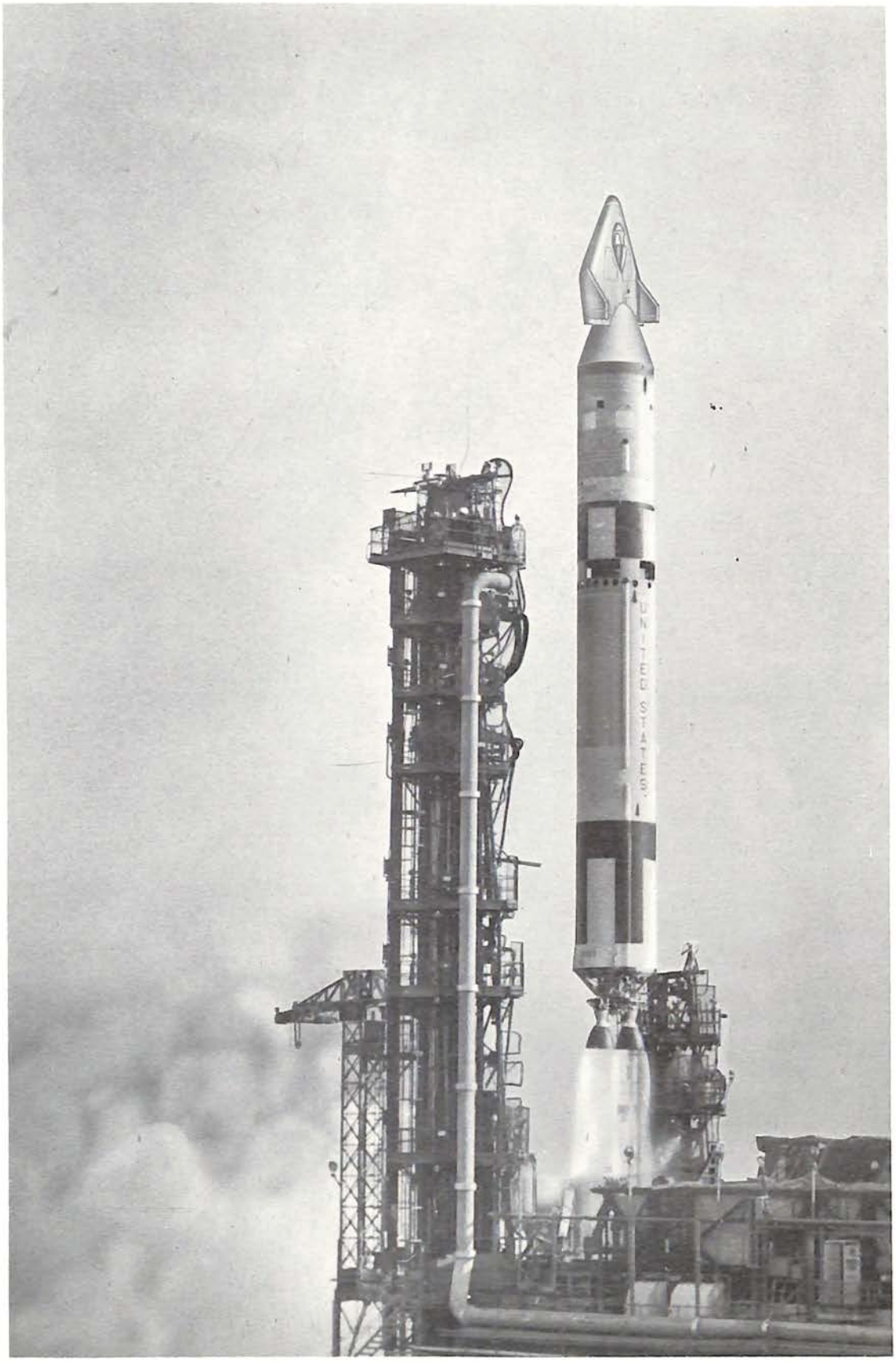
MINIMUM MANNED LIFTING BODY ENTRY VEHICLE

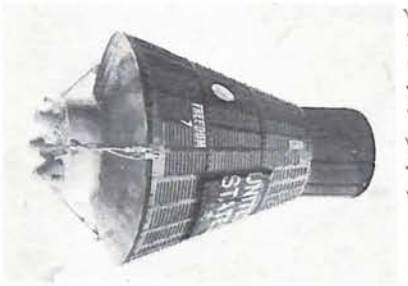
VOLUME I

REPORT NO. B497 ~ 8 MARCH 1965

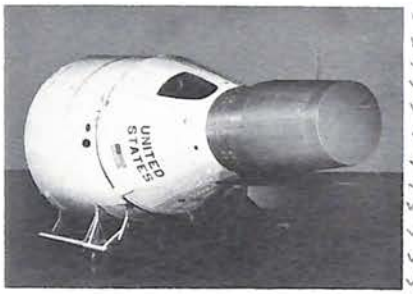


MCDONNELL

MAC EXPERIENCE FOR MANNED M-2 DEVELOPMENT

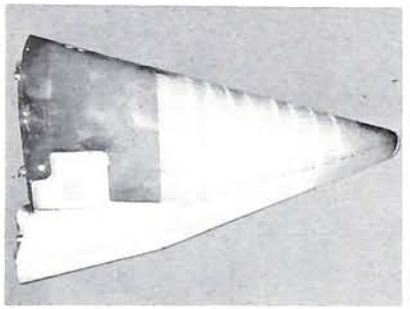


MERCURY

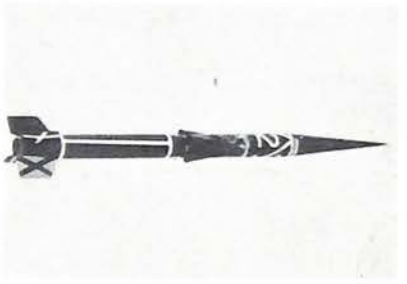


GEMINI

MANNED ORBITAL FLIGHT

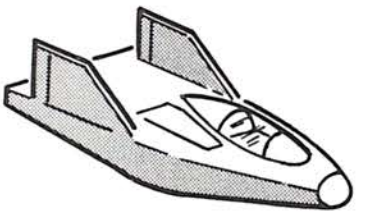


ASSET



ALPHA DRACO

HYPERSONIC LIFTING FLIGHT



MANNED M-2 PROGRAM

FIGURE 1.1-1

1.2 Representative Technical Approach - The representative technical approach presented in Section 3 of this report is based on extensive use of all phases of Gemini background, technology, and equipment. This will include airborne systems, ground support equipment, and the checkout and launch network. The concept is directed toward utilization of the Gemini Launch Vehicle (GLV) Titan II with no interface changes. This approach is based on extending all phases of the Gemini program as far as possible into a Manned M-2 lifting entry program, as shown in Figure 1.2-1, with essentially the only major change being a new airframe. This would make possible a significant cost saving through utilization of developed hardware systems.

Through the concept of utilizing an existing program and qualified equipment as the primary base, new development costs will be minimized, realistic schedules may be predicted, and maximum reliability can be achieved.

Presentation of a representative framework defining a preliminary vehicle concept, flight profile, and program plan will provide the baseline for establishing firm guidelines at the beginning of the program. This baseline will be further evaluated and defined after submittal of the proposal until the contract is awarded.

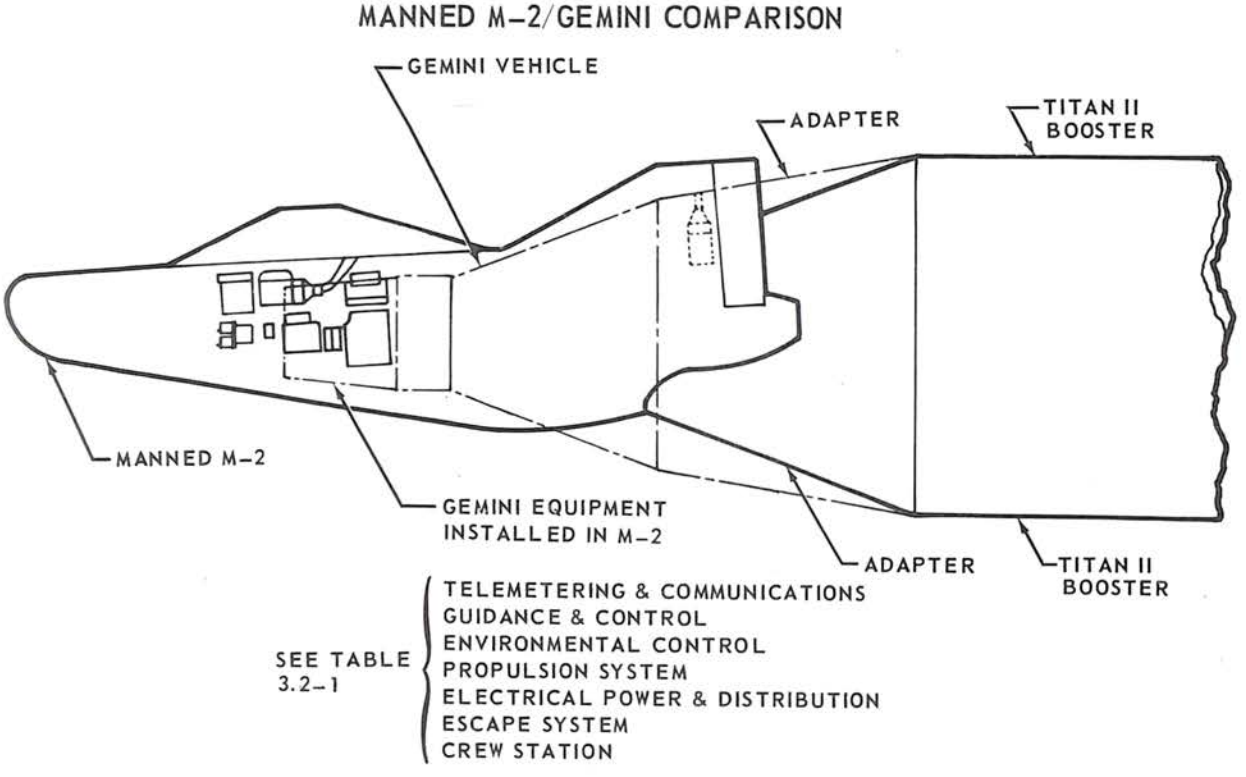


FIGURE 1.2-1

3.2 (Continued)

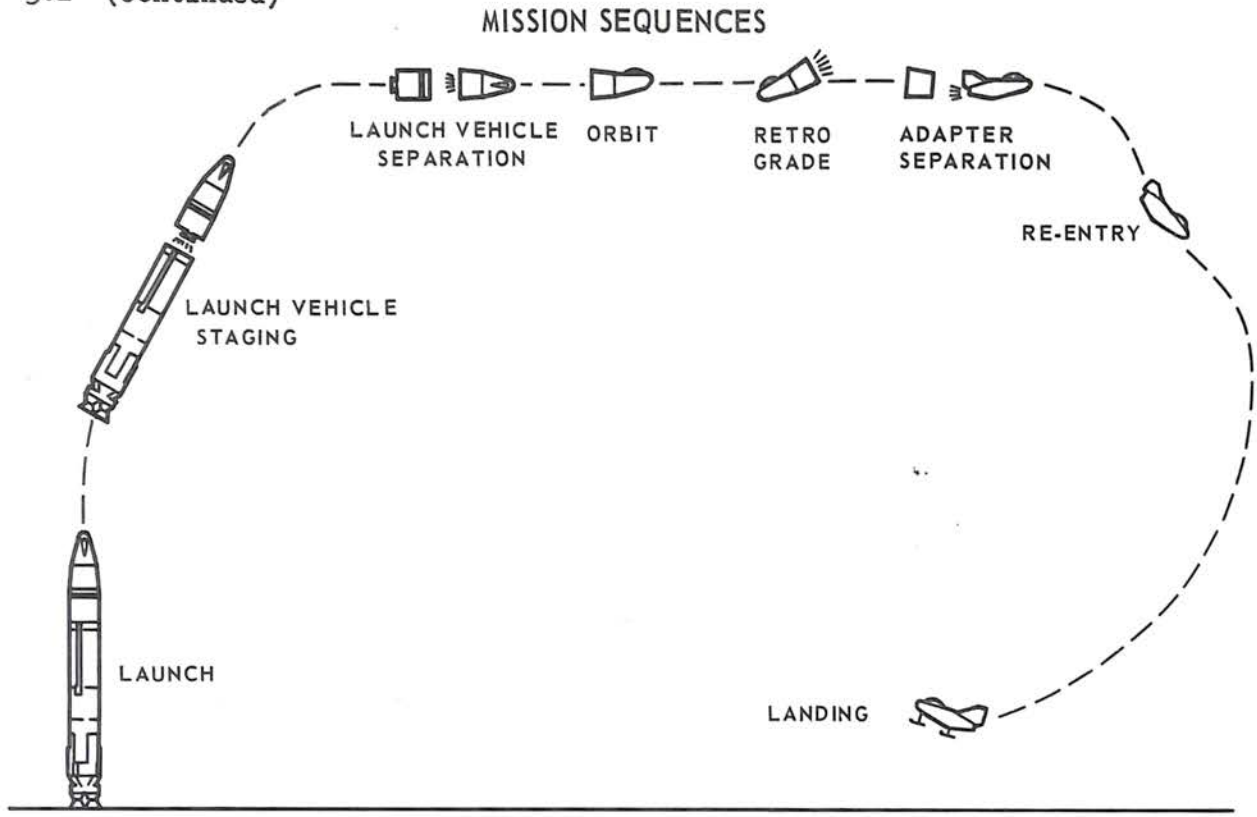


FIGURE 3.2-2

1. Normal Sequence - For the normal sequence launch, the standard Gemini Titan II (GLV) guidance system is utilized. The pilot monitors the malfunction detection system and initiates abort action if required. Backup guidance is by spacecraft computer and/or pilot through the launch vehicle secondary autopilot. Guidance switch-over is automatic for fast malfunction and by pilot for slow malfunction.

   The pilot waits for launch vehicle thrust tail-off, then fires the pyro separation ring and aft firing thrusters for separation. At insertion, the computer provides data for a panel display of insertion errors.

   Attitude control during insertion and orbit phase is by the pilot who may select rate command or direct modes. Attitude reference is obtained from either an out-the-window view of Earth-horizon or the inertial platform feeding an attitude ball display.

   For retrograde, the pilot turns the spacecraft through 180 degrees in yaw and pitches to the retrograde attitude. The vehicle is stabilized using either the rate command (primary) or direct mode attitude control. The pilot initiates retro rocket sequential firing at the desired time using attitude ball or out-the-window view as a reference. He then controls to initial re-entry attitude and initiates adapter jettison by pyro charge. Attitude thrusters provide control prior to obtaining aerodynamic control effectiveness. The pilot maintains attitude control and monitors trajectory displays throughout

3.2.4.1 (Continued)

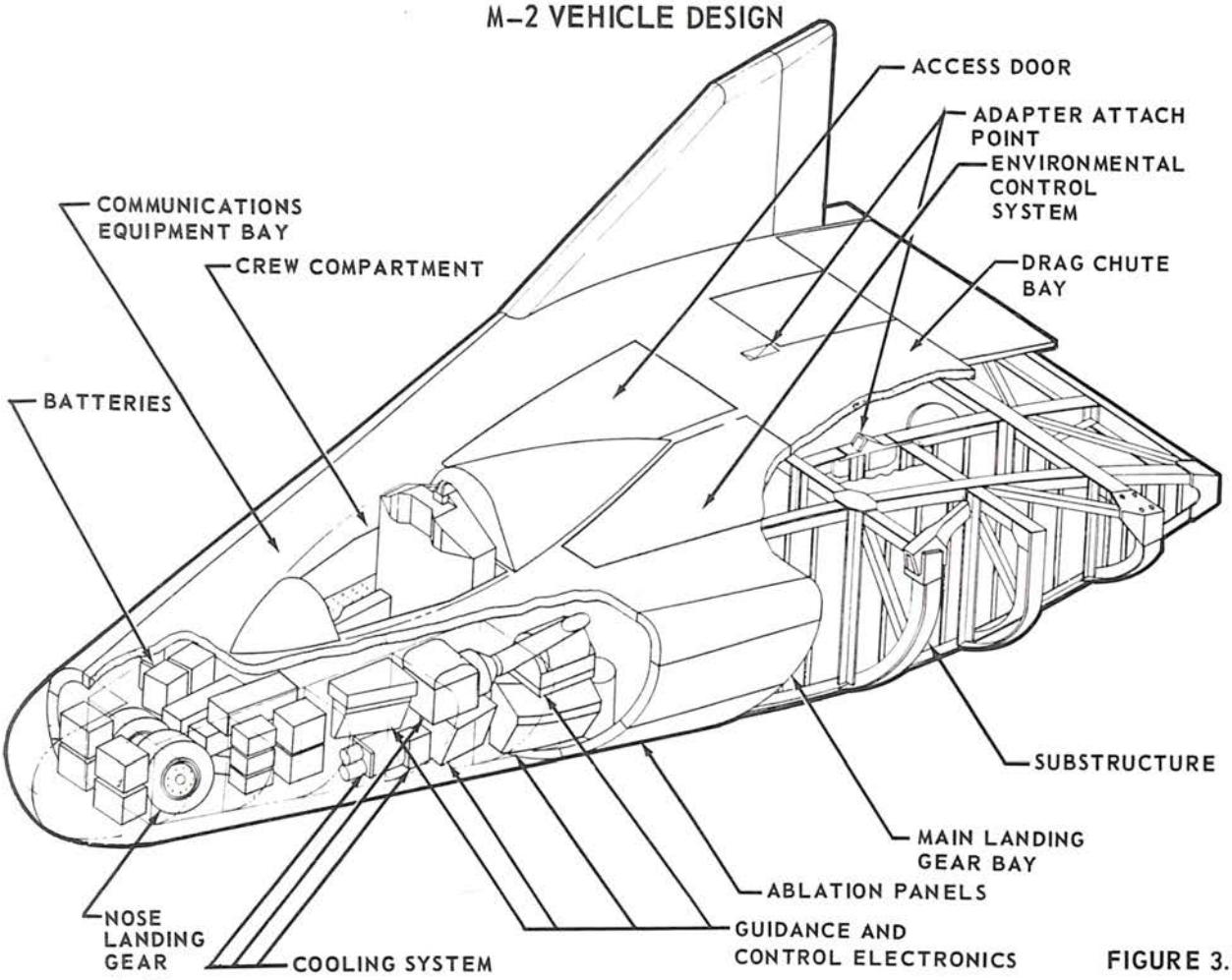


FIGURE 3.2-9

bottom elevon and rudders are also made from a high density ablator. The vehicle upper surface, inside and outside fin surfaces, and upper control panels are constructed from super alloy materials such as Rene' 41 or L-605. A detail study will be made to confirm this representative choice of materials.

3.2.4.2 Substructure - The representative vehicle airframe design consists of side beams with cross bulkheads at major equipment support locations. Truss-work, shear web, and fitting attachments are incorporated in areas of concentrated load, such as vehicle-to-interstage attach points and crew compartment installation.

A. Crew Compartments - The crew compartment is designed as an integral part of the vehicle structure. A crew compartment with structural and system attachments made in such a manner that it may be removed for access and maintenance will be considered during the study with consideration of weight, cost, and complexity.

B. Equipment Bays - Equipment is located as far forward as possible for better vehicle balance. Access is provided by top structural doors and through the side in the crew compartment area.

3.2.4.4 (Continued)

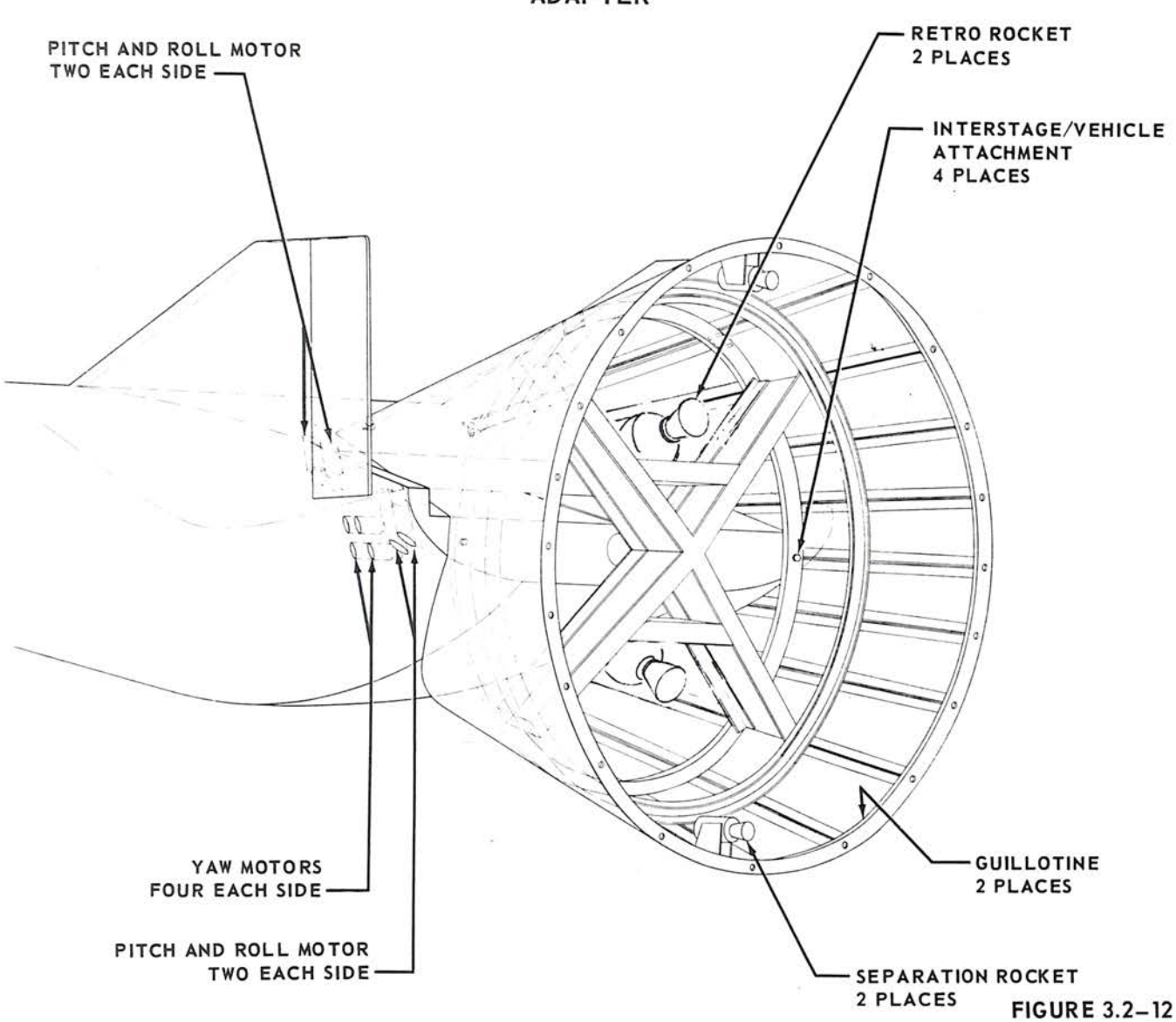


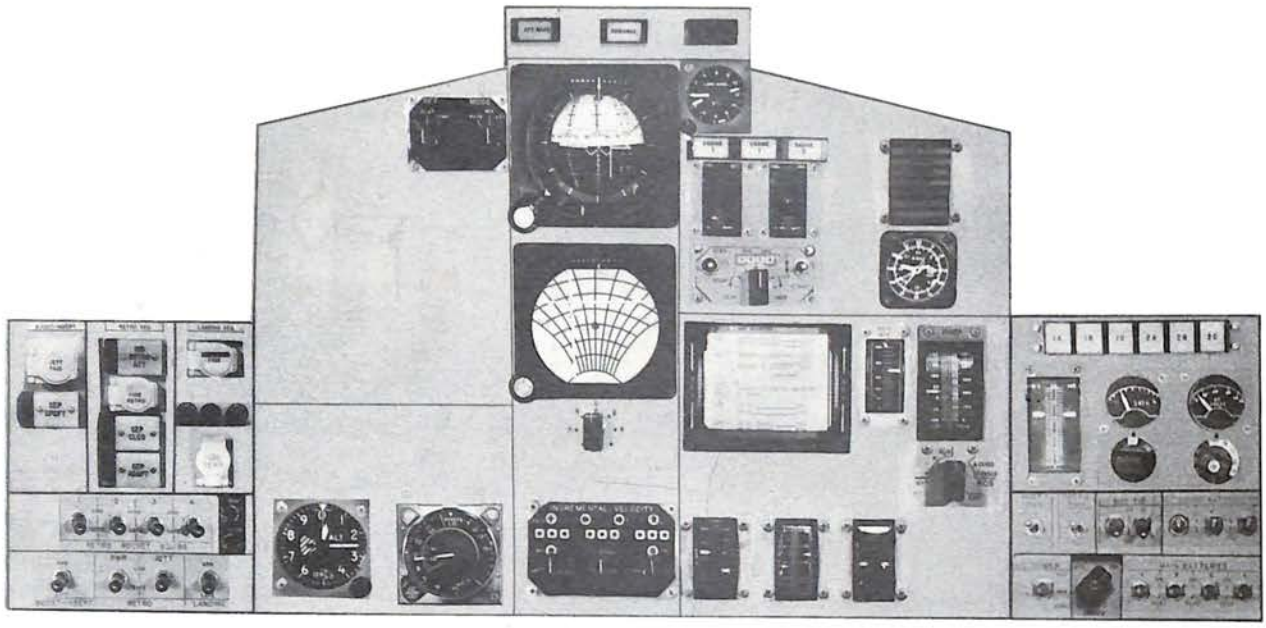
FIGURE 3.2-12

loaded separation device similar to Gemini is used at the vehicle adapter interface.

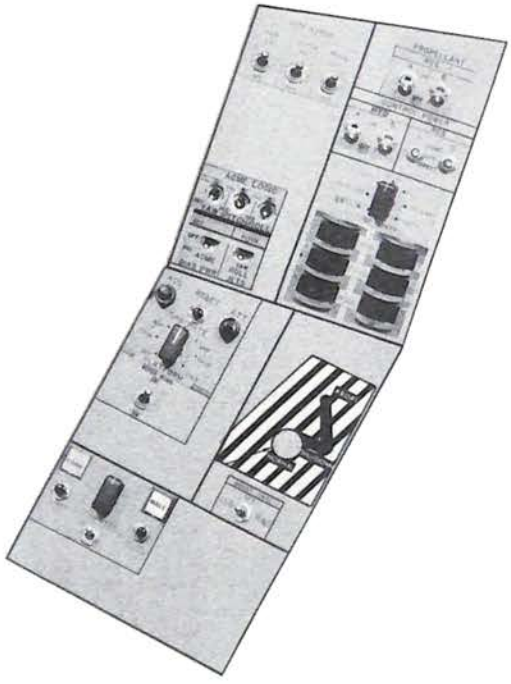
3.2.5 Crew Station Design - Cabin arrangement in general parallels panel and console placement utilized in modern fighter aircraft. Controls and displays are grouped by systems or by operating sequence and are located so that left hand actuation is feasible during mission phases requiring attitude control by the right hand. Figure 3.2-13 shows the proposed general arrangement and Gemini instruments which would be available. Additional re-entry instrumentation would utilize developed and fully qualified meter movements, but would require different case and dial faces for specific applications.

Sequential controls are located on the upper left hand panel. Lever lock toggle switches are used to arm launch, retro, re-entry, or landing sequences

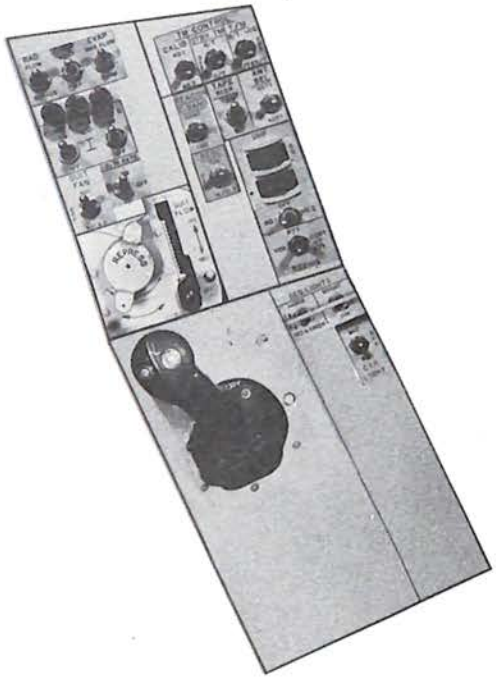
COCKPIT GENERAL ARRANGEMENT



CENTER PANEL



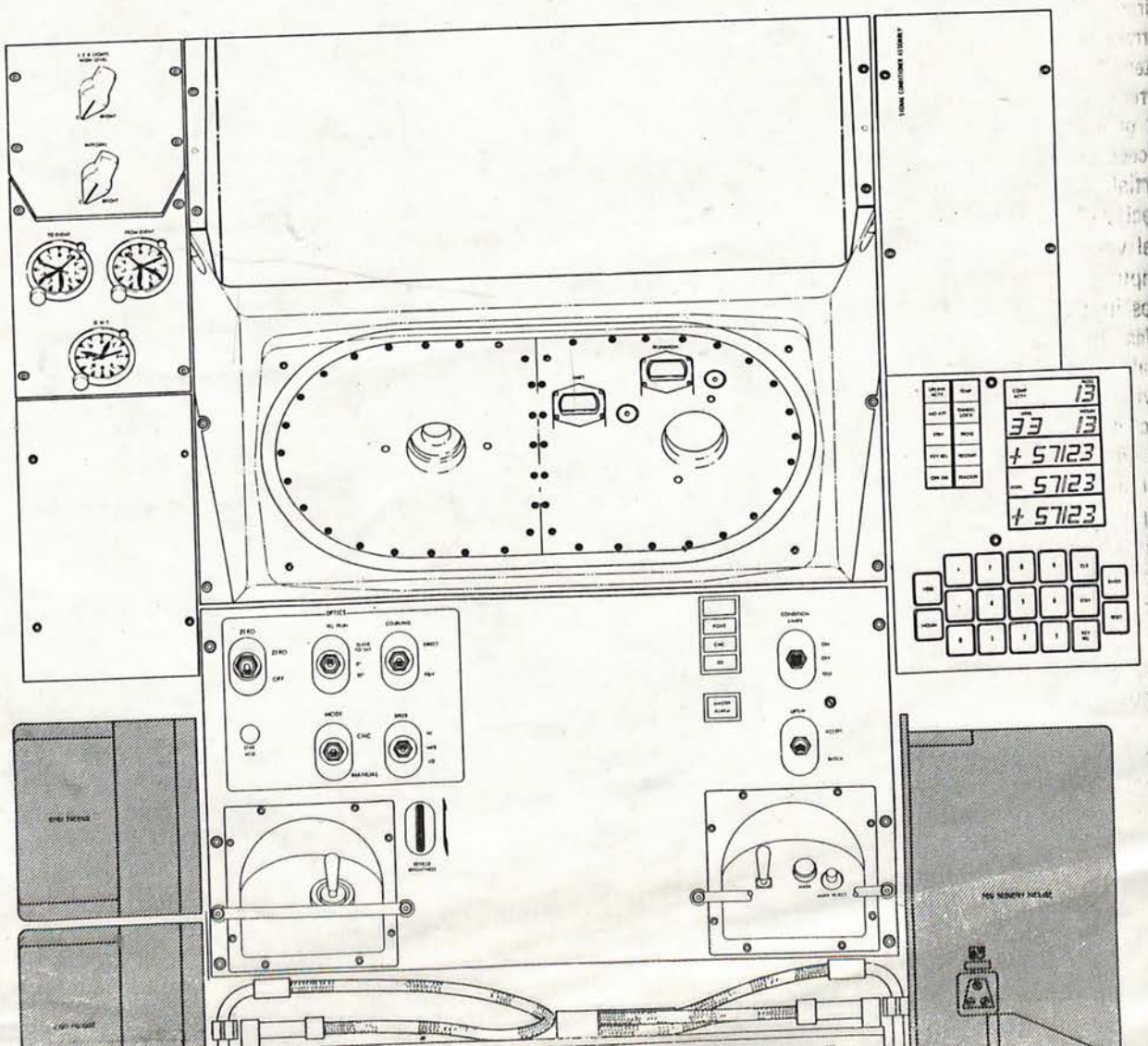
LEFT SWITCH/CIRCUIT PANEL



RIGHT SWITCH/CIRCUIT PANEL

FIGURE 3.2-13

Primarily, the central processor performs operations indicated by the basic instructions of the program stored in memory. Communication within the central processor is accomplished through the write amplifiers. Data flows from memory to the flip-flop registers or vice versa, between individual flip-flop registers, or into the central processor from external sources. In all instances, data is placed on the write lines and routed to a specific register, or to another functional area under control of the write, clear, and read logic. The logic section accepts control pulses from the sequence generator and generates signals to read the content of a register onto the write lines, and write this content into another



Pledge yourself to freedom
and our future in space through
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Dave Scott Al Worden Jim Irwin

APOLLO 15