nose cone recovery package. The carrying of a human passenger looks quite feasible for the third or fourth firing. We believe such a program will provide a significant link between previous high altitude experiments and future efforts in the development of troop- and cargo-transport missiles and manned space vehicles. The time frame we have in mind for the project is about a year from now.

The project is envisioned as a Joint Army-Navy-Air Force effort, with ABMA providing the carrier vehicle and recovery gear and Navy and Air Force contributing the space medical and biological experiments. We plan to recommend that system responsibility rest with ABMA.

Informal discussions have been held among Dr. von Braun's people and the aero- and space-medical people from Pensacola, Randolph, and Holloman. These discussions at the working level have been marked by a cooperative attitude on the part of all concerned, and we believe a very valuable joint program can be worked out.

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authority of CG, USAMICOM
by M. A. Corthell Scty Div IYSOGS
3 Aug 64

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12 FEB 1958
CaptGMMontgomery/og/4840

I must emphasize that no official negotiations have been made between ABMA and the above Air Force and Navy agencies. We do not feel that such official discussions will be appropriate until after the next joint working level conference, which is planned for late February.

I will keep you informed of new developments.

Sincerely,

J. B. MEDARIS
Major General, USA
Commanding

1 Incl:
Outline for Proposal
"Man Very High"

Copies Furnished:
ORDAB-D/Dr von Braun
-D/Dr Stuhlinger
-DSP/Mr Koelle
-CP
-CL/Record
-CL/Reading
-C/Reading

CONCURRENCE:

ORDAB-D ______________________ Date ______________

ORDAB-C ______________________ Date ______________

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PROPOSAL FOR

PROJECT "MAN VERY HIGH" (MVH)

OUTLINE

I. INTRODUCTION

1. Purpose of Proposal (1/4 to 1/2 page)

(Brief statement as to scope, objectives, and participating agencies.)

2. Requirement (1 to 2 pages)

Gross role of MVH Project in providing:

a. Important contribution toward future needs for returnable payloads, such as:

(1) Troop and cargo transport vehicles

(2) Orbital vehicles

(3) Space vehicles

(4) Re-usable boosters for above vehicles

b. Next logical step beyond previous pertinent projects, such as:

(1) Early experiments with animals in high altitude rocket firings

(2) Nose cone heat protection and recovery

(3) Project "Man-High"

II. MVH PROJECT DESCRIPTION (10 to 20 pages)

1. Broad Objectives

2. Proposed Flights and Missions

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3. System Description

a. Basic vehicle

b. Capsule

c. Recovery equipment

d. Payloads and Instrumentation

4. Sequence of Operation

5. Detailed Areas of Responsibility

III. SCHEDULING AND FUNDING (3 to 6 pages)

IV. CONCLUSIONS AND RECOMMENDATIONS (1 page)

CONFIDENTIAL

17 Feb 58

PROJECT "MAN VERY HIGH" (MVH)

1. OBJECTIVE: The objective of this project is to subject a human being to the environmental conditions of rocket and space flight at the earliest possible date.

2. PARTICIPANTS: This project is a joint effort of the three services, the Department of the Army providing the rocket vehicle, the Department of the Air Force providing the crew and associated equipment, and the Department of Navy providing the recovery ships and organization. The following individual groups are suggested for participation:

a) Department of the Air Force:

1. Air Research & Development Command
2. Wright Air Development Center
3. Holloman Air Force Base
4. U. S. A. F. School of Aviation Medicine

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b) Winzen Research Laboratory -- Capsule Design:

c) Cook Research Laboratory -- Capsule Recovery System:

d) Department of Army: ABMA - Provide the Rocket Vehicle and the overall Systems Responsibility which will Include the Launching Crew and Basic Ground Equipment.

e) Department of Navy: - Supply the Rescue Ships and Support Organization.

3. PRELIMINARY PERFORMANCE:

Three to four Jupiter-C Missiles will be made available for this project in 1959. This vehicle's performance is such that a capsule of several thousand pounds can be propelled to altitudes of 160 statute miles and more if required by the research objectives. The following acceleration values will be obtained:

Maximum during ascent trajectory: 7 g's for a few seconds

Free flight: Approximately 6 minutes of free gravity

Reentry trajectory: Approx. 6 g's maximum for about 17 seconds

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CR 69 316, 17 Feb 58

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The maximum altitude obtained for the trajectory selected here as an example is approximately 255 Km's or 158 statute miles. The range from take-off to impact is approximately 276 Km's or 149 nautical miles.

A typical trajectory for this type of project has the following characteristics which are indicated in the attached chart.

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CG ABMA REDSTONE ARSENAL ALA

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FOR COL COFFIN INFO FOR GEN SCHOMBURG AND ORDPM AND DR.

HERBERT YORK FROM ORDAB-CL-35-3 DREWRY

Subject: Proposed Project ADAM (U)

1. The objective of subject project will be to carry a manned, instrumented capsule to an altitude of approximately 150 statute miles during CY 1959; to perform psycho-physiological experiments during the acceleration phase and the ensuing six minutes of weightlessness; and to effect a safe re-entry and recovery from the sea of the manned capsule. The project will be based on proven REDSTONE hardware, current capabilities, and fully-known techniques.

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2. A series of working level meetings among personnel of this Agency and representatives of Air Force and Naval aero-medical agencies have resulted in the formulation of joint plans for the conduct of high altitude experiments under the tentative code name "Man-Very-High" (redesignated ADAM). As of the last such

10 MAR 1958

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Lt Col G. H. Drewry, Jr./jr
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J. A. BARCLAY
Brigadier General, USA
Commanding

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meeting, on 3 March, it was understood that Gen Flickinger, Surgeon and Chief of Human Factors Division, Hqtrs, Air Research and Development Command, planned a meeting in the near future with Chief, R&D, D/A to discuss the details of the proposed project and to formally request D/A participation. Project objectives, Army fund requirements, and broad development plan, outlined below, were prepared in anticipation of such a discussion. ABMA has since learned informally that Air Force has delayed and perhaps cancelled Gen Flickinger's planned visit. It appears that Hq, USAF, may have decided against a Joint Army-AF program and are proposing a solely Air Force project using THOR Hardware.

3. The proposed project will be a joint Army-Air Force effort (plus Navy support) with participation by:

a. Army Ballistic Missile Agency

b. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas.

c. Air Force Aero-Medical Research Lab, Holloman Air Force Base, New Mexico.

d. Winzen Research, Inc. (Air Force Contractor)

e. Cook Research Laboratory (Army Contractor)

f. Selected Naval Agencies (for recovery operation and Aero-Medical support to AF agencies above).

4. It should be noted that the keynote of any experiment of this nature should be the attainment of the highest degree of reliability of the missile system involved. It is the opinion of

this Agency that no IRBM hardware will have demonstrated sufficient reliability to allow manned experiments during the time frame which can be attained with the ADAM program. Reliability is even more important in the case of manned IRBM hardware since the IRBM's are aerodynamically unstable and a malfunction such as premature loss of thrust or a failure of the control servo loop would result in large angle of attack buildup followed by explosive disintegration of the vehicle. In the case of an aerodynamically stable vehicle such as the proposed modified REDSTONE, such a malfunction would not result in a catastrophe.

5. The carrier vehicle will consist of a modified REDSTONE thrust unit and an instrument compartment as used in satellite and re-entry firings (JUPITER C components not needed for satellite program). A conical nose cap will replace the upper stage assembly normally carried on the satellite vehicle. An additional cylindrical skin section of approximately nine feet in length will be inserted between the thrust unit and the instrument compartment. A heat-protected re-entry cone, of essentially the same shape and dimensions as the full-scale JUPITER nose cone, will be carried within this cylindrical section. The re-entry cone will be installed with the spherical nose cap toward the aft end of the missile and the cone base will be attached to the base of the instrument compartment. The man-carrying capsule will be a cylinder of approximately three feet in diameter and five and one-half feet in length. It will be of double-wall construction with the inner and outer walls separated by an insulating and sound-proofing

material. The cylinder will be inserted through a port in the missile skin into the re-entry cone near its junction with the instrument compartment so that the capsule axis is perpendicular to the cone and missile axes. The human passenger will then be in a reclining position relative to the missile thrust axis. The missile will be fired into a trajectory with an apex of approximately 150 miles and a range of approximately 150 miles. Maximum acceleration and deceleration of the manned capsule will be limited to 7g or less. Shortly after cutoff of the engine (using LOX and alcohol as propellants) the thrust unit and extra cylindrical skin section will be separated from the forward assembly consisting of re-entry cone plus instrument compartment plus missile nose cap. After separation this entire assembly will be controlled in attitude by a spatial attitude control system and compressed air nozzles located in the instrument compartment. The attitude of the upper assembly will be programmed so that the re-entry cone axis is approximately 20 degrees from the vertical, which will insure a nose-first re-entry. After the attitude is thus programmed, the re-entry cone will be separated from the remainder of the forward assembly and an attitude control system within the cone will maintain proper attitude thereafter. Shortly before re-entry, a set of drag flaps which are equally spaced around the circumference of the re-entry cone and hinged to the cone base will be rotated to a position 90 degrees from the cone axis (maximum drag position). An accelerometer within the cone will monitor deceleration during

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re-entry and will assume control of the drag-flap system when deceleration reaches approximately 6 to 7g. The drag flaps will be programmed to the rear to keep deceleration below 7g (by reducing drag) during the remainder of the re-entry phase. When the re-entry cone speed has been reduced to below Mach 1, a parachute will be expelled and will slow the cone to an impact velocity in the order of 50 feet per second. Impact will occur at sea and the cone will float until recovered. The cone will be equipped with the necessary radio beacon and signal equipment to insure its detection and early recovery by a Naval Task Force. The capsule will contain an 8-hour air supply for the passenger to allow adequate time for recovery operations. In addition to equipment required for normal operation of the ~~[illegible]~~ adam experiment, the carrier vehicle will be equipped with a maximum of safety devices for expelling the manned capsule and returning it safely in the event of vehicular malfunction during firing, ascent, coast or re-entry phases.

6. It has been agreed that ABMA will have system responsibility and will provide the carrier vehicle, re-entry cone and recovery package (similar to JUPITER nose cone recovery package). Air Force agencies will provide the experimental capsule to be carried within the re-entry cone and will design the psycho-physiological experiments, provide the animal and human passengers, and furnish necessary capsule instrumentation. Air Force will request Navy participation in recovery operation and in ground environmental testing.

7. The project will involve the completion and assembly of four modified REDSTONE (JUPITER C) thrust units (left over from re-entry program and not required for satellite program), special re-entry cones and passenger capsules. They will be scheduled for firing during the period of 12 to 18 months after initiation of project. Of the four firings, the first two will carry animal passengers while the third and fourth will carry human passengers. The missile firings will be preceded by a number of re-entry cone drop tests performed from balloons.

8. Army Fund requirement by fiscal year is given below. These fund estimates do not, repeat, do not, include reimbursement for existing hardware in the amount of 3.5 million dollars. Funds are acceptable in the form of R&D, P&P, or any combination thereof.

a. FY 1958 - ~~$3.725~~ 2.955 million

b. FY 1959 - ~~$5.440~~ 4.020 million

c. FY 1960 - ~~$2.110~~ 1.680 million

9. It is strongly recommended that the above joint project be proposed by D/A to the Advanced Research Projects Agency without delay and without further attempts at coordination with Hq, USAF. Such action is deemed necessary in order that ARPA may have official knowledge of the Army's capability to support a joint project ~~before a solely Air Force project is approved.~~ The joint project outlined above has obvious advantages which cannot be over-emphasized:

a. The ADAM experiment will provide the initial step toward the development of manned orbital and space vehicles and, of perhaps more immediate importance to the Army, it will prove invaluable in the Solution of technical problems ~~establishment of an Army mission and~~ development program in the area of cargo- and troop-transport by rocket.

~~b. The successful demonstration of a Joint-Service effort of this nature, which is directly applicable to a long-range national space program, will provide a strong argument for administration of such a national program by the Department of Defense.~~

10. It is further recommended that ~~1.725~~ 2.955 million dollars ~~for~~ in FY 1958 funds be provided this Agency immediately so that ~~the Army~~ necessary work can begin. ~~capability can be maintained in a competitive position.~~

11. The above is a summary of the project proposal, and will be followed by a more detailed proposal in the near future.

Copies furnished:
- Rec Cy-CL
- -CL Reading File
- -C Reading File
- -CP
- -CM
- -D (Dr. von Braun)/Info Cy
- -DV (Dr. Stuhlinger)/Info Cy
- -XT/Info Cy
- -I/Info Cy

CONCURRENCE:

ORDAB-C ______________________________ DATE ______________________

MEETING ATTENDANCE "MVH"
3 MARCH 1958

NAME	ORGANIZATION	POSITION
G. Heller	Army Ballistic Missile Agency	Research Proj Off.
David W. Woodbridge	ABMA	Research Proj Off.
V. E. Snowi	Winzen Research, Inc.	Consultant
Otto C. Winzen	Winzen Research, Inc.	President
Richard G. Revord	Winzen Research, Inc.	Asst. Sec.
Julian E. Ward	SAM, USAF	Deputy Ch, Space Med.
George R. Steimkamp	SAM, USAF	Ch, Space Medicine
Rudolf Hermann	University of Minnesota	Professor
Bernard Johnson	Cook Research Labs	Project Engineer
Raymond O. Fredette	Cook Research Labs	Asst. Director
Harold V. Hawkins	Cook Research Labs	Asst. Director
T. J. Dylewski	Cook Research Labs	Staff Engineer
J. H. McClow	Cook Research Labs	Staff Engineer
M. E. Huston	ABMA, S & M Lab	Recovery Proj Engr
W. A. Mrazek	ABMA, S & M Lab	Director
H. H. Koelle	ABMA, S & M Lab	Ch, Prel. Design
D. W. Barton	ABMA, S & M Lab	Asst. Rec. Proj Engr
James W. Carter	ABMA, S & M Lab	Project Engr
F. L. Williams	ABMA, S & M Lab	Project Engr
J. H. Graham	ABMA	Research Proj. Off.
George Bucher	ABMA	Research Proj. Off.
J. R. Bruce	ABMA	Research Proj. Off.
Arthur W. Thompson	ABMA	Research Proj. Off.
C. C. Parker	ABMA	Missile Firing Lab
Capt G.M. Montgomery	ABMA	Control Office
R. E. Lindstrom	ABMA, S & M Lab	Project Engr
O. C. Jean	ABMA, Aeroballistics Lab	Flight Mech.
R. F. Hoelker	ABMA, Aeroballistics Lab	Flight Mech.

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George R. Steimkamp	SAM, USAF	Ch, Space Medicine
Rudolf Hermann	University of Minnesota	Professor
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Raymond O. Fredette	Cook Research Labs	Asst. Director
Harold V. Hawkins	Cook Research Labs	Asst. Director
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R. F. Hoelker	ABMA, Aeroballistics Lab	Flight Mech.
A. J. Finzel	ABMA, S & M Lab	Deputy Rec. Proj. Engr
H. G. Paul	ABMA	S & M Lab
G. A. Kroll	ABMA, S & M Lab	Ch, Fuselage Design
D. G. Simons	A.F. M.D.C.	Space Biology
J. Kuettner	A.F. C.R.C.	Physicist
E. Stuhlinger	ABMA	Research Proj. Off.
Wernher von Braun	ABMA, Dev Opr Div	Director

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Report Nr. D-TR-1-58

DEVELOPMENT PROPOSAL

FOR PROJECT ADAM

17 April 1958

Regraded UNCLASSIFIED by authority of CG, USAMICOM, by W.R. Heflin, I+S off. on 19 March 64.

ARMY BALLISTIC MISSILE AGENCY
Redstone Arsenal, Alabama

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DEVELOPMENT PROPOSAL

FOR

PROJECT ADAM

A. INTRODUCTION

1. Objective

This project will be the initial phase for a program to meet the U. S. Army requirement to improve the mobility and striking power of U. S. Army forces through large scale transportation by troop-carrier missiles.

The objective of the proposed project will be to carry a manned, instrumented capsule to a range of approximately 150 statute miles; to perform psycho-physiological experiments during the acceleration phase and the ensuing six minutes of weightlessness; and to effect a safe re-entry and recovery of the manned capsule from the sea.

2. Scope and Significance

Existing hardware and recovery techniques available to the Army Ballistic Missile Agency make it possible to accomplish the above objective during CY 1959. Realistic estimates show that the first man can be transported by missile within 18 months from receipt of authority and funds. Use of the reliable and aerodynamically stable REDSTONE Missile will provide maximum assurance of success. The choice of a trajectory with a maximum altitude of 150 miles and a range of the same magnitude will allow both accelerations and heat transfer to be kept well within acceptable limits. An uninterrupted zero-gravity flight of more than six minutes will be achieved.

The well-defined scope of the project, its reasonable cost, its high safety factor and the immediacy with which it can be accomplished will provide, at an early time, a wealth of crucial information required for future troop transportation projects. Specifically, it will supply fundamental knowledge on human behavior during transportation by rocket, cabin design criteria, recovery techniques for manned re-entry vehicles, emergency escape procedures, and data transmission techniques.

In addition it will, as a pioneering achievement of the highest order, enhance the technological prestige of the United States in the eyes of its friends, allies and citizens.

3. Participating Agencies

The proposed project will be an Army sponsored effort with participation by:

a. U. S. Army Ballistic Missile Agency (overall system responsibility).

b. U. S. Army Medical Service.

c. U. S. N. Task Force for recovery operations.

d. Selected contractors.

Medical cooperation of the other armed services will be requested through the Surgeon General, U. S. Army.

B. DESCRIPTION OF EXPERIMENT

1. Equipment and Methods

a. Carrier Vehicle

The carrier vehicle (Fig. 1) will consist of a modified REDSTONE thrust unit and an instrument compartment as used in satellite and re-entry firings (JUPITER C components no longer needed for re-entry and satellite firings). A conical nose cap will replace the upper stage assembly normally carried on the satellite vehicle. An additional cylindrical skin section of approximately nine feet in length will be inserted between the thrust unit and the instrument compartment. A heat-protected recovery body, of essentially the same shape and dimensions as the full-scale JUPITER nose cone, will be carried within this cylindrical section. The recovery body will be installed with the spherical nose cap toward the aft end of the missile and the cone base will be attached to the base of the instrument compartment. The man-carrying capsule will be a cylinder of approximately three feet in diameter and five and one-half feet in length. It will be of double-wall construction with the inner and outer walls separated by an insulating and sound-proofing material. The cylinder will be inserted through a port in the missile skin into the re-entry cone near its junction with the instrument compartment so that the capsule axis is perpendicular to the cone and missile axes. The human passenger will then be in a reclining position relative to the missile thrust axis and will remain in that position throughout the entire flight so as to keep acceleration effects to a minimum.

b. Sequence of Events

The missile will be fired into a trajectory with an apex of approximately 150 miles and a range of approximately 150 miles (Fig. 2). At approximately two minutes after liftoff, the missile will reach the cutoff altitude of 200,000 feet and its maximum ascent acceleration of 6g (Fig. 3).

Shortly after cutoff of the engine, the entire nose assembly, including the recovery body, will be separated from the remainder of the missile, and the 6-minute weightless coasting period will begin (three minutes before and three minutes after apex).

Between cutoff and apex, the entire double cone assembly will be controlled in attitude by a spatial attitude control system and compressed air nozzles located in the instrument compartment. The attitude will be programmed so that the recovery body axis is aligned with the re-entry tangent (160 degrees from the vertical).

During the weightless coasting period, multiple measurements of physiological, psychological, environmental, and technical nature will be telemetered to earth and simultaneously recorded on magnetic tape within the vehicle. In addition, motion pictures will be taken of the instrument panel, the occupant, and the view of earth as seen from the capsule. By means of mirrors, prisms, and observation ports in the capsule, the occupant will also be able to observe the earth's surface.

The passenger will be subjected to a number of proficiency tests during the weightless period. Such tests may, on the second manned flight, include the operation of a control device, with which the passenger could override the automatic attitude control system within safe limits.

At apex, the recovery body will be separated from the remainder of the forward assembly and an attitude control system within the cone will maintain proper attitude thereafter. When this second separation is complete, a set of drag flaps which are equally spaced around the circumference of the recovery body and hinged to the cone base will be rotated to a position 90° from the cone axis (maximum drag position). As the recovery body descends to an altitude of 300,000 feet, a period of measurable deceleration will begin. An accelerometer within the recovery body will monitor deceleration during re-entry and will assume control of the drag-flap system when deceleration reaches 7g at approximately 110,000 feet altitude. The drag flaps will be programmed to the rear to keep deceleration at 7g (by reducing drag) for approximately 15 seconds, after which time the deceleration level will begin to fall off rapidly.

At 10,000 feet, when the recovery body speed has been reduced to below Mach 1, a ribbon parachute will be ejected and will impart a shock load of approximately 6g for less than one second. The parachute will slow the recovery body to an impact speed of the order of 50 feet per second. The resulting impact deceleration load will be approximately 5g and the cone will submerge to a depth of a few feet, from which it will return and float in a stable position.

Electronic and light beacons and dye markers will alert naval vessels and helicopters as to cone location so that rapid recovery may be effected.

2. Current Capabilities

In order that development personnel may concentrate on the primary objective - the study of a human being during missile transport - it is important that the experiment be based on proven, reliable hardware and existing capabilities, and that the technical problems and hazards inherent in "pushing the state of the art" be avoided.

a. Basic Carrier

The first requirement is a safe carrier which is aerodynamically stable during ascent. This will eliminate the dangers of unstable missile which, in case of engine cutoff or control failure, tumble and instantly destroy themselves in violent explosions. In addition, the carrier rocket should be amply tested and operational. These two requirements exclude, for this early experiment, the intermediate range missiles such as THOR or JUPITER, since neither is aerodynamically stable nor adequately tested. The REDSTONE thrust units available from the terminated JUPITER C re-entry program are reliable work horses and aerodynamically stable. Such units will soon be available and are well along in various stages of fabrication and assembly. As of 1 April 1958, a total of 39 REDSTONE Missiles have been fired, including six of the elongated (JUPITER C) type. An evaluation of these 39 R&D firings indicates a considerable number of small deficiencies such as control failure during terminal guidance, failure in the arming and fuzing circuitry and the like. But from the standpoint of this project, 38 out of the total of 39 REDSTONE firings would have offered the possibility of safe recovery of the occupant. The REDSTONE thrust units and the engineering adaptation to the manned experiment will be ABMA's principal contribution to the proposed project.

b. Capsule

The next requirement is for a sealed and instrumented capsule. To avoid duplication of effort and funds, the Army plans to capitalize on the experience and techniques developed by the U. S. Air Force and the U. S. Navy. For example, a capsule similar to that used by the Air Force in its project "Man-High", in which a manned balloon gondola was carried to an altitude of 100,000 feet, might be employed. Such a capsule is thus a current capability. The "Man-High" balloon capsule contractor, Winzen Research, Inc. (WRI), is a possible contractor.

c. Bio-Medical Aspects

The armed forces medical services possess an excellent capability for the design of required bio-medical experiments. Through participation of the NRC-Armed Forces Bio-Astronautics Committee (presently being organized), an optimum bio-medical program is assured. Primary medical responsibility will be exercised by the Army Surgeon General.

d. Recovery Body

The recovery body in which the space capsule is imbedded will follow closely the configuration developed during the JUPITER nose cone re-entry program. The maximum heat input to be expected in this experiment will amount to only one-eighth of that encountered in the aforementioned project and will not affect the interior of the capsule. This aspect of the project is again an ABMA capability.

e. Recovery Package

The recovery of the capsule will follow the methods of the JUPITER nose cone recovery system successfully developed by the Cook Research Laboratory (CRL) who will supply the necessary parachutes, marker and timer systems.

f. Control and Telemetering

The solution of control and telemetering problems is an ABMA capability.

Some development work is required for the manual stability control, the drag vane control, and the emergency escape system. They do not present basic development problems.

3. Proposed Primary Responsibilities

REDSTONE Missile	ABMA
Capsule	WRI (Winzen Research, Inc.) is under consideration
Recovery body	ABMA
Recovery and locators	CRL (Cook Research Laboratory)
Emergency ejection	CRL

Selection and preparation of the biological passengers and biological experiments	U.S. Army Medical Services
Emergency ground tests	CRL
Balloon tests	ABMA
Missile firings, including tracking	ABMA
Integrated systems management	ABMA
Instrumentation	To be determined
Telemeter, onboard and ground	To be determined

C. DEVELOPMENT PLAN

1. Schedule

After project initiation, a series of wind tunnel tests at ABMA will serve to determine optimum configuration of the recovery body including drag vanes. This will be followed by engineering and fabrication of 12 recovery bodies by ABMA.

Possible development of the capsule at Winzen Research, Inc. will be paralleled by preparation of the elongated REDSTONE thrust units at Chrysler Corporation Missile Division and by the development of the recovery system at CRL under Army contract.

The first integrated recovery units are expected after an estimated ten months. They will be subjected to a series of drop tests from two million cubic foot plastic balloons at 90,000 feet. The balloon ascents should be conducted from a Navy vessel ("baby carrier"). In at least one of these tests, a downward-firing solid propellant rocket will augment velocities. While the first drops will be made with unoccupied capsules, two tests will carry animals. It is contemplated that at least one manned balloon drop will be made.

Missile firings are scheduled to start one year after initiation. A total of four firings, at three-month intervals, is planned. The first two missiles will carry animals, the third a human subject without manual control, and the fourth a human subject with manual control. It is expected that the first manned troop carrying rocket will be launched in the last quarter of CY 1959 if the project is approved in 2nd quarter, CY 1958. Final evaluation of data will be available two years after initiation.

This program is condensed in the attached schedule (Fig. 4).

2. Fund Requirements

Total fund requirements for this four-missile project are as follows. Costs are in millions of dollars and do not include missile hardware already available for application to this program, the value of which is 3.5 million dollars.

FY 58	4.750
FY 59	4.550
FY 60	2.080

D. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions:

(1) Information on the psychological and physiological reactions of man during missile transport is urgently needed if the Army is to meet its requirement of improvement in troop transport and increased mobility.

(2) Hardware and methods currently available can be employed to transport a man by missile during CY 1959, if aggressive action is taken immediately.

(3) The reliable REDSTONE missile hardware available to the Army Ballistic Missile Agency together with the experience and medical techniques developed by the Armed Services and their aero-medical research agencies offer the most immediate means for accomplishment of such a project.

2. Recommendations:

(1) That this project be approved as the next significant step toward the development of a U. S. Army capability for the transportation of troops by ballistic missiles.

(2) That FY 58 funds in the amount of 4.750 million dollars be provided the Army Ballistic Missile Agency without delay so that the goal of transporting a man by ballistic missile during CY 1959 can be met.

E. TECHNICAL DISCUSSION

1. Observational Program

Measurements during proposed firings will embrace the areas of human reactions, capsule environment, vehicle behavior and special observations. While details of this program are not yet firm, it can be anticipated that the following measurements will be needed in these areas:

(1) Human reactions

Electrocardiogram

Blood pressure

Respiratory rate and depth

Galvanic skin resistance

Two body temperatures

Motion picture coverage of passenger

(2) Capsule enviroment

Capsule pressure

O_2 partial pressure

CO_2 partial pressure

Capsule air temperature

Capsule skin temperatures

Humidity

Cosmic radiation

Gravitational force (for weightlessness determination)

Noise

Vibration

(3) Vehicle behavior:

A great number of standard vehicle measurements will be made (Mach number, accelerations, angular rates, pressure, attitude, surface temperatures, angle of attack in pitch and yaw, etc.). Sequence of events (separations, drag-vane operations, parachute release, etc.) will also be measured.

(4) Special observations:

The measuring program will include a number of special observations not yet fully determined. They will include wide angle motion and still pictures of ground, sky, passenger and the flight sequence. Data will be both telemetered and stored on vehicle-borne tape recorders. Television transmission of pictorial data is contemplated.

2. The Capsule

The capsule as proposed by Winzen Research, Inc., (Fig. 5) is a cylindrical structure of 5.5 feet in length and 3 feet in diameter. (The REDSTONE diameter is 70 inches). This will necessitate selection of a small passenger. The capsule will have double walls separated by plastic insulation for protection against vibration, noise and temperature. The end plates will be temperature-protected and will contain windows with wide angle viewers. The internal structure will be a removable single unit (Fig. 6), to be separated by a spring-loaded control lever.

The capsule will be stress tested for 15g.

The human passenger will have an instrument panel informing him of conditions and events expected to be of interest to him. He will have UHF and VHF communication with launch point and recovery task force. The total weight of the occupied capsule will be 900 pounds.

The climatic control of the capsule follows the concept of the "Man High" project with the exception that, in view of the short flight time, sea level pressure will be maintained.

3. Emergency Provisions

Since the most critical conditions from a safety standpoint generally prevail during launching, means will be provided to eject the manned capsule on ground command while the missile rests on the launching platform (Fig. 7).

In the event of such an emergency ejection, the trajectory of the capsule will carry it outside the danger zone into a specially constructed water reservoir. A 4-foot parachute will stabilize the capsule before water impact.

During ascent, emergency ejection is possible until the vehicle reaches Mach 2. In this case a 46-foot lightweight ribbon parachute will slow the capsule after the small 4-foot first stage chute has been deployed.

4. The Recovery Body

The recovery body as proposed by CRL and ABMA is a heat-protected cone of 8.5-foot length and 5.5-foot maximum diameter. It carries the horizontal capsule in its widest upper section (Fig. 5) and has a gross weight of 2,500 pounds.

To eliminate intolerable decelerations during descent, the cone is drag-controlled. Adjustable drag flaps of approximately three feet in length are attached to the maximum-diameter section and will improve the aerodynamic stability of the cone (Fig. 8).

By varying the deflection angle, the total drag area of the cone can be changed by a factor of 5. An acceleration-sensing control will actuate the drag flaps hydraulically. In this way, the sharp re-entry g peak will be cut off at a tolerable level. In the descent from 800,000 feet (150 miles) a cutoff at 7g (M = 6) is acceptable and achievable. The duration of the 7g load will be approximately 15 seconds.

An attitude control system will keep the cone axis in alignment with the trajectory to eliminate normal accelerations. Reference data will be provided this control system by the stabilized platform of the double cone before separation. Reaction jets and nozzles using compressed air will stabilize the cone in all three degrees of freedom.

A manual over-ride can be provided to permit the occupant to steer the attitude of the recovery body with a control stick while it is above the atmosphere. An interlock system will remove the manual capability if a given time, angle or angular rate limit is exceeded, and will return the system to automatic control. Since heat input is moderate, heat protection can be provided by a 0.25-inch fiberglass coating with a weight of about 175 pounds. Maximum skin temperatures will not exceed 400°C.

The parachute recovery system will be located at the base of the body. It will operate by pyrotechnic ejection with barometric control. Electronic, acoustic and optical locator devices successfully tested in the re-entry cone program will be employed.

To keep the recovery body in a stable floating position after water impact, water will be allowed to enter the cone envelope.

5. Instrumentation and Telemetry

A telemetry system utilizing approximately 26 sensing devices is planned to transmit biological and/or physiological data and capsule environmental data. In addition, several of the events data are included to give information on the operation of the recovery package. The physiological data will include such readings as pulse, blood pressure, body temperature, etc., as mentioned previously.

A television system having a sufficient resolution is considered desirable for observation of the passenger during transport. The TV system would probably require a separate transmitter.

Two means of voice communication to the ground are proposed as follows: one separate transmitter and one voice channel on the telemetry system.

The following items are the estimated instrumentation for the nose cone:

1. Approximately 30 to 35 sensors (total)

2. One telemetry system including transmitter (30 to 35 information channels including an undetermined number of commutated channels)

3. One TV transmitter

4. One voice communication transmitter.

The required number and arrangement of antennas is presently under study. A number of antennas will be needed on the nose cone section in addition to some parasitic arrangement on the cover. Also under study are the ground facilities for TV and voice coverage; however, preliminary studies of all the above problems are being made by ABMA.

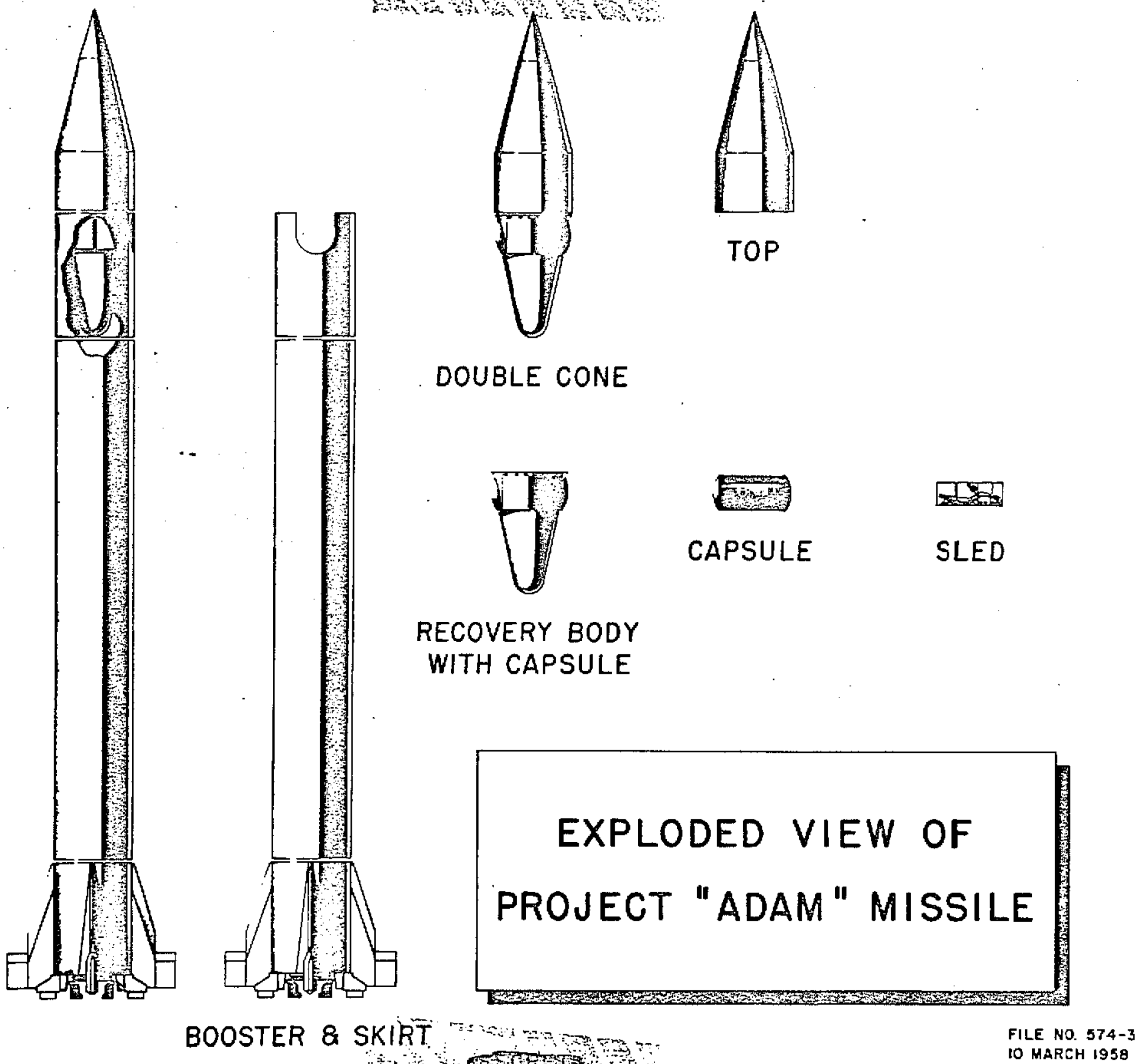

DOUBLE CONE
TOP
RECOVERY BODY
WITH CAPSULE
CAPSULE
SLED
BOOSTER & SKIRT
EXPLODED VIEW OF
PROJECT "ADAM" MISSILE
FILE NO. 574-3
10 MARCH 1958

Fig 1

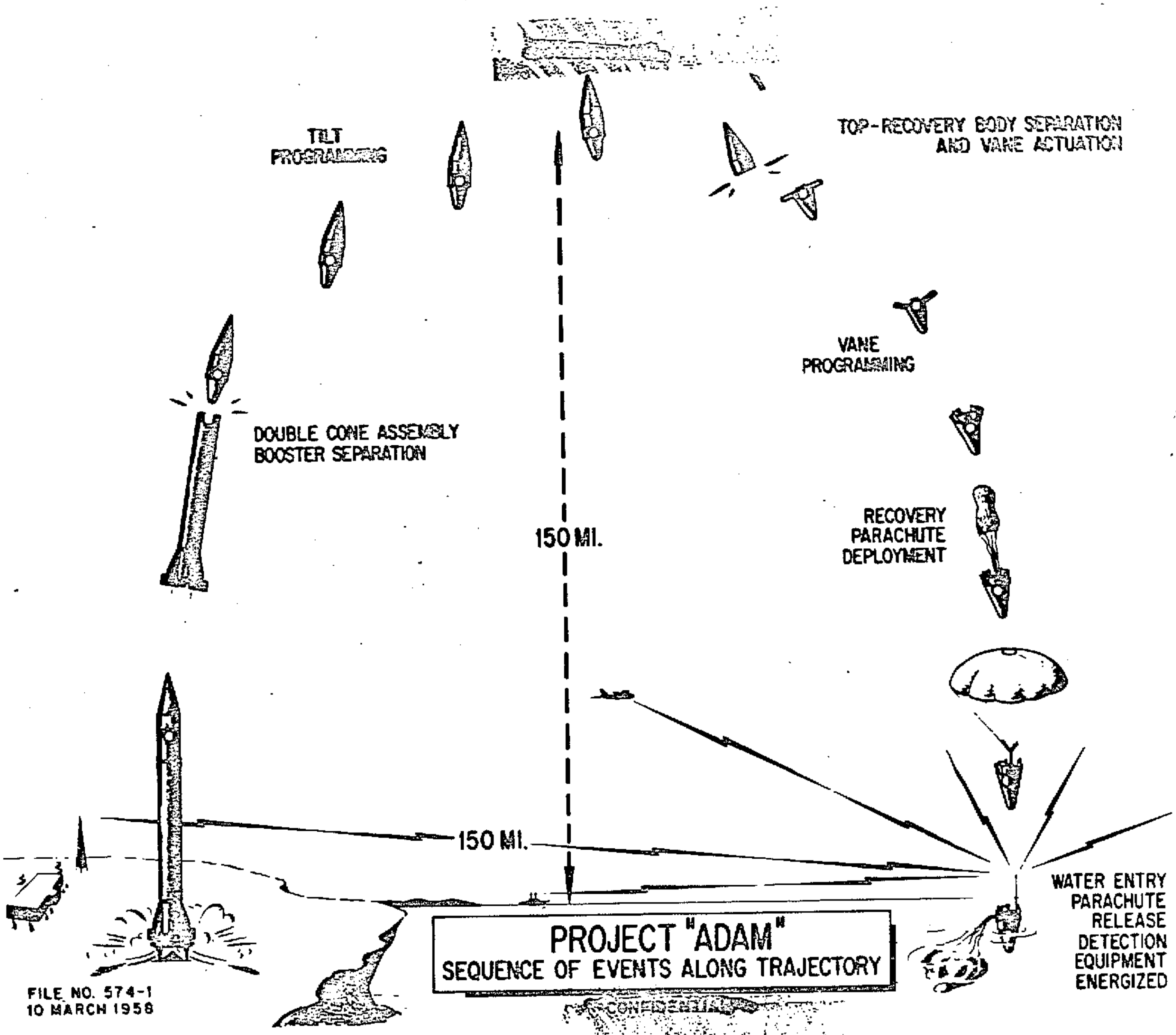
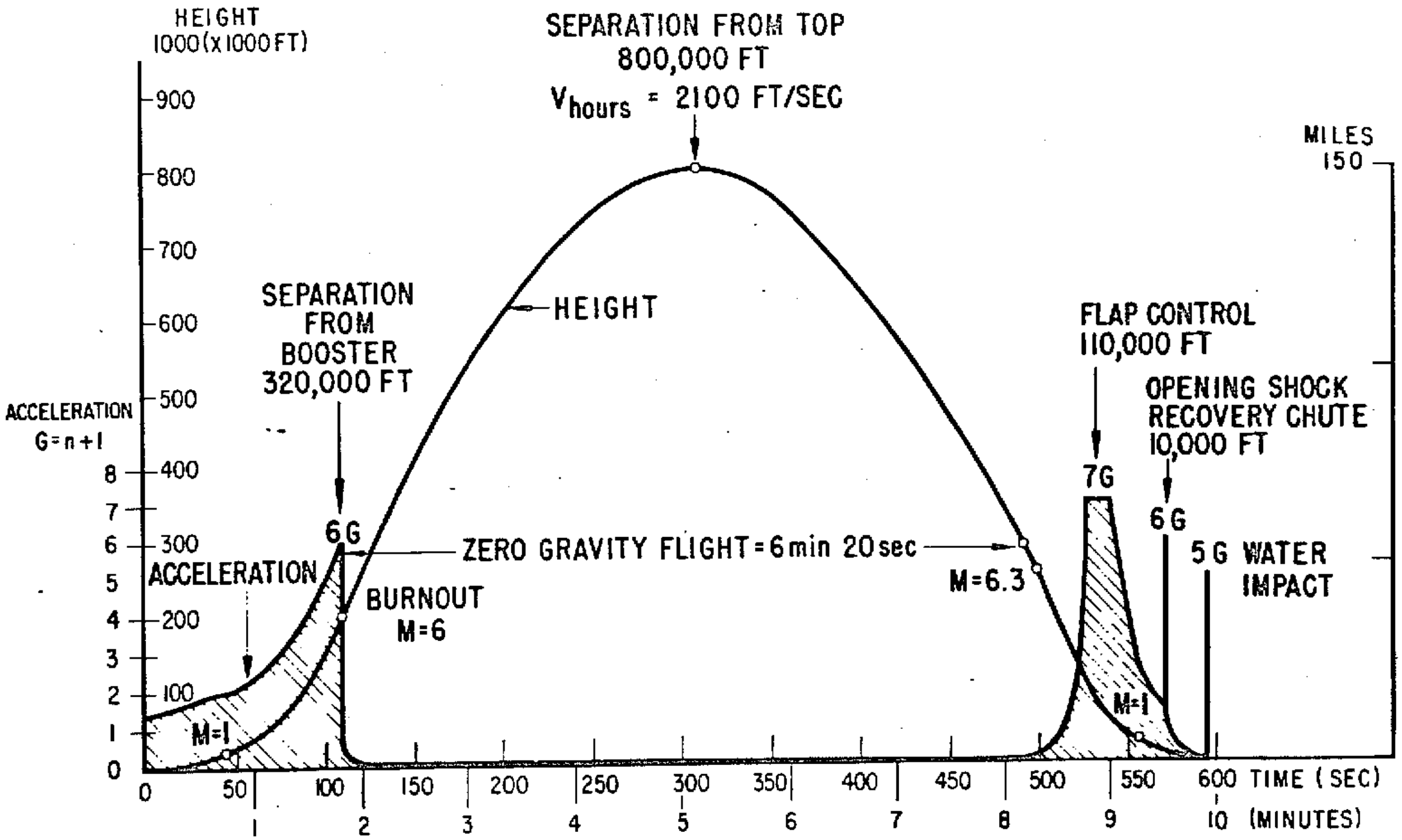

TILT PROGRAMMING
TOP-RECOVERY BODY SEPARATION AND VANE ACTUATION
VANE PROGRAMMING
DOUBLE CONE ASSEMBLY BOOSTER SEPARATION
150 MI.
RECOVERY PARACHUTE DEPLOYMENT
150 MI.
WATER ENTRY PARACHUTE RELEASE DETECTION EQUIPMENT ENERGIZED
PROJECT "ADAM"
SEQUENCE OF EVENTS ALONG TRAJECTORY
FILE NO. 574-1
10 MARCH 1958
CONFIDENTIAL

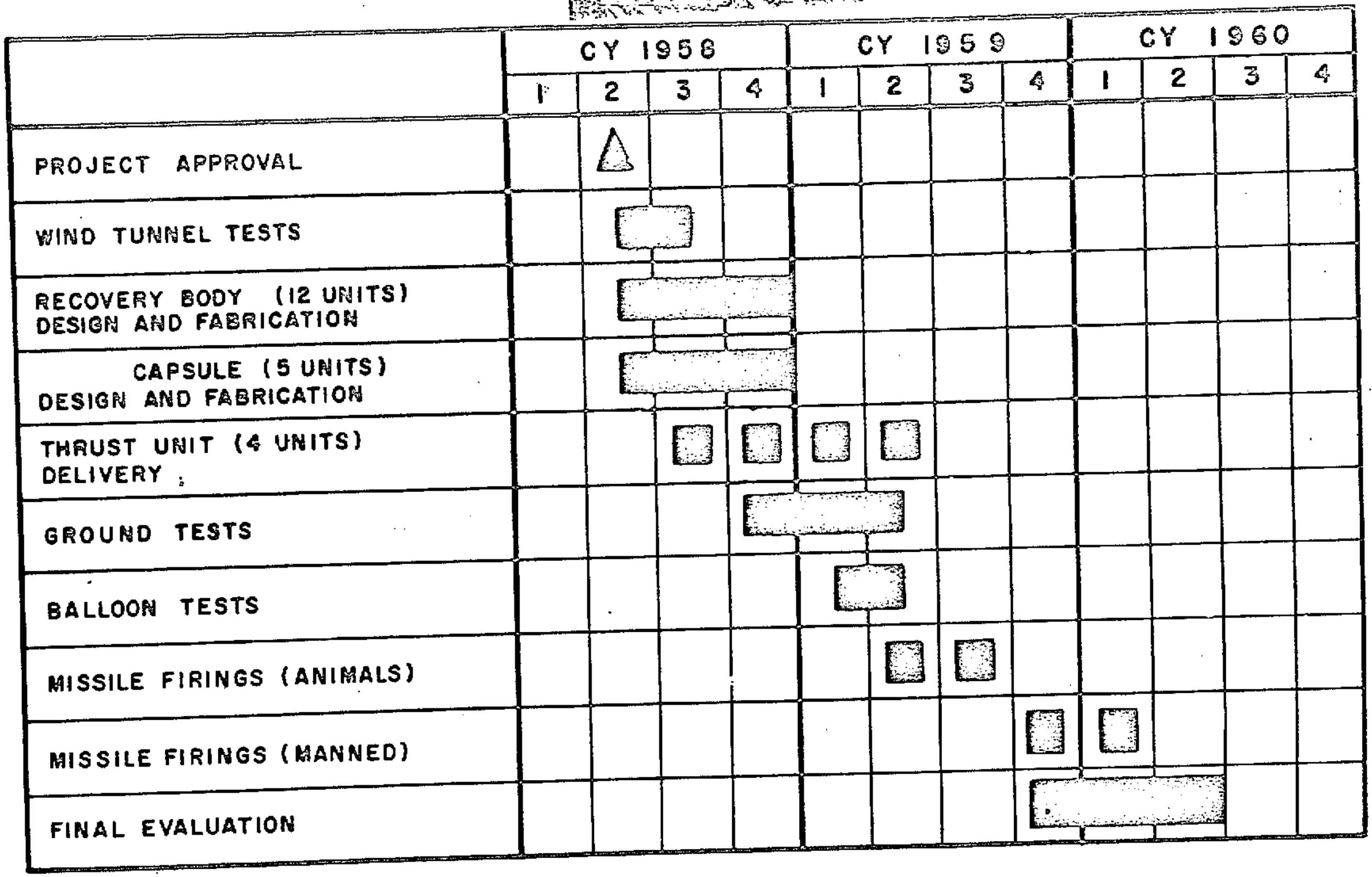
Fig 2



PROJECT "ADAM"
TRAJECTORY AND G LOADS VS TIME

FILE NO 574-6
10 MAR 58

Fig 3



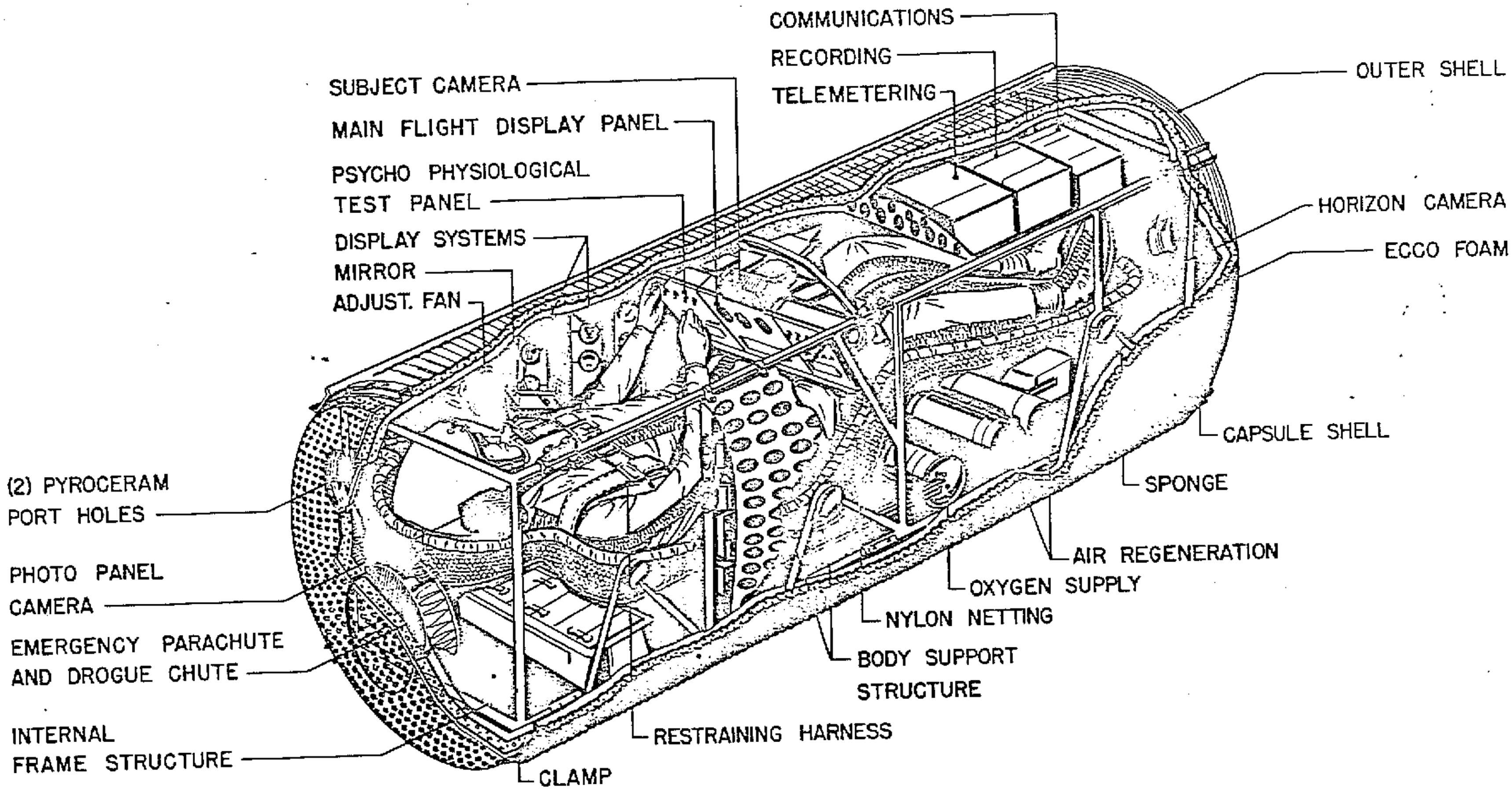
PROJECT ADAM DEVELOPMENT SCHEDULE

FILE NO 574-6
27 MAR 1958

SECRET

Fig 4

SECRET



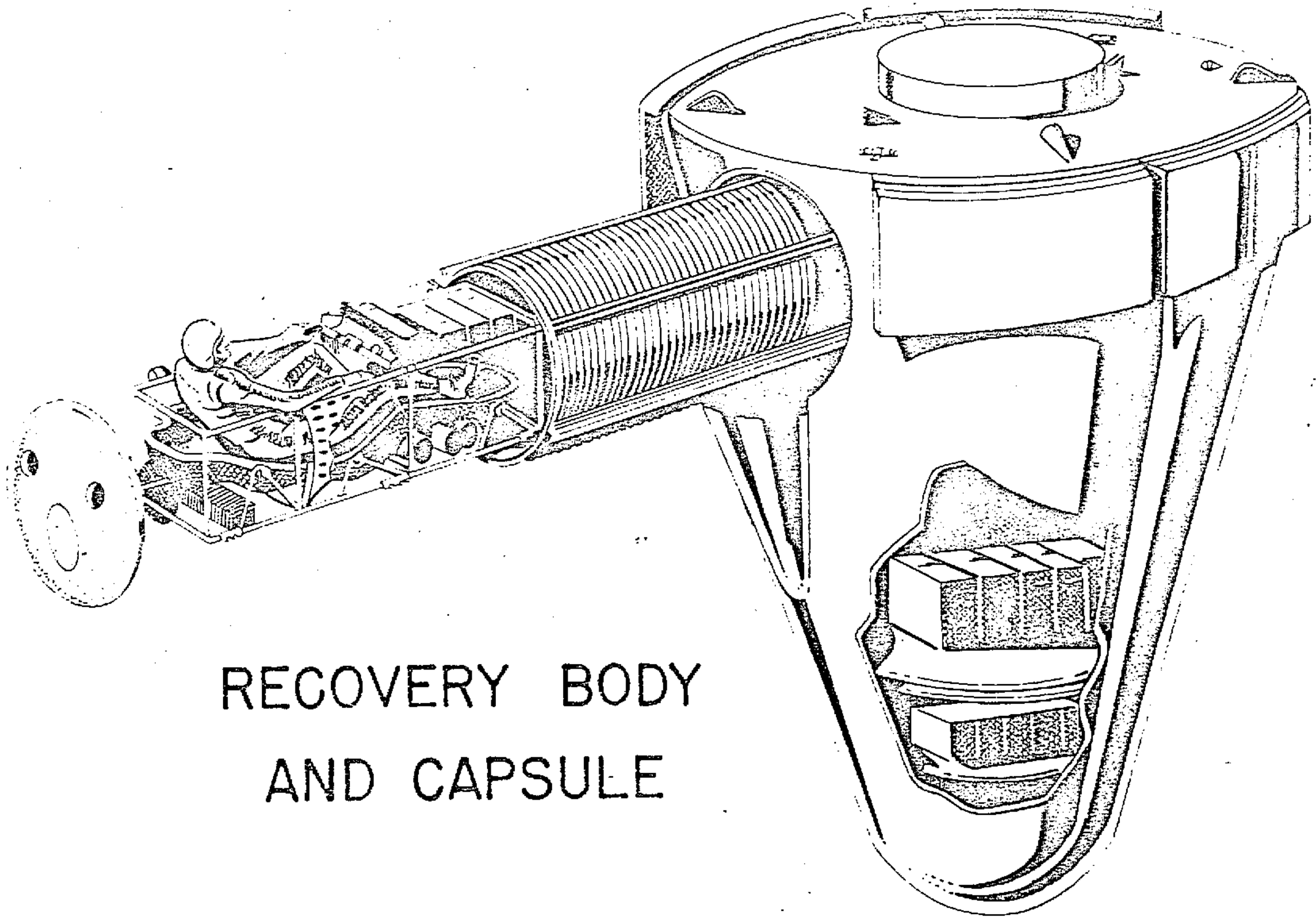
PROJECT "ADAM" CUTAWAY OF CAPSULE

SECRET

FILE NO. 574-7
10 MAR 58

Fig 5

[redacted]



RECOVERY BODY
AND CAPSULE

[redacted]

FILE NO. 574-4
10 MAR 58

Fig 6

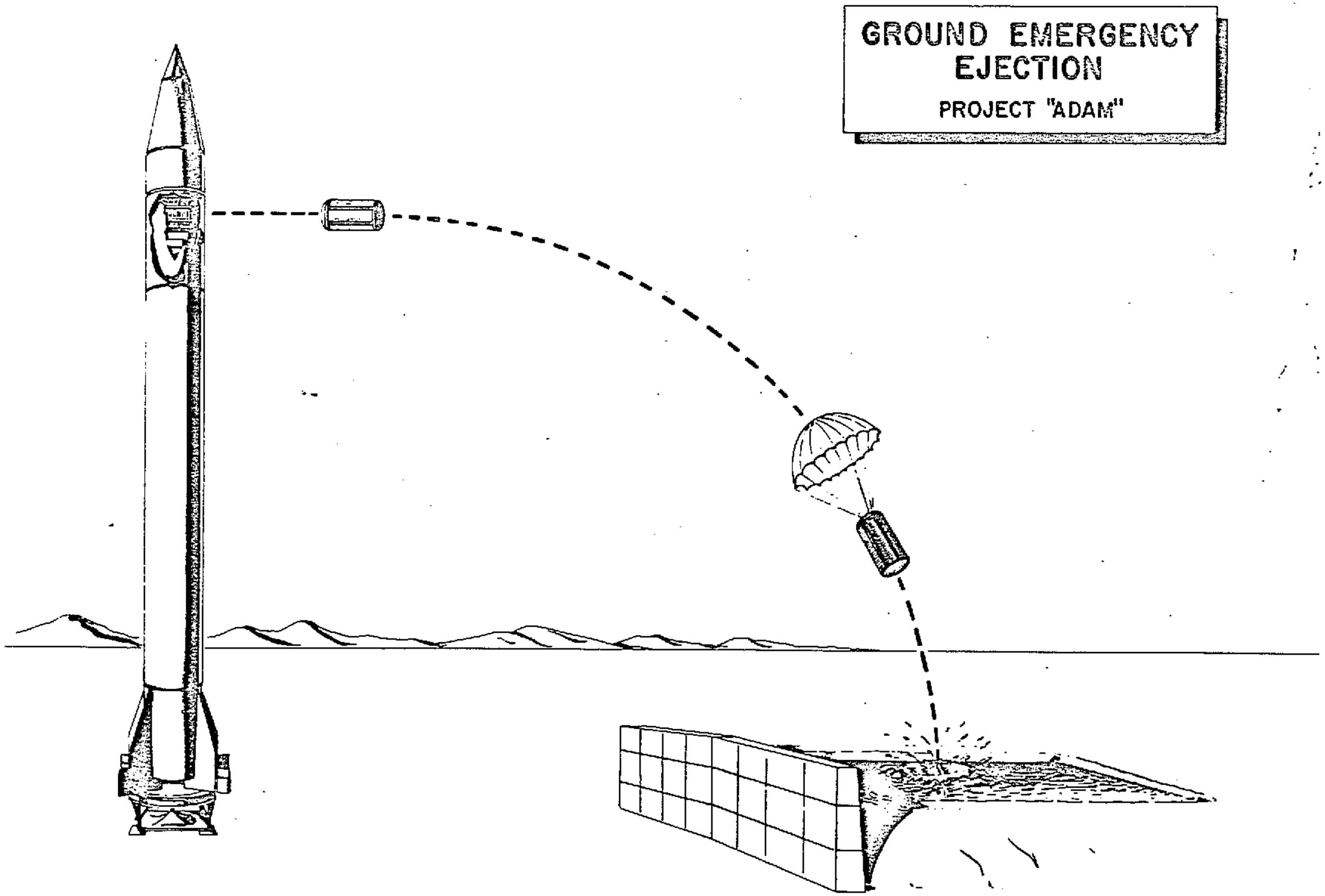


Fig 7

FILE NO 574-2 10 MAR 1958

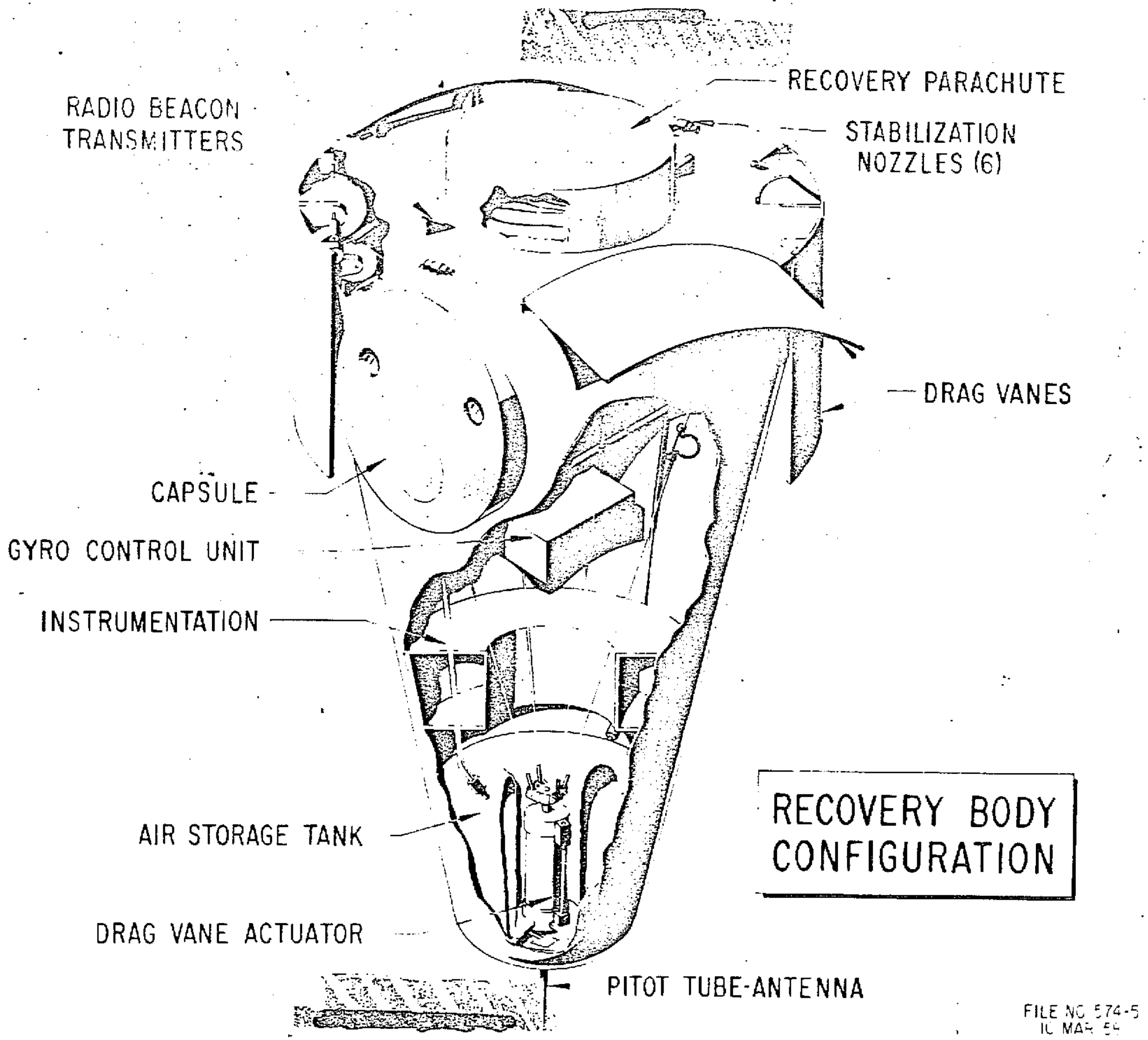

RECOVERY PARACHUTE
RADIO BEACON TRANSMITTERS
STABILIZATION NOZZLES (6)
DRAG VANES
CAPSULE
GYRO CONTROL UNIT
INSTRUMENTATION
AIR STORAGE TANK
DRAG VANE ACTUATOR
PITOT TUBE-ANTENNA
RECOVERY BODY CONFIGURATION
FILE NO 574-5

Fig 8

ORDAB-DV

Comments to Air Force Presentation on Man-in-Space Projects

Advanced Research Projects Agency, ATTN: Dr. H. York

Director, Research Projects Lab, DOD, ABMA

19 May 1958

1. The undersigned appreciated it very greatly to be invited to the Air Force presentation on current Man-in-Space Projects. In the following, a few comments are offered regarding these projects. They followed from discussions of the undersigned with other members of ABMA, and should therefore be considered as reflecting the opinion and the experience of personnel at ABMA.

2. The overall plan for the development of a Man-in-Space capability is well conceived, with possibly two exceptions:

a. The time schedule attached to the Air Force proposals appears too optimistic in view of actual missile development schedules encountered in previous Army, Navy, and Air Force projects. (See Paragraph 3A.)

b. It is considered advisable to include in a Man-in-Space Program as an integral part a few rocket launchings of recoverable manned capsules. Such rocket launchings have been proposed in connection with an Army Rocket Transportation Project. (See Paragraphs 3C and D.)

3. Comments:

A. The development time required to develop a missile into a vehicle safe enough to carry a man should not be underestimated. A period of at least two years should be allowed after the first fully successful flight before a man is entrusted to a rocket vehicle. The Navajo, for example, never reached this state of reliability. The Redstone had its first successful flight in 1953, but not before 1956, or even 1957, would one have considered to put a manned capsule into the Redstone. Jupiter and Thor were launched successfully one year ago, but at least one, possibly two, more years of testing and improvement will be necessary before either one is reliable enough to carry a man. This testing time goes up considerably if modifications like second stages or new fuels are introduced. A new missile system, such as the fluorine-fueled Thor with a second stage, should be allowed a minimum of one and one half years for development, and then at least two years of testing before a man is put aboard. The first manned flight with this system should therefore not be expected before early 1962. Manned flights involving Titan missiles may not be feasible before 1963 or 1964, in view of the fact that the first normal Titan for ground use has not been launched yet. The Atlas, which had its first flight test in 1957, is another example for the long testing time required to make even a simple missile, not prepared for manned orbital flight, reliable. At the present time, there are still turbo-pump failures in the Jupiter, the Thor, and the Atlas.

D. The most common failures of missiles occur either in the propulsion system or in the guidance and control system. If such a failure should happen in a manned vehicle, the natural procedure would be to shut down the motor, or to inactivate and zero the guidance and control system, and to have the man bail out when, during the ensuing free coasting (or uncontrolled) flight, the vehicle has reached an altitude which is safe for parachute operation. This procedure is feasible only if the missile is aerodynamically stable. If it is aerodynamically unstable, it will build up prohibitive angles of attack upon loss of thrust, or loss of control, and it will explode within a fraction of a second. There would be no time for bail-out. While the Redstone is an aerodynamically stable missile, all the newer missiles (Thor, Jupiter, Atlas, Titan, Polaris, and Pershing) are unstable. This decisive difference means that the newer missiles must reach even a higher degree of reliability than the Redstone before they are suited for manned flight.

C. Manned orbital flight involves three major problem areas: (a) to take the man up into the orbit; (b) to keep him alive in the orbit; (c) to bring him down to earth again. Each of these areas consists of a large number of sub-problems; the third area, for example, includes the following: orienting the satellite before the retro-rocket is fired; firing the retro-rocket; controlling the re-entry angle; breaking the high velocity in the upper layers of the atmosphere; absorbing the re-entry heat; applying dragbrakes; deploying a parachute; impacting in water; floating on the water; sending signals for the retrieving crews; finding the floating capsule by retrieving crews; and finally, recovery from the water.

It is believed that it would be very reassuring for the human passenger, and relieving for the project engineer, if some of the almost countless problems connected with manned orbital flight could be solved in shorter flight tests before the first manned satellite flight. The propelled part of the ascent; bail-out maneuvers during this phase; weightless periods of several minutes durations; capsule orientation during descent; drag-brake operation; parachute deployment; impact in water; and the complete recovery operation, can be tested out in an almost perfect manner by shooting a manned capsule with a rocket through a ballistic trajectory of modest altitude (about 150 miles). The velocity region around Mach number 5, which is a very essential, and still untested, phase of the re-entry maneuver, could be thoroughly investigated. It is very strongly recommended that this manned rocket flight be inserted in the Man-in-Space Program as an integral part.

D. The U. S. Army has a requirement to transport men and material over distances of several hundred miles by rocket vehicles. Studies and investigations bearing on this project are presently underway at the Army Ballistic Missile Agency.

As a first step towards the problem of transport by rockets, the Army Ballistic Missile Agency has proposed to establish a project which provides for the 150 mile transport of a man by a modified Redstone Missile. Details of this project are described in the attached brochure ("Project Adam"). The duration of this project is about 18 months from initiation, including two manned rocket flights.

Since the technical problems to be solved in connection with this project are so intimately related to problems encountered in a "Man-in-Space" Project, it is suggested that the Air Force take full advantage of the experience and the data gained in Project Adam. It should be pointed out that the major problems to be solved in connection with manned satellite recovery are no longer heat or trajectory problems; these questions can be answered with presently available knowledge. The main problems are of technological and procedural nature, and they can be solved satisfactorily only by an experimental approach. It is therefore suggested that the Advanced Research Projects Agency, while supporting the Air Force's Man-in-Space Project, give its full support to Project Adam as an indispensible part of any program which envisions manned satellite flight.

ERNST STUHLINGER

COPY FROM AMC FILES 10-1-65

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
WASHINGTON 25, D. C.

ORD/I 8587 (S)

27 June 1958

MEMORANDUM FOR RECORD

SUBJECT: Conference with Director, Central Intelligence Agency (U)

1. On 26 June, by direction of the Chief of Research and Development, and with the concurrence of the Secretary of the Army, Major General John B. Medaris, Commanding General, Army Ordnance Missile Command, accompanied by Colonel Robert E. Coffin, Chief, Missiles and Space Division, OCRD, called on Mr. Allen Dulles, the Director of Central Intelligence Agency to discuss AOMC's Project ADAM. General Medaris outlined the nature of the project as a REDSTONE missile fitted with a special recovery capsule which would allow carrying a man to an altitude of about 150 to 175 nautical miles. He stated the program would require about $9 million in FY 1959 and approximately $2.5 million in FY 1960. The project, if started now, could be completed in December 1959. Mr. Dulles and Mr. Bissell, CIA, evidenced great interest in the project. General Medaris asked if CIA would be interested in financing a portion of the project. Mr. Dulles stated he is interested to the extent that he would like to fund a portion of the project, however, he cannot make a commitment on money at this time. He will investigate the feasibility of using CIA funds for this purpose with the Director, Bureau of the Budget and will inform the Army through the Assistant Chief of Staff, Intelligence.

2. Mr. Dulles was particularly interested in the use of this vehicle as a resupply vehicle particularly if this capability could be developed quickly.

3. After a discussion as to how this should be staffed through governmental levels, Mr. Dulles stated he felt Presidential approval would be required prior to actually launching a man in a missile. It was agreed that the Office, Chief of Research and Development would immediately initiate an action to establish Project ADAM as an approved formal Army development project. The details of funding would be worked out at a later time. Mr. Dulles promised full support and stated he intended to discuss this project with Dr. James Killian again. Mr. Dulles indicated that Dr. Killian had previously indicated enthusisam for this project.

4. General Schow, ACofS, Intelligence, was informed of the above at about 1600, 26 June.

ROBERT R. COFFIN
Colonel, GS
Chief, Missiles and Space
Division

Copies furnished:
DRD (2)
S&S (2)
ACSI
CG, AOMC

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C O P Y

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ADVANCED RESEARCH PROJECTS AGENCY
Washington 25, D. C.

C O P Y

11 July 1958

MEMORANDUM FOR THE SECRETARY OF THE ARMY

SUBJECT: Project ADAM

In order that you may be fully informed concerning ARPA decisions as they affect advanced research projects proposed by the Department of the Army, this Agency has carefully considered Project ADAM in connection with its merits as a part of the Man-in-Space program. It is felt that the cost of the project cannot be justified in terms of its contribution to this program, and we can not, therefore, include it therein. If the project may be carried out for the fact of its contributions toward other objectives, we would be pleased to receive information on applicable data.

While the decision respecting our Man-in-Space program must be considered firm, I should like to assure you once again that it remains ARPA's intention to utilize the Army's research competence to the maximum extent consistent with program fiscal and policy considerations.

This Agency, being research oriented, cannot appropriately participate in activities of a non-research policy nature relating to roles and missions of the several Military Departments. On the other hand, ARPA cannot, and will not fail to consider the research capabilities of any organization, including those of the Department of the Army, with the capability to contribute to the advancement of our scientific space and ballistic missiles defense research and development effort.

/s/ Roy W. Johnson
/t/ Roy W. Johnson
Director

Rees sent copies to Lab

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From AMC files 10-1-61

DA-5

~~SECRET~~

OFL

Dr, telecon 240419Z Aug 58 DA TT 0595
Cy 1 of 4 (CA 60253, 24 Aug 58), sub: Mi Shot

FOR KAISER FROM DUNHAM

FOLLOWING MEMO TO SEC ARMY FROM DEP SEC DEF IS TRANSMITTED FOR INFO TO CG AOMC PER 22 AUG REQUEST BY CAPTAIN MONTGOMERY:

PARAPHRASE NOT REQUIRED EXCEPT PRIOR TO CATEGORY B ENCRYPTION -- PHYSICALLY REMOVE ALL INTERNAL REFERENCES BY DATE-TIME GROUP PRIOR TO DECLASSIFICATION -- NO UNCLASSIFIED REFERENCES IF THE DATE-TIME GROUP IS QUOTED.

Regraded Uncl ... MICOM
Intel + Sec Mr. Corthell 9 Apr 64

15 AUG 58

MEMORANDUM FOR THE SECRETARY OF THE ARMY

SUBJECT: PROJECT "ADAM"

REFERENCE IS MADE TO YOUR MEMORANDUM DATED 8 AUGUST 1958.

I RECOGNIZE THE MANY ELEMENTS IN SUPPORT OF PROJECT "ADAM" OUTLINED IN YOUR MEMORANDUM. HOWEVER, IN THE LIGHT OF CURRENT SOVIET DEVELOPMENTS AND CERTAIN OTHER PROGRAMS RELATING TO THE MOVEMENT OF PERSONNEL IN A SPACE ENVIRONMENT, THE NATURE OF THE PROJECT SUGGESTS THAT DECISIONS REGARDING IT SHOULD AWAIT FURTHER STUDY.

IN VIEW OF YOUR INDICATION THAT THE DIRECTOR OF CENTRAL INTELLIGENCE HAS CERTAIN INTERESTS IN THIS PROGRAM, I HAVE

AKSED THE DIRECTOR OF THE ADVANCED RESEARCH PROJECTS AGENCY TO CONSULT WITH YOU OR YOUR DESIGNEE AND, AS APPROPRIATE, TO ARRANGE FOR NECESSARY DISCUSSION WITH THE DIRECTOR, CENTRAL INTELLIGENCE. IN THE EVENT THAT A MILITARY OR PARA-MILITARY JUSTIFICATION FOR THIS PROGRAM, NOT PREVIOUSLY CONSIDERED AND NOT COVERED BY OTHER SIMILAR PROGRAMS ALREADY APPROVED, CAN BE DEVELOPED, INCLUSION OF THIS PROJECT AS PART OF THE DOD RESEARCH PROGRAM MANAGED BY ARPA CAN BE RECONSIDERED.

SHOULD CONSULTATION BETWEEN THE DEPARTMENT OF THE ARMY, ARPA, AND CIA LEAD TO THE CONCLUSION THAT PROJECT "ADAM" HAS RAMIFICATIONS BEYOND THE RESPONSIBIPITIES OF THE DEPARTMENT OF DEFENSE, IT MAY THEREAFTER BE REFERRED BY ARPA TO THE NATIONAL AERONAUTICS AND SPACE COUNCIL FOR FINAL DETERMINATION AS TO WHETHER THE PROGRAM SHOULD BE PURSUED AND BY WHICH GOVERNMENT AGENCY.

/S/ DONALD A QUARLES

(END DA-5)

- from AOMC FILES
10-1-65

FOR INFORMATION

[illegible] FILE

ORDXM-X
JOURNAL ENTRY
30 Sep 58

SUBJECT: Telephone Conversation With Lt Col Wolters, OCRD, 30 Sep 58

1. Major General William W. Dick will accompany Mr. Holaday on his tour of AOMC next week.

2. Col Wolters referred to the TWX regarding the Radio Telescope in England. He indicated that to exchange information with this Agency in England would require clearance by ARPA. This clearance has not been obtained, therefore no information can be exchanged. He further indicated, that we should give specific titles for each item we want clearance to give to personnel in England.

3. Col Thomas, Lt Col Young and two other representatives from ARPA will be at AOMC on Thursday and Friday, the 2nd and 3rd of October to discuss the six vehicle JUNO X Program.

4. As action officer level Col Wolters desires to discuss the views of AOMC regarding NASA participation in the PROJECT ADAM. He indicated that there were some informal discussions between General Daly, representatives of ARPA and NASA on the possibilities of an over-all DOD/NASA programfor "Man in Space." He had specifically in mind the development of a common capsule that would be used in all vehicles. He also indicated that NASA had the feeling that they would want to direct the program with the Army furnishing the vehicle. Col Holmes replied that this would not be an acceptable method of handling the project as far as AOMC is concerned. AOMC should be given the mission and the responsibility for accomplishing the mission to include all aspects. Further stated that with respect to participation by NASA in PROJECT ADAM that we would be willing to discuss technical and useful aspects of PROJECT ADAM for the "Man in Space Program" by NASA bearing in mind that PROJECT ADAM is designed to meet Army requirements for a man carrying vehicle by missiles.

(Col S. C. Holmes/cb)

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ORDXM-M
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From AMC files
10-1-65

FOR INFORMATION
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..SGS.......
..READING FILE

ORDXM-R
JOURNAL ENTRY
1 Oct 58

SUBJECT: Telephone Conversation Between Lt Col Wolters, OCRD and Col Holmes, ABMA

Col Wolters stated he had more information on NASA interest in PROJECT ADAM. He first desired to add Mr. [illegible], Chief of Man in Space Program to the list of personnel arriving at ABMA on Monday. He also added Major [illegible] from OCRD. Col Wolters stated that NASA is now considering offering ABMA a package deal and submitting a proposal as a special project for the "Man in Space" program; however, NASA will probably require a common capsule with a possible requirement to go to a larger vehicle later in the program. He understood that it would consist of 12 firings starting in January which he recognized as not being feasible. He estimated that NASA would have approximately thirty eight million dollars for the whole program for FY 59.

(Col S. C. Holmes/cb)

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COPY FROM AMC FILES 10-1-65

Washington, D. C.
November 12, 1958

MEMORANDUM For Dr. Silverstein

Subject: Assignment of responsibility for ABMA participation in NASA manned satellite project.

Reference: Letter 10/17/58, J. B. Medaris to T. Keith Glennan, (ORDAB - CL)

1. The AOMC in the reference letter raised certain questions about the assignment of responsibility for the proposed ABMA participation in the NASA manned satellite project.

2. In general, NASA will act as systems manager for the complete project. ABMA should be asked to exercise technical responsibility on those matters dealing with the interplay of missile and capsule design characteristics and missile firing problems. Specifically:

(a) NASA will exercise management responsibility for the complete system including the flight program.

(b) NASA will, through its contractors, furnish the capsule hardware and systems and be responsible for checkout and operation of all on-board equipment.

(c) ABMA will furnish the booster based on the REDSTONE missile. This will include responsibility for:

(1) Pre-flight engineering and feasibility studies.

(2) Design and construction of booster with necessary modifications to adapt it to the capsule

(3) Pre-flight assembly of booster, installation of capsule on booster, and checkout of booster systems and of inter-connected booster-capsule systems.

(4) Launching of booster vehicle including pre-launch safety and countdown procedures.

(d) NASA will be responsible for selection, training, pre-flight preparation, and in-flight monitoring of the crew.

(e) At present it appears that existing normal AMR responsibilities and procedures for vehicle tracking and data acquisition will be followed.

(f) Responsibility for the actual recovery operation will be determined following later discussions between NASA and AMR, Navy, and ABMA groups.

3. It should be understood that the REDSTONE-boosted flights are only a portion of the whole program and thus problems peculiar to these

flights cannot be allowed to force any major design compromises or modifications to the manned satellite capsule.

Paul E. Purser
Aeronautical Research Scientist

Max A. Faget
Aeronautical Research Scientist

PEP/MAF:lgs

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ORDXM-X

Agreements Concerning Responsibility in The NASA Manned Satellite Project

ORDXM-R
Col Holmes

ORDXM-X

14 Nov 58

1. Confirming our discussion of 14 November 1958, there is transmitted herewith a copy of a NASA internal memorandum dated 12 November 1958, subject: "Assignment of Responsibility for ABMA Participation in NASA Manned Satellite Project."

2. The general conditions of this memorandum were discussed by General Medaris with Dr. Glennan during their meeting of 12 November 1958. There is mutual agreement between General Medaris and Dr. Glennan on the division of responsibility between ABMA and NASA in this project, and it was agreed that the attached memorandum makes an appropriate summary of the division.

GLENN CRANE
Lt Colonel, GS
Spec Asst to Commanding General

1 Incl
Cy memo dtd 12 Nov 58,
subj as above

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ORDXM-X - Reading File

COPY FROM AMC FILES (0-1-6)

UNCLASSIFIED

ORDXM-X REDSTONE Missiles for NASA Man-in-Space Program

ORDXM-R ORDXM-X 14 Nov 58
Col Holmes

1. Confirming our discussion of this date, Mr. W. J. North of NASA telephoned the undersigned and requested a cost estimate and finding schedule required to furnish the eight REDSTONE missiles for the NASA man-in-space program. Mr. North stated that our estimates should be based on the following desired firing schedule. It is noted that all eight REDSTONE missiles are scheduled for firing and none are planned as backup missiles. The firings would be conducted:

a. Two during the fourth quarter, CY 59.

b. Three during the first quarter, CY 60.

c. Three during the second quarter, CY 60.

2. Mr. North requested that he be furnished a teletype this date giving the above information, and it is understood that you will take action on this matter. Mr. North stated that on the basis of this teletype, he would be able to reply during the first part of next week to release the funds. This is in accordance with the recent discussions on 12 November 1958 between General Madaris and Dr. Connan.

Copies furnished:
ORDXM-C
ORDAB-C
ORDAB-CL

GLENN CRANE
Lt Colonel, GS
Spec Asst to Commanding General

1.0

PROJECT ADAM

Chronology

10 January 1958	Meeting held at ABMA to discuss formulation of Joint Army-Navy-AF project "man Very High."
3 March 1958	Second tri-services meeting on "Man Very High" at ABMA.
10 March 1958	Preliminary proposal for Joint Project "Man Very High"submitted to OCRD by TWX. Info copies furnished ARPA and OCO.
28 March 1958	Third tri-service meeting held at Winzen Research, Minneapolis.
17 April 1958	Project redesignated "ADAM" and proposed as an Army project in view of AF decision not to participate in "Man Very High." Formal proposal submitted to OCRD.
16 May 1958	Sec/Army forwarded ADAM proposal to ARPA recommending approval and ARPA funding.
19 May 1958	Army presentation to ARPA.
26 June 1958	Copies of ADAM proposal furnished CIA by OCRD.
11 July 1958	Memo from Director, ARPA to Sec/Army stated ADAM was not considered necessary to "Man-in-Space" program and therefore would not be funded by ARPA. Following statement was included: "If the project may be carried out for the fact of its contributions toward other objectives, we would be pleased to receive information on applicable data."
8 August 1958	Memo from Sec/Army to Sec/Def recommended ADAM as a national political-psychological demonstration. It also referred to CIA interest in ADAM . Memo further recommends that Presidential approval be obtained through action by the Operations Coordinating Board. On recommendation of the Director of R&D (Dr. Martin), and contrary to recommendation of Army Military Staff, no mention of Army military application was made. Defense funding \$9 million FY 59 and \$2.5 million FY 60 was requested.
15 August 1958	In reply to 8 Aug memo, Dep Sec/Def stated that in light of current Soviet developments and "Man-in-Space" program already under way, decision on ADAM

"Regraded ... by authority of CG USAMICOM by H. R. Heflin I+S ofc on 19 Mar 64."

Cy 1 of 2 cys
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should await further study. He recommended that Sec/Army designate a representative to confer with ARPA and CIA, and suggested that if a military or para-military justification can be developed, incorporation in ARPA programs can be reconsidered.

11 September 1958 — Army-ARPA-CIA conference held with Major General Daley as Army representative. Results of meeting indicated little chance for approval of ADAM unless time scale can be compressed.

For later chronology, see Project MERCURY and Army Rocket Transport Program.

SECRET

C-AA 18338
18 December 1958

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EFM
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INFORMATION CONCERNING G&C HARDWARE

PROCUREMENT FOR ADAM MIS AND JUNO II PROGRAMS

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INFORMATION CONCERNING G&C HARDWARE PROCUREMENT FOR ADAM MIS (MAN IN SPACE) AND JUNO II PROGRAMS.

1. As a result of a meeting held on 12 December 1958 in the Guidance and Control Laboratory with respect to the proposed programs (Adam MIS and Juno II, see page 4), procurement of the following hardware in the G&C area was determined necessary:

a. <u>Adam - Redstone (Jupiter C)</u> 8 vehicle program
<u>List of principal components</u>

LEV-3 Stabilizer Ass'y
  Gyros, pitch and yaw-roll
  Integrator with junction box (FICo substitute for KG accel)
Program Device, Mod. 4
Control Computer
Control Relay Box
Actuators, C-1 (4 per missile)
Distributors (main, measuring, power and tail)
Inverter and Regulator
Batteries and Power Supplies (for telemeter, measuring, network, command and servo)
Miscellaneous (timers, stepswitch, terminal boxes, etc.)

For the 8 vehicle program, 10 sets of components should be provided with the exception of the LEV-3 assembly (pitch, yaw-roll gyros and accelerometer), where 12 assemblies are requested by the Gyro and Stabilizer Branch to secure the fulfillment of the program.

b. <u>Adam - Jupiter</u> 3 vehicle program
<u>List of principal components</u>

ST-90 Stabilizer Ass'y and Amplifier Box
Guidance Computers (velocity and displacement-full guidance system.)
Control Computer
Program Device J
Angle-of-Attack Meter Ass'y (boom - Edcliff)
Control Accelerometer Ass'y (2 per missile)
Actuator Ass'y - Pitch, Yaw and Roll
Distributors (main, measuring-booster and top,and power)
Inverter and Regulator (1 or 2 depending on telemetering and tracking equipment)
Batteries and Power Supplies (for telemeter, measuring, network and command)
Miscellaneous (timers, stepswitch, etc.)

For this 3 vehicle program, 4 sets of equipment seem to be necessary.

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c. <u>Juno II</u> 8 vehicle program
<u>List of principal components</u>

ST-90 Stabilizer Ass'y and Amplifier Box
Interim Guidance Computers (velocity terms only)
Coordinate Resolver Computer
Control Computer A } See Remarks
Control Computer B }
Program Device J
Angle-of-Attack Meter Ass'y (boom-Edcliff)
Control Accelerometer Ass'y (2 per missile)
Actuator Ass'y - Pitch, Yaw and Roll
Spatial Attitude Control System (See Remark a) (actuators and nozzle ass'y - 4 per missile)
Distributors (main, measuring - booster and top, and power)
Inverter and Regulator (1 or 2 depending on telemetering and tracking equipment)
Batteries and Power Supplies (for telemeter, measuring, network and command)
Rotational Launcher System - (motor drive ass'y, regulator, filters, etc.)
Miscellaneous (timers, stepswitch, etc.)

10 sets of components should be provided for these vehicles plus additional accelerometers for control, since this instrument will be new in the control area.

Accelerometer control instead of angle-of-attack control would be highly desirable. Until now only laboratory investigations are available and only missile #19 (firing date Aug. 59) is scheduled for accelerometer control. If this flight test substantiates the laboratory investigations, we should use this type of control on the Juno II and Jupiter-Adam vehicles, since the boom type angle-of-attack meter on the tip of the shroud or the tip of the capsule escape rocket could be avoided.

2. Remarks:

a. A new type of spatial attitude control system is now under consideration which uses non-leaking Bendix cold gas nozzles instead of the arrangement used on previous Juno II vehicles. The Bendix nozzle has been tested in the G&C Laboratory and can be operated like a Moog valve (pneumatic servo-valve). This system would eliminate Control Computer B and the Globe Ind. actuators and reduce the requirements on the air supply. No definite statement as to which system should be used can be made at this time and procurement of this item should be excluded until after pending laboratory tests are conclusive (around middle of January). Eight Bendix cold gas nozzles would be required per missile and Control Computer A would have to be modified.

b. For the early flights of Jupiter vehicles in the Juno II or Adam programs, G&C equipment previously ordered for the R&D phase of the Jupiter program can be used.

c. The telemetry, tracking and range safety equipment will be similar to that used on previous Jupiter C and Juno II vehicles and a request for procurement of hardware will be submitted separately.

3. Total Hardware Requirements for the Adam MIS and Juno II Programs.

	ADAM		JUNO II
	Redstone (8 vehicles)	Jupiter (3 vehicles)	(8 vehicles)
LEV-3 Ass'y	12		
ST-90 and Amplifier Box		4	10
Guidance System		4	10 (interim)
Coordinate Resolver			10
Program Device	10 (Mod 4)	4 (Mod J)	10 (Mod J)
Control Relay Box	10		
Booster Actuators	40 C-1	4 + 8 (roll + pitch, yaw)	10 + 20
Accelerometers (control)		8	24 **
Control Computer	10	4	10 type A * 10 type B *
Globe Actuators			40 *
Inverter 1800 VA	10	4 or 8 (depends upon tracking, telemetering)	10 or 20
Distributors (main, tail, power, measuring)	10 sets	4 sets	10 sets
Batteries and Power Supplies (telemetering, measuring, command, network.)	10 sets	4 sets	10 sets
Miscellaneous (timers, step-switch, etc.)	10 sets	4 sets	10 sets
Rotational Launcher			10 sets

* Note: If Bendix nozzles for attitude control are chosen these procurement items change to:

Control Computer	10 mod. Jupiter
Bendix Nozzles	80

** See explanation in text under Juno II (1, item C)

[redacted]

F. W. Brandner

F. W. BRANDNER
JUNO Project Engineer
Guidance and Control Lab

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16 Dec 58

G&C planing schedule (firing dates) for Adam and Juno II program

Program		1959 J	F	M	A	M	J	J	A	S	O	N	D	1960 J	F	M	A	M	J	J	A	S	O	N	D	
Adam	8 Redstone (Jup-C)										X 52 unmanned		X 55		X manned or capsule test		X	X	X	X	X					LEV3 + [illegible] fixed accelerom[eter] for Velocity C.O.
Adam	??? 3 Jupiter (talking stage)									• unmanned		•		•												St 90 + full guidance system + α-control
Juno II	4 + 8 Jupiter (19c-j)		X 14	X 16		X 19 a		X 19 b		X 19 c		X 19 d		X 19 e	X 19 f		X 19 g		X 19 h		X 19 i		X 19 j			St 90 + interim guidance system + α-control
Juno II	possible modification if 3 Jupiter for Adam are ordered		• 14	• 16		• 19 a		• 19 b						• 19 c	• 19 d	• 19 e	• 19 f	• 19 g		• 19 h		• 19 i		• 19 j		

Notes:

On the Jupiter vehicles 19c-j and the 3 proposed for "Adam" the possibility should be provided to switch over from α-control to accelerometer control if the flight-results from missile # 19 are favorable. Hardware will be installed in all the vehicles so that the switch over can be made on the launching pad.

Missile # 19b is a spare and no firing date has been set.

16. Dec 1958

DISPOSITION FORM

SECURITY CLASSIFICATION (If any)

UNCLASSIFIED

FILE NO.	SUBJECT		
ORDAB-DSRW	Mercury-Adam Project		
TO All Laboratories, DOD	FROM AB-DSRW	DATE 14 Jan 59	COMMENT NO. 1

DrKuettner/pb/3622

1. With the arrival of funds from NASA and the selection of McDonnell Aircraft (St. Louis) for the manned space capsule the project has started rolling.

2. The official name of this NASA Project is "Mercury", its objective is the manned satellite. The name "Adam" generally accepted within ABMA may be used informally, but only for ABMA's part in it, namely the manned and unmanned checkout flights with Redstone and Jupiter.

3. Tight schedules have forced our team into the undesirable situation to begin work before the capsule design is finalized. Close contact with the capsule contractor will be initiated from the very beginning. As the proposed capsule design does not seem to deviate appreciably from NASA's conception, we are distributing NASA's (classified) final specifications for the time being to your information.

4. A general description of the project scope and ABMA's role in it is contained in a recent (classified) document prepared by ABMA for NASA. It may prove helpful until better information is available and is likewise being distributed.

5. In spite of present uncertainties a preliminary "Model Description" of missile MR 1, to be fired (unmanned) during October 1959, is being prepared. It will be distributed shortly. Changes will be unavoidable and will be coordinated.

6. In view of the human life involved in this project the measuring program should be exceptionally detailed. It must be realized that, to replace a full scale aircraft flight test program by a few unmanned test shots, is a staggering problem. It will be necessary to be able to track down any conceivable malfunction during each flight. The laboratories directing requests for the measuring program to Mr. Hoberg, G&C Lab, may keep this view point in mind.

7. Among the new problems to be solved in this project will be normal and emergency procedures during manned firings. The inclosed memorandum gives a preliminary description of the problem based on the experience and thinking of the Missile Firing Lab. Attention is invited to Section III of the memo. New thoughts and critical comments are invited.

8. Missile numbers will be as follows: Mercury Redstones will be MR 1 through 8 (corresponding to the previous RS 52, 55, 58 through 63). Mercury Jupiter will be ~~MJ~~ 1 and 2.
MJ

9. All questions pertaining to the Mercury Project and its military transport version may be directed to: Joachim Kuettner, Man In Space Project Office, Structures & Mechanics Laboratory.

DD FORM 1 FEB 50 96 REPLACES NME FORM 96, 1 OCT. 48, WHICH MAY BE USED.

1 Inclosure

Joachim Kuettner

JOACHIM KUETTNER
Man In Space Project Engineer
Structures & Mechanics Lab

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MEMORANDUM ON BOARDING, LAUNCHING, AND EMERGENCY PROCEDURES DURING MANNED FIRINGS

In informal conferences at Cape Canaveral and Huntsville with members of ABMA's Missile Firing Laboratory (Dr. Debus, Dr. Gruene, Mr. Zeiler, and others), the problems arising at manned firings and possible solutions were discussed. The following notes give a preliminary and somewhat undigested appraisal of the situation.

I. BOARDING OF MISSILE

It is generally agreed that, for safety and psychological reasons, the occupant shall spend as little time as possible in the sealed capsule on top of the missile prior to firing. Before the passenger boards, the capsule must be securely attached to the missile and all components which do not involve the occupant and the capsule sealing should be completely checked out. After boarding, it will take about 30 more minutes to check out the occupant, the sealed cabin, and the physiological and environmental telemetry measurements. (A more thorough estimate can be made after the capsule design is finalized.)

When this checkout is completed, it will be necessary for the occupant to spend at least <u>another 30 minutes on the missile</u> before the actual firing. For, if everything goes well, it will take about 5 minutes to clear the service tower, 10 minutes to remove it, 3 minutes to clear the rest of the launching pad, and another 10 minutes for the final countdown. It is doubtful that this total of 28 minutes can be substantially reduced without major technical changes in established launching procedures.

It, therefore, appears that the occupant will have to <u>board the capsule about 1 hour prior to the scheduled firing time</u>. (This does not include any reserve for possible holds.)

During the occupant's idle half-hour on the missile, he may want to listen in on the countdown. To ensure excellent communication during this time and in view of RF silence, a closed-loop communication link between capsule and block house is considered. This applies also to the recorder checkout which should not rely on telemetry. Even though wiring between capsule and missile shall be kept to a minimum, this type of wire connection may be imperative.

II. POSSIBLE EMERGENCIES AND ESCAPE PROCEDURES

A. Missile Does Not Lift Off

1. This can be an ignitor failure which may require 15 minutes to replace, hence recycling to X-15 minutes. There is no necessity for ejection, and the occupant may remain in his seat.

2. It could be a wiring or similar problem which may require varying amounts of time to rectify - anything from 30 minutes up. In this case, it is probably advisable to take the occupant from the capsule and postpone the firing temporarily.

B. Insufficient Thrust

The missile does not leave the pad. Engine must be cutoff immediately. If no damage is done, the situation would resemble that of A. However, there is the possibility of a tail damage (for example, due to rough combustion with injector damage and dome explosion), and the missile may fall over. In this case, emergency ejection is indicated.

While manual ejection by the occupant - as well as by the blockhouse control - must be provided, automatic cutoff and ejection should be considered in view of the time element involved. Both thrust-chamber pressure and missile attitude may be appropriate sensors for cutoff and ejection. Angular rates may also be considered. The "tip-over" case with capsule ejection may be tested on the static test stand of the Test Laboratory.

C. Thrust Failure Within 10 Seconds

If the missile has not moved more than about 1 inch up, the situation may still be that of B. In other cases, the missile may fall back and crush its tail with a subsequent explosion. Emergency ejection is clearly indicated. In this stage, the missile can be seen only in the blockhouse, from where ejection could be triggered. Thrust-chamber pressure could again be used as sensor for an automatic ejection. (To distinguish this case from B, which does not require ejection, the trigger may be armed only at lift-off (break-wire) and should be disarmed before scheduled cutoff.)

D. Thrust or Guidance Failure During Boost

1. If the missile is aerodynamically stable, there is no immediate emergency; but, since no separation is ensured, ejection will be necessary. An attitude-sensing device would again provide automatic ejection before the trajectory flattens out too much, or a thrust chamber pressure sensor may do the job.

2. If the missile is unstable, it may flip over and explode. Immediate automatic ejection is imperative. Manual ejection will be useless as the required reaction time is of the order of 1/10 of a second. The main point is to eject before the missile is pointed horizontally or downwards or before it explodes. Aeroballistics Laboratory may check the flip-over rates in the worst cases (e.g., complete loss of thrust and control at maximum dynamic pressure). This should be compared to the lag time of the automatic trigger, consisting of gyro-sensing delay, relay-reaction time, thrust build-up in escape rocket, etc. A telemetry link to confirm completed ejection is required.

E. Explosion in Normal Flight

Although most unlikely, this case may need some further investigation. An analysis of films taken from the abortive flights of JUPITER 1A, 1B, and 9* may give expansion rates of the fireball. There is some chance that a thrust-chamber pressure-sensing device may give sufficient advance warning for automatic ejection.

F. Missile Off Course

There is only a slight chance that the Range Safety Officer will agree not to destroy the missile in flight if it is headed for inhabited areas. He may, however, be more reluctant and selective in his decision if an occupant is aboard. The case must clearly be anticipated.

If the "off-course flight" covers one of the cases discussed under D, ejection may already have taken place. Otherwise, it appears necessary to take the following action:

*See Major Robert N. Flint, ABMA Signal Office

1. Give the capsule occupant proper advance warning of the impending ejection.

2. Receive a confirmed signal (telemetry) that ejection has taken place.

3. Allow a safety period to elapse before the missile is destroyed (probably of the order of 3 seconds from ejection - to be determined more accurately later).

III. IMMEDIATE PROBLEMS

A. As indicated in the foregoing discussion, certain problems require immediate attention. These are listed below along with possible courses of action.

1. One or more automatic ejection systems are needed. (The suggested sensors of thrust-chamber pressure and attitude are examples only.) A study of this problem by the Guidance and Control Laboratory should incorporate the trigger-delay time.

2. Possible flip-over rates during unstable flight conditions and fireball expansion rates will be studied by Aeroballistics Laboratory.

3. Reliable communication with the occupant during flight must be assured (Guidance and Control Laboratory).

4. A critical review of the emergency cases and optimum solutions may be undertaken by the Missile Firing Laboratory.

5. A test program is to be designed by the Test Laboratory.

6. A reliability study (malfunction probabilities) for the JUPITER C and the whole system should be undertaken by the Systems Analysis and Reliability Laboratory.

7. Discussions with the Range Safety Officer will be initiated.

B. In preparation for these studies, an inter-laboratory conference will be held shortly. In the meantime, new thoughts and critical comments are invited.

Joachim Kuettner

JOACHIM KUETTNER
Man In Space Project Office