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5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : MG/Deputy Director, Gemini Program

FROM : MGS/Director, Gemini Systems Engineering

SUBJECT: Circumlunar Missions

DATE: JUN 29 1965

1. On Thursday, June 24, I attended a meeting at MSC in which representatives of Martin-Denver and MAC (including Messrs. McDonnell, Burke and Yardley) presented a proposal for a circumlunar flight using the Gemini spacecraft and the Titan IIIC booster. In attendance at the meeting was Dr. Gilruth, Messrs. Low, Mathews, Kleinknecht, Evans, and Guild of MSC and myself.

2. In this proposal the Gemini spacecraft modified for circumlunar flight is launched into earth orbit with a GLV. The Titan IIIC launches a stripped down transtage that provides the propulsion for injection to circumlunar velocities after rendezvous with the spacecraft. The general arrangement and flight hardware are summarized in enclosure (1) (Figure 2.1-1 of Attachment C).

3. The principal changes to the Titan IIIC involve using a double transtage. The first provides propulsion during launch to earth orbit and contains the attitude control and an equipment module for use during rendezvous with the spacecraft. A Gemini Target Docking Adapter is mounted on top of the second transtage.

4. A significant number of changes are proposed for the spacecraft. Weight saving items are summarized in enclosure (2) and enclosure (3) (page 1-8 and Table 1.2-1 of Attachment C). The most significant changes to the spacecraft are summarized as follows:

- a. Addition of a Unified S-Band System.
- b. Additional OAMS tankage and TCA's substituted for the retrograde rockets.
- c. Additional heat protection using coated columbium and ablation shingles.
- d. Shortening of the R&R section by 20 inches.
- e. Use of three fuel cell sections.
- f. "Blow-down" RCS and independent pressurization of fuel and oxidizer.



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5. Three flights are recommended:
 - a. Heat Protection Qualification (Titan IIIC - one transtage on ballistic trajectory);
 - b. Spacecraft Qualification (manned, GLV in earth orbit);
 - c. Manned Circumlunar Orbit.
6. The Martin schedule, enclosure (4) (last page of Attachment A), indicates completion by April 1967. The MAC schedule (not available) is even earlier using two refurbished spacecraft and a go-ahead by July 1.
7. No money estimates were presented by Martin or MAC; however, some preliminary estimates by GPO indicated \$350M.
8. I think the proposal is feasible, but not within the time and effort indicated. The equipment and mission are too marginal to absorb changes and additions that will be required without extensive redesign and testing.
9. I personally would prefer to see us advance our earth orbital capability. With the same or fewer modifications to the spacecraft advocated in this proposal and additional Agena payloads, we could attain a significant lead in the design and operation of earth-orbital space stations. Gemini is ideally suited to the preliminary determination of problems and to the initial development of techniques and procedures leading to advanced manned earth-orbital missions. The time and money spent in additions or extensions of this type to an earth-orbital Gemini would be more than repaid in time and money saved in later, more expensive, and complicated programs.

Eldon W. Hall

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Enclosures: 4 as stated

- Attachments: A "Configuration, Weight Summary, Performance, Transtage #2 Performance, EOR Operations, Mission Profile, and Related Schedules", by Martin-Denver (Unclassified)
- B "Rendezvous Concept for Circumlunar Flyby in 1967", by Martin-Denver, P-65-91, June 1965 (Proprietary)
- C "Gemini Large Earth Orbit (U)", by McDonnell, E743, Vol. I - Technical, June 19, 1965 (Confidential)

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GEMINI - LARGE EARTH ORBIT

GENERAL ARRANGEMENT - LAUNCH VEHICLES FOR
RE-ENTRY MODULE AND DOCKING ADAPTER
CONFIGURATION 1

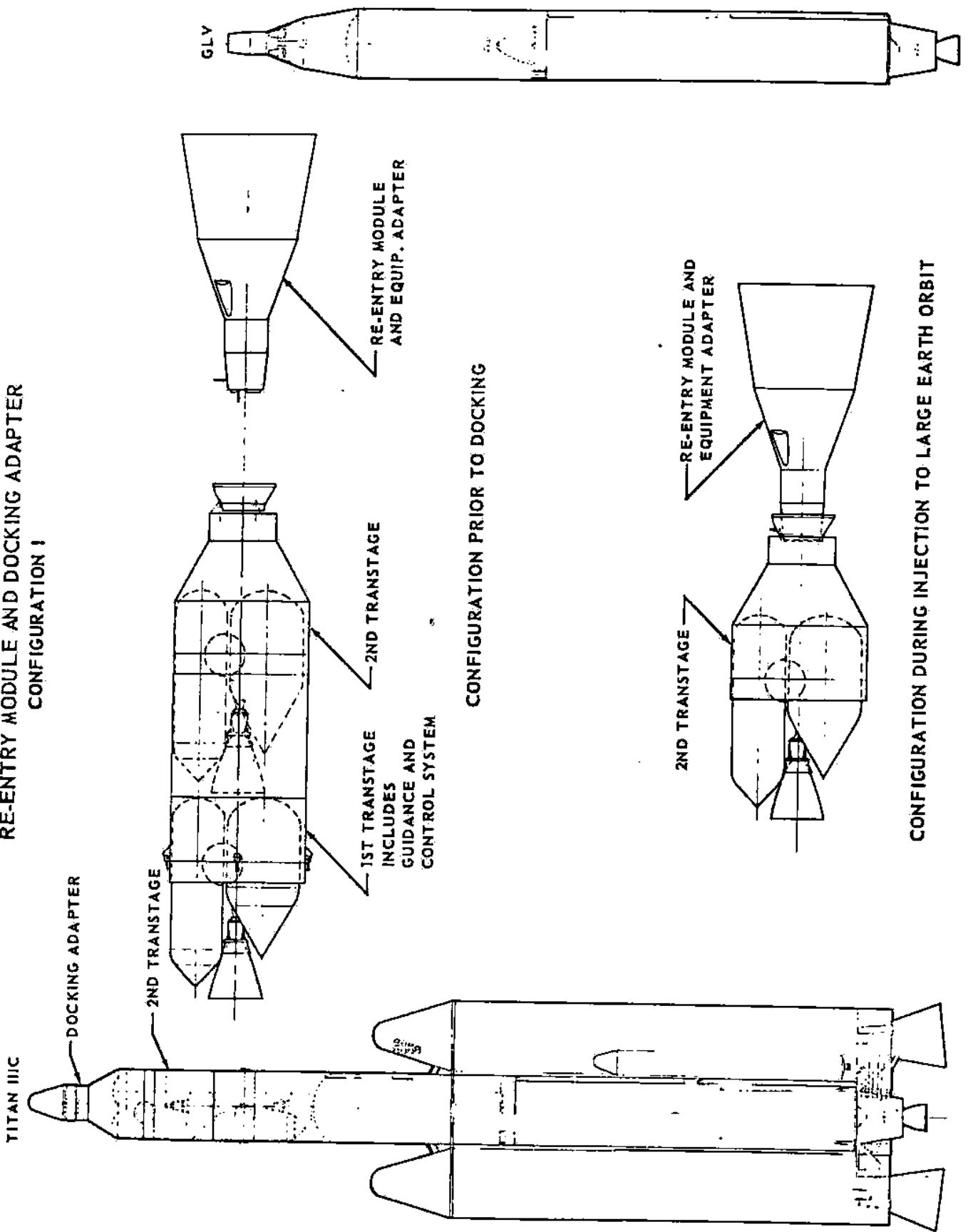


FIGURE 2.1-1

GEMINI - LARGE EARTH ORBIT

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VOLUME 1

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1.2 Design Changes for Weight Consideration - For Configurations I and II, it is necessary to make changes to the present Gemini design and system concepts to make the spacecraft weight compatible with the launch vehicle capability. A summary of these weights is given in Table 1.2-1. Those changes applicable to both configurations as weight saving items are:

- A. The paraglider provisions are eliminated in the rendezvous and recovery section, and the can is shortened twenty inches; no change to the RCS section.
- B. The retrograde and adapter equipment sections separation provision is removed. Separation provisions are not needed.
- C. Reduce the density of insulation used on the RCS and R & R sections since the ablative layer provides bond line temperatures which are lower than Gemini re-entry shingle temperatures.
- D. One of three squib batteries is removed from the re-entry module.
- E. Convert RCS to "Blow Down" system, remove heaters and motor shutoff valves, add pyrotechnic valves which improve system reliability.
- F. One of the two UHF voice transmitter receivers is removed. Backup is provided by the unified S band system.
- G. The parachute riser ring guard and the drogue chute are deleted.
- H. The rendezvous radar is modified to include only the range and range-rate components.
- I. The fuel cell water is considered potable. The drinking water supply is reduced accordingly.
- J. Reduce heat protection by changing L/D from .25 to .15 and range from 5,300 n.m. to 3,838 n.m. (Nominal footprint 900 n.m., maximum dispersed range 2,600 n.m. - heat protection margin achieved by designing for 3,838 n.m.)
- K. S-6 ablative material is used in lieu of S-3 for afterbody heat protection.

GEMINI - LARGE EARTH ORBIT

TABLE 1.2-1
SUMMARY OF WEIGHT SAVING ITEMS THAT
ARE INCLUDED IN CONFIGURATIONS I AND II

ITEM	WEIGHT EFFECT (POUNDS)
5-6 ABLATIVE MATERIAL IN LIEU OF S-3 FOR AFTERBODY HEAT PROTECTION	-57
RENDEZVOUS AND RECOVERY SECTION REDESIGN	-50
REMOVAL OF THE RETROGRADE SYSTEM AND ADAPTER EQUIPMENT SECTION SEPARATION PROVISIONS	--411
REMOVAL OF (2) 85-POUND FWD FIRING AND (4) 100-POUND RADIAL FIRING THRUSTERS	-100*
REDUCE THE DENSITY OF INSULATION USED ON THE RCS AND R & R SECTIONS DUE TO BOND LINE TEMPERATURES WHICH ARE LOWER THAN GEMINI RE-ENTRY SHINGLE TEMPERATURES	-15
REMOVAL OF ONE SQUIB BATTERY FROM THE RE-ENTRY MODULE	
CONVERT TO RCS "BLOW DOWN" SYSTEM, REMOVE HEATERS AND MOTOR SHUTOFF VALVES, ADD SQUIB VALVES	-9
USE OF A 7-DAY INSULATED LIQH CARTRIDGE IN LIEU OF 14-DAY LIQH CARTRIDGE	-20
REMOVAL OF UNNECESSARY RENDEZVOUS AND DOCKING PROVISIONS INCLUDING REMOVAL OF THE NOSE FAIRING AND EJECTOR AND REPLACEMENT WITH A NON-JETTISONED NOSE COVER	-22
REDUCTION IN GEMINI COMMUNICATIONS COMPONENTS (REF. PARA. 3.4)	-31*
THE HORIZON SENSORS AND INSTALLATION ARE DELETED	
THE DROGUE CHUTE AND PARACHUTE RISER RING GUARD ARE DELETED	-44
THE RENDEZVOUS RADAR IS MODIFIED TO INCLUDE ONLY THE RANGE AND RANGE-RATE COMPONENTS	-41
THE FUEL CELL WATER IS CONSIDERED POTABLE. THE DRINKING WATER SUPPLY IS REDUCED ACCORDINGLY	-28
REDUCE HEAT PROTECTION BY CHANGING L/D FROM .25 TO .15 AND RANGE FROM 5,300 N.M. TO 3,838 N.M.	-30**
	-86
	-236
TOTAL CONFIGURATION I	-1,049
TOTAL CONFIGURATION II	-1,150

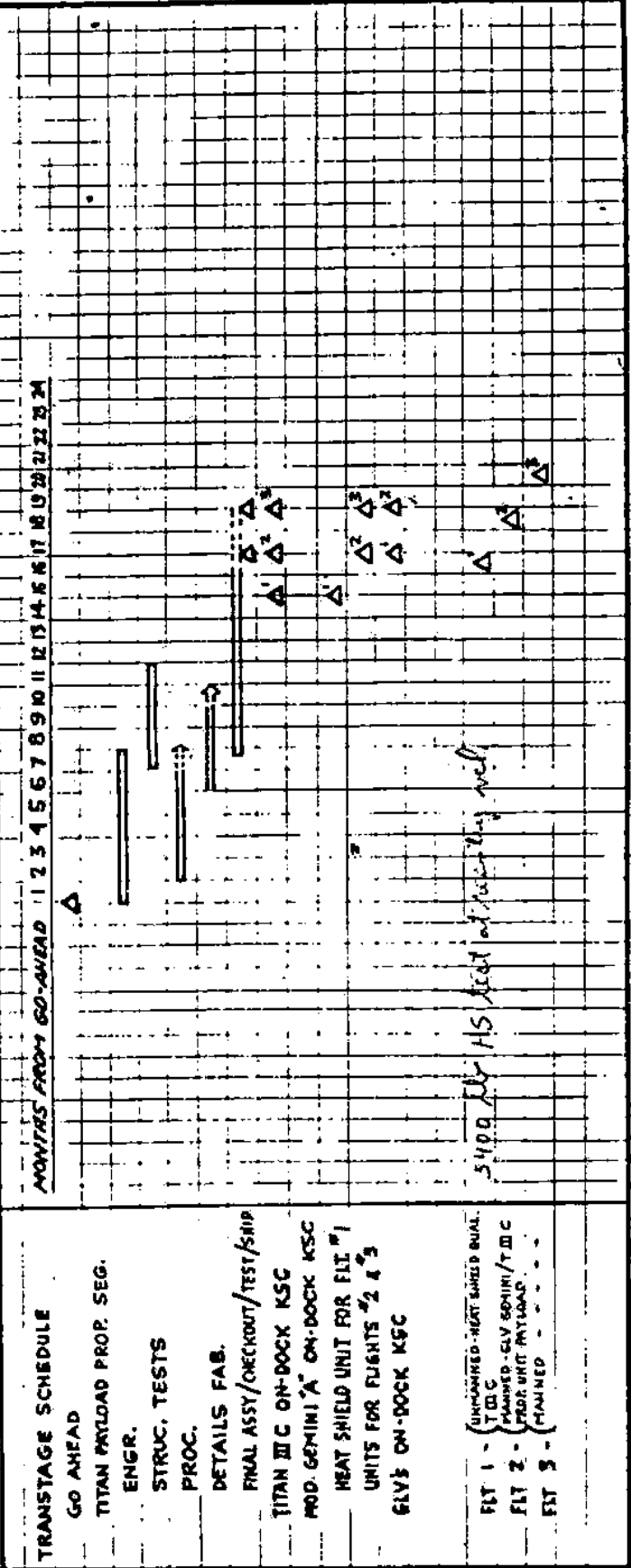
*CONFIGURATION II ONLY

**CONFIGURATION I ONLY

RELATED SCHEDULES

	1964			1965			1966			1967			1968																	
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
TITAN III FLIGHT PROGRAM																														
TITAN III A COMPLEX 20																														
TITAN III C 5 SEG. - " 40																														
TITAN III C 5 SEG. - " 41																														
GEMINI A FLIGHT PROGRAM																														

NOTE: 3 ADDITIONAL PROGRAMMED T III-C BOOSTERS NOT YET SCHEDULED FOR FLIGHT



FLIT 1 - (UNMANEED - HEAT SHIELD UNAL. T III C)

FLIT 2 - (PROP. UNIT PAYLOAD)

FLIT 3 - (MANEED)