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UNITED STATES GOVERNMENT

Memorandum

VNH

1352.1.3

TO : MG/Deputy Director, Gemini Program DATE: July 17, 1964

FROM : MGS/Director, Gemini Systems Engineering

SUBJECT: List of missions

The following is a quick list of missions (or important experiments) which could be accomplished with a follow-on Gemini program. Certain items may require up-rated GLV launch capability or up-rating of spacecraft performance.

Also enclosed is an equally quick vehicle layout of some of these suggestions. Improved quality will follow.

1. Land landing demonstration.
2. Propellant transfer.
3. Extended duration research (medical, physical, environmental).
4. Apollo rendezvous simulations.
5. Apollo DSIF check out.
6. Rendezvous with empty Apollo Command Module.
7. Rendezvous with LEM.
8. Apollo chaser.
9. Minimum space station.
10. Extended duration at low g's (G-can).
11. MOL-rendezvous - joint Air Force mission.
12. Space assembly and repair.
13. Satellite rendezvous - OAO - photographic adaptor.
14. Satellite recovery (like OSO).
15. Satellite chaser (no velocity match).

16. Space escape, personnel reentry (dummy tests).

17. Spacecraft assembly and checkout for orbital launch of unmanned mission.

18. Gemini deep space guidance and navigation.

19. Gemini circumlunar.

20. Gemini lunar orbit.

21. 3-seat rescue craft.

22. Control of upper stage reentry to reduce hazards.

23. 1-man Gemini and telescope.

John T. Hammond
for Eldon W. Hall

VEHICLES	MISSION	EXPERIMENT
3 GLV/SC 1 Agena + can	Extended duration Experiments Land landing	Medical remedial (centrifuge; exercise) Physical (propellant transfer; tether tests; fabrication in vacuum; angular momentum control) Environmental (radiation; thermal; suit tests; life systems) Scientific Extra-vehicular
1 GLV/SC 1 Agena + g can	Extended duration at assigned g	Medical Environmental Scientific Extra-vehicular
1 GLV/SC 1 Agena	Satellite rendezvous OAO Photo Adaptor	Scientific Extra-vehicular
3 GLV/SC	Apollo support Rendezvous with CM Rendezvous with LEM Rendezvous simulation Joint Air Force Mission Rendezvous with MOL	Scientific Extra-vehicular

box P48

GV-02312

SEP 18 1964

TO : NASA Headquarters
Attention: W. C. Schneider, MG

FROM : GA/Manager, Gemini Program

SUBJECT: Advanced Gemini Missions

This letter is in answer to your request for information on possible follow-on missions to the present 12-flight Gemini Program.

The missions in this letter are conceptual only as manpower and funds are not available to the Gemini Program Office for detailed feasibility studies. Coordination of mission requirements or hardware availability has not been initiated with the Apollo Program Office or other agencies mentioned in this letter. General hardware characteristics and schedule information have been considered in all cases.

Several mission possibilities are further discussed in the enclosure to this letter. Some of these missions could be combined and others would require more than one flight, but for simplicity, all missions are discussed as separate individual missions.

Original Signed By
W B Mitchell
for Charles W. Mathews

Enclosure

cc:
GA/Deputy Manager, Gemini Program
GV/Manager, Vehicles and Missions, Gemini Program

GV5:CCGuild:cs 9-14-64

WBE

JBH

WBM

NOTES ON ADVANCED GEMINI MISSIONS

CONCEPTUAL STUDY JULY 30, 1964

Advanced Missions. - Advanced missions are those missions beyond the presently scheduled 12-flight program. On completion of the present program, Gemini will have developed operational hardware capable of making further significant contributions to the national space effort.

Advanced Mission Studies. - There is now a need for establishment of the requirements and capabilities for these advanced missions. Funding and [illegible] should be initiated in the near future to provide [illegible] of manufacturing activities.

Mission Ground Rules. - The following ground rules were observed in selecting the missions to be discussed in these notes:

a. All missions should provide direct or indirect support to the National Manned Lunar Landing Program.

b. Missions proposed for Apollo hardware support are based on the desirability of early check-out and testing of critical hardware items. It is anticipated that some of this hardware will be available before the flight testing of complete Apollo systems.

c. The missions considered here are [illegible] following the present Gemini Program. In order to maintain availability, a minimum of hardware development and testing is desirable.

d. All of the missions included in this report propose that the Gemini Spacecraft be launched with the Gemini Launch Vehicle (GLV). Some performance improvement would be desirable. About 1,000 pounds of payload could be gained reliably without launching unmanned test flights and at a cost less than the cost of a single Gemini flight.

e. Rendezvous missions are proposed with nonmaneuvering targets. It is expected that the Gemini Spacecraft will develop and demonstrate this rendezvous capability.

f. All missions proposed will require a minimum of spacecraft modification. Spacecraft modifications desirable, and required for some missions include: (1) added spacecraft onboard propulsion capability, (2) added spacecraft retrograde propulsion, and (3) added spacecraft reentry protection.

Advanced Mission Description. - Following are [illegible] advanced Gemini missions in accordance with the [illegible] given above:

a. [illegible] - [illegible] planned [illegible] may [illegible] [illegible] present [illegible]

missions. [illegible] a special flight should be [illegible] to [illegible] trate performance for a space mission.

b. [illegible] Guidance [illegible]. - [illegible] Apollo or Apollo Lunar Excursion Module (LEM) could be [illegible] in flight using the Gemini computer. Apollo guidance hardware could also be installed if available.

c. Testing of Apollo Docking Hardware. - The Apollo docking mecha- nism can be installed on the Gemini and Agena vehicles for detailed in- space testing.

d. [illegible] with the Apollo Command and Service Module (CSM) A Gemini Spacecraft rendezvous could be planned with the Apollo CSM. This operation can provide manning of the CSM at an early date. The mission could be conducted before "man-rating" of the Saturn I-B and/or with pro- totype Apollo equipment.

e. Apollo Chaser Mission. - A combined Gemini-Apollo mission can be flown by launching a Gemini Spacecraft into orbit with the Apollo during earth orbital operations. The Gemini Spacecraft translational capability can be used for close approach to the Apollo vehicle. The Apollo Space- craft could be manned or unmanned as required by the Apollo schedule. With a manned Apollo Spacecraft, ship-to-ship space communications could be investigated.

f. Extended Flight Duration Space Research. - Some problem [illegible] expected with extended duration space flight due to weightlessness [illegible] on blood circulation and due to the limited space provided in the [illegible] and Apollo Spacecraft. The Agena or another target vehicle could [illegible] ified to provide a pressurized can that would have space for [illegible] exercise or physiological research. The astronauts could spend [illegible] three hours per day in the can to relieve the cramped spacecraft condition. Access would be through extra-vehicular transfer. Empty Atlas or Centaur tanks can also be considered to provide an enclosed area.

g. Minimum Space Station Experiment (P-Can). - A pressurized can (P-Can) can be launched on the Atlas/Agena for use as a minimum space station. The station would be manned through rendezvous. Detailed research can be accomplished on extended duration space flight with full-time manning of the station. Larger systems could also be launched using the Saturn or Atlas/Centaur boosters.

h. [illegible] Station [illegible] [illegible] a minimum [illegible] space station could [illegible] [illegible] artificial gravity [illegible] [illegible] [illegible] the spacecraft [illegible] [illegible] to provide [illegible] of artificial gravity [illegible] effects of short radii could also [illegible]

i. [illegible] Laboratory (MOL) [illegible]. - [illegible] with a manned laboratory, a rendezvous mission with an Air Force MOL can be planned. A prototype MOL could be manned through rendezvous before Titan II, Gemini-B, or the MOL are "man-rated". Limited duration of the first MOL flight could be provided safely.

j. Space Assembly and Repair Mission. - A mission can be planned to investigate, prove, and develop extra-vehicular assembly, maintenance and repair capability. A useful mission can be designed around the Orbiting Astronomical Observatory system. The OAO telescope could be adapted to photographic use through extra-vehicular modification. Photographic plates could be brought back in the Gemini Spacecraft, thereby adding a high resolution capability to the OAO mission.

k. [illegible] Satellite Recovery. - A Courier, Orbiting Solar Observatory (OSO), or Explorer satellite could be recovered from space before reentry to provide data on materials exposure to the space environment. Additional propulsion capability would be required for the higher altitudes associated with this mission. Part of the propulsion capability could be provided through dual rendezvous. By first rendezvousing with the Agena, the Agena propulsion system could be used for the second rendezvous. Alternate methods of providing additional propulsion capability are orbital transfer of propellants from the Agena and/or use of a specially designed Agena-launched propulsion module.

l. Satellite Chaser Mission. - This mission would be similar to the satellite recovery mission but examination of the target satellite would be by electromagnetic or optical sensors. Close approach to the target satellite would be required but velocity match would not be necessary. This type of mission would provide identification of objects in space or provide photographs to help in determining satellite failure modes.

m. Lifeboat Rescue Mission. - One or more Gemini missions [illegible] flown to develop a personal reentry system for [illegible]. If such equipment were developed, Apollo rescue missions (earth orbit) could also be flown.

n. Gemini Deep Space Guidance and Navigation. - The equipment and operational techniques to control a spacecraft and navigate in deep space could be tested on a high elliptic orbit Gemini mission. The propulsion capability for this mission would be provided through rendezvous. The primary object of the mission would be to [illegible] attitude [illegible] the earth fills the entire view. An Agena/[illegible] could be used as the target vehicle system.

o. [illegible] Mission. - [illegible] be provided either through [illegible] [illegible] [illegible] [illegible] required for the mission. [illegible] vision of [illegible] on the spacecraft [illegible]

shield. Reentry heating from escape velocity can be made less severe on the spacecraft afterbody by removing the spacecraft lifting capability. If this ballistic reentry were used, thicker ablative shingles and insulation would be adequate heat protection.

p. Gemini Lunar Orbit Mission. - Gemini rendezvous with an Agena-Centaur target vehicle could provide lunar orbit capability to the circum-lunar configuration discussed above. The Agena-Centaur would be launched with the Saturn C-1B. The Gemini Spacecraft would be launched with the GLV. After rendezvous, the Centaur stage would provide translunar injection and the Agena stage would provide in-and-out velocity for lunar orbit.

NASA HEADQUARTERS ROUTING SLIP

	CODE	NAME *(if necessary)*		ACTION
				APPROVAL
1.	MGS	V. Huff		CONCURRENCE
				FILE
2.				INFORMATION
				INVESTIGATE AND ADVISE
3.				NOTE AND FORWARD
				NOTE AND RETURN
4.				PER REQUEST
				RECOMMENDATION
5.				SEE ME
				SIGNATURE
6.				REPLY FOR SIGNATURE OF:
7.				

REMARKS:

I'm having viewgraphs made of these per Eldon's request

Nils

FROM:	CODE:	NAME:	DATE:
	MGS	N.P. Franzier	

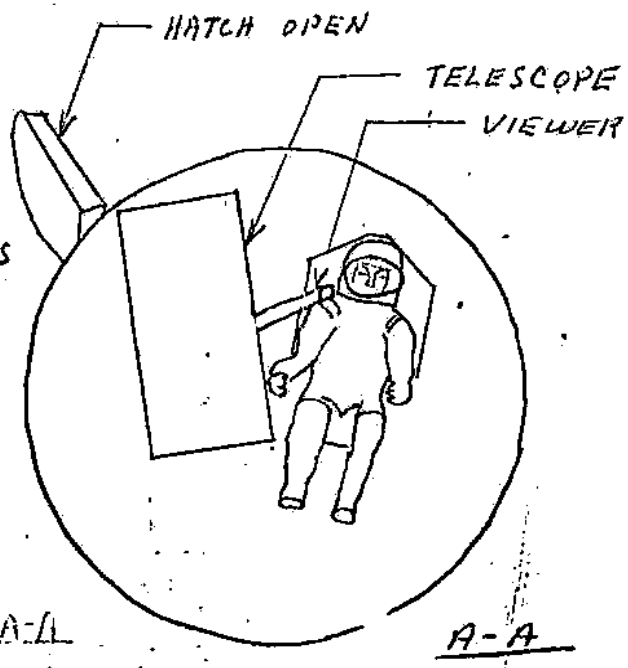
NASA Form 26 (Rev. July 1959) U.S. GOVERNMENT PRINTING OFFICE 1959 OF—813026

ALTERNATE GEMINI MISSIONS

UNE MAN GEMINI

OBJECTIVES:

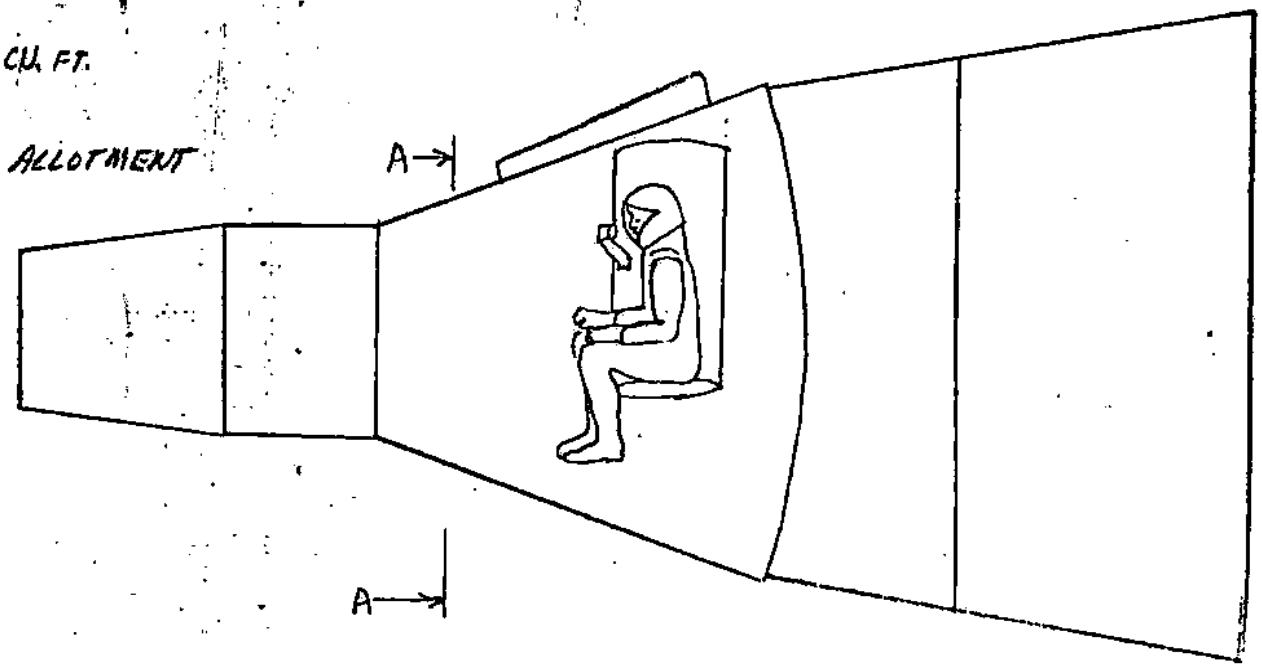
1. INCREASE EQUIPMENT CARRYING CAPABILITY
2. PROVIDE FOR HIGHER INCLINATION ORBITS
3. INCREASE ORBITAL MANEUVER CAPABILITY



A-A

GAINS DUE TO REMOVAL OF R.H. ASTRONAUT

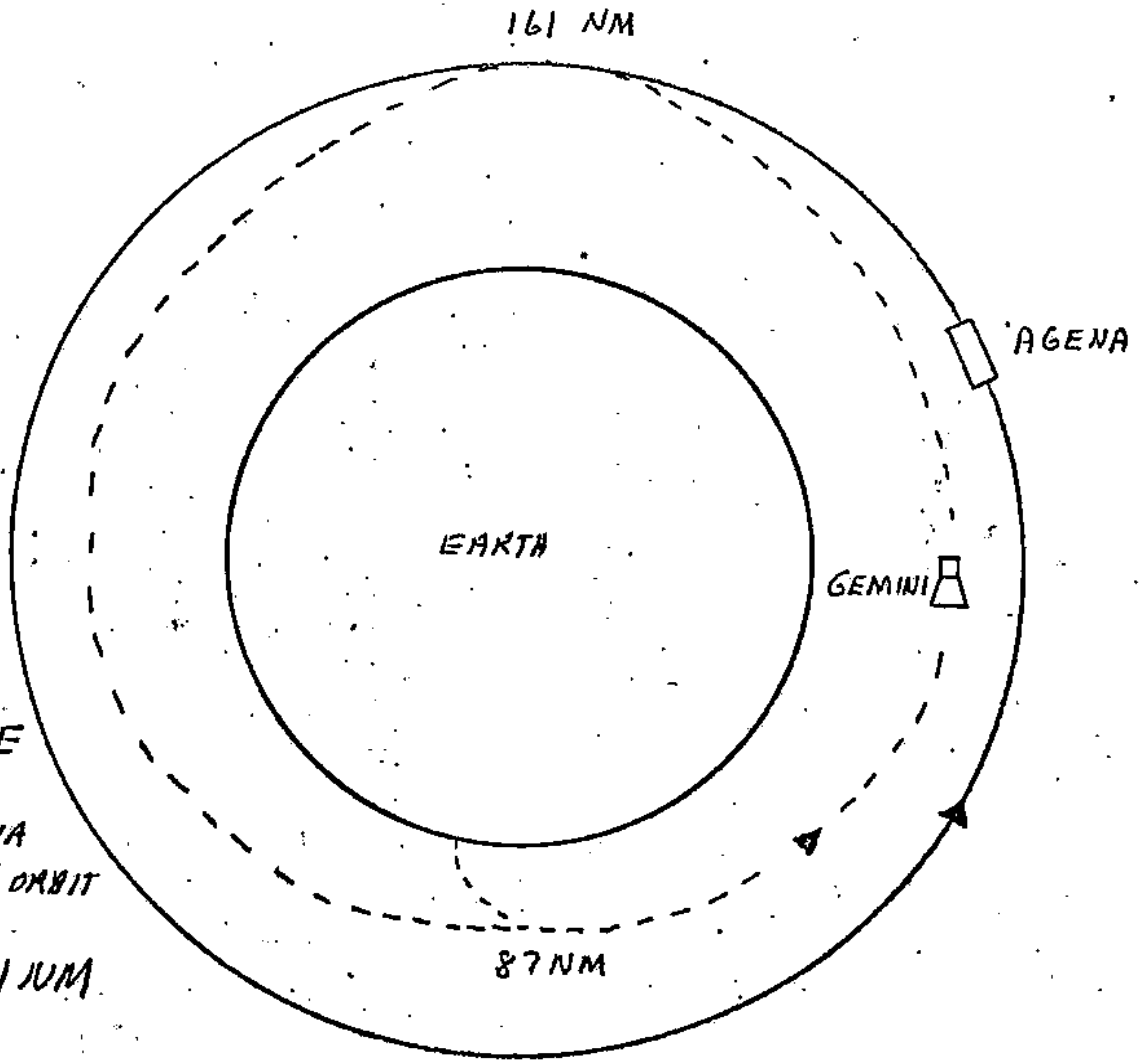
1. ADDITIONAL CABIN SPACE OF 24 CU. FT.
2. ADDITIONAL 500 LBS WEIGHT ALLOTMENT FOR EQUIPMENT



GEMINI SPACECRAFT FIRST LAUNCH

OBJECTIVE :

IMPROVED PROBABILITY OF LAUNCHING AGENA ONTIME VERSUS LAUNCHING GEMINI ONTIME



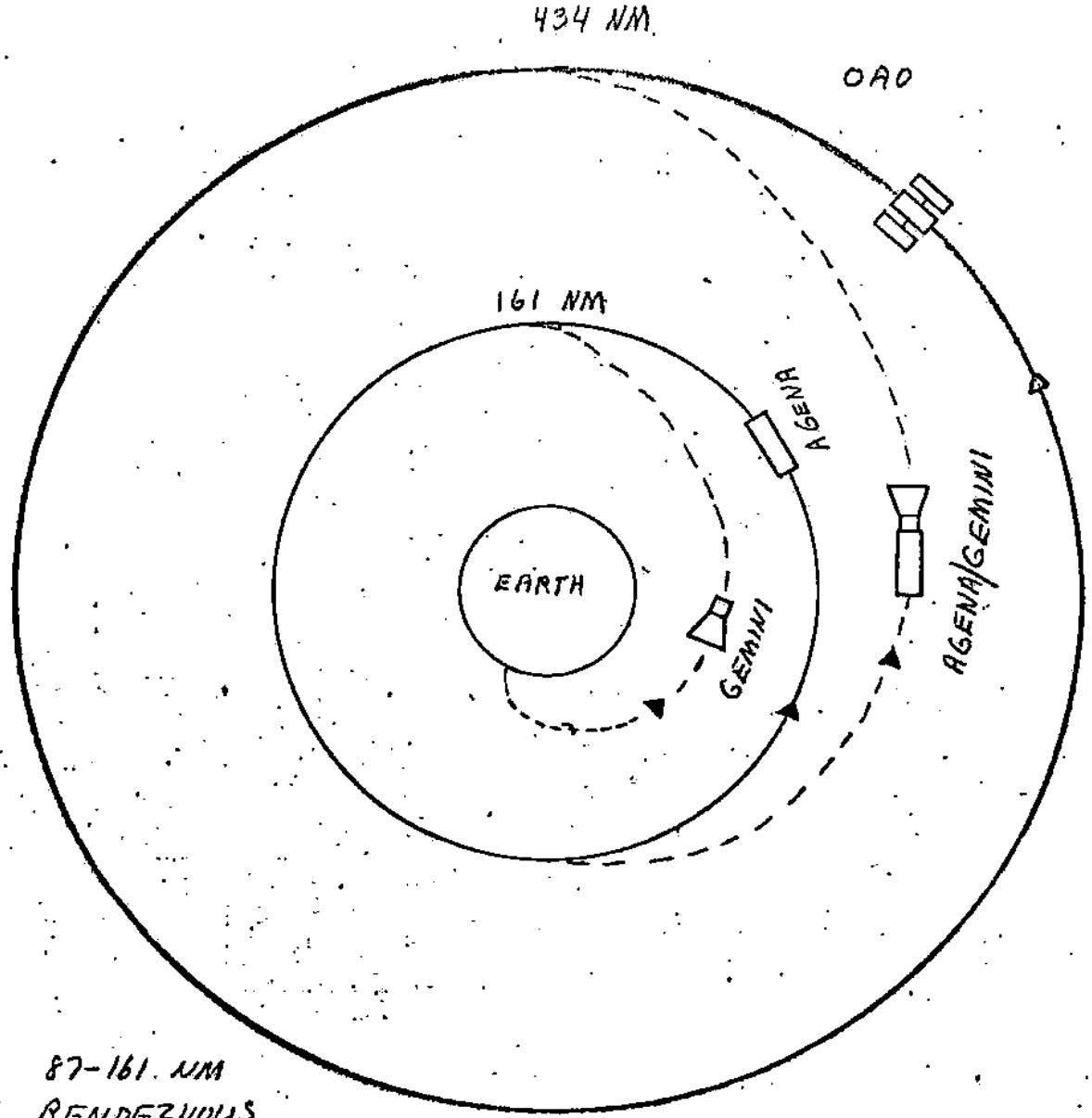
FLIGHT SEQUENCE :

1. FIRST LAUNCH GEMINI INTO 87-161 NM ELLIPSE
2. SECOND LAUNCH AGENA INTO 161 NM CIRCULAR ORBIT
3. RENDEZVOUS AT 161 NM

GEMINI POSTRENDEZVOUS MISSION

OBJECTIVES:

1. DEVELOP POSTRENDEZVOUS CAPABILITY
2. RECOVER SCIENTIFIC EXPERIMENT AND DATA PACKAGES
3. DEMONSTRATE EXTRAVEHICULAR MAINTENANCE CAPABILITY



FLIGHT SEQUENCE:

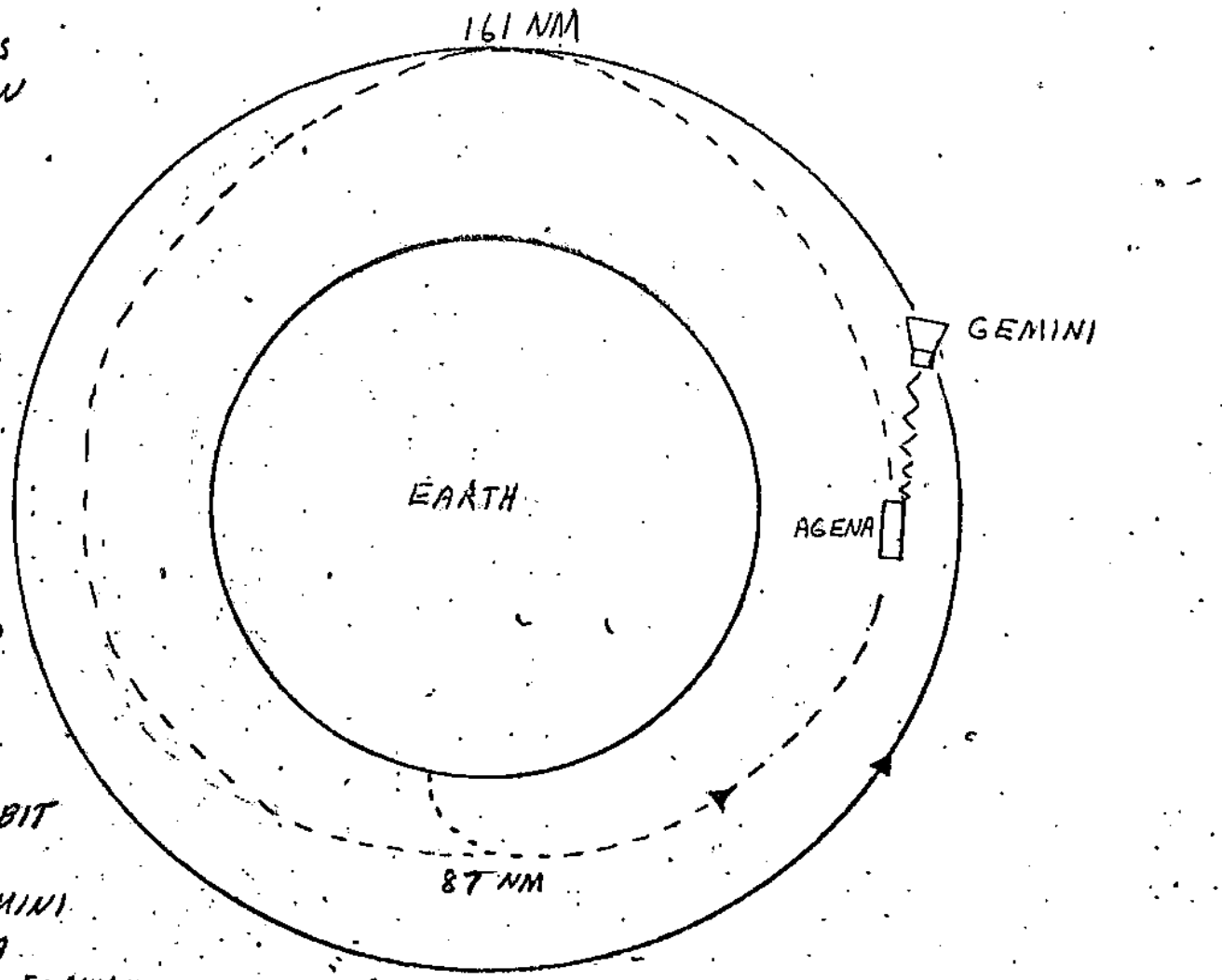
1. AGENA PLACED IN 161 NM CIRCULAR ORBIT
2. GEMINI LAUNCHED INTO 87-161 NM ELLIPSE; THEN PERFORMS RENDEZVOUS WITH AGENA AT 161 NM
3. GEMINI/AGENA PERFORMS RENDEZVOUS WITH OAO AT 434 NM

GEMINI RADIO COMMANDED AGENA RENDEZVOUS

OBJECTIVES :

1. SIMULATE UNMANNED FERRY VEHICLE RENDEZVOUS WITH MANNED SPACE STATION

2. DEVELOP ALTERNATE RENDEZVOUS MODE IN THE EVENT OF GEMINI OAMS MALFUNCTION OR DEPLETION



FLIGHT SEQUENCE :

1. UNMANNED AGENA PLACED INTO 87-161 NM ELLIPSE

2 MANNED GEMINI PLACED INTO 161 NM CIRCULAR ORBIT

3. AT 250 NM RANGE, GEMINI RADIO COMMANDS AGENA TO RENDEZVOUS AT 161 NM

SIMPLIFIED GEMINI RENDEZVOUS MODES

1. PILOT SOLUTION OF ORBITAL MECHANICS
2. PURE OPTICAL RENDEZVOS
3. GROUND COMMANDED RENDEZVOUS
4. ON BOARD EPHEMERIS COMPUTATION
5. SEMI OPTICAL RENDEZVOUS

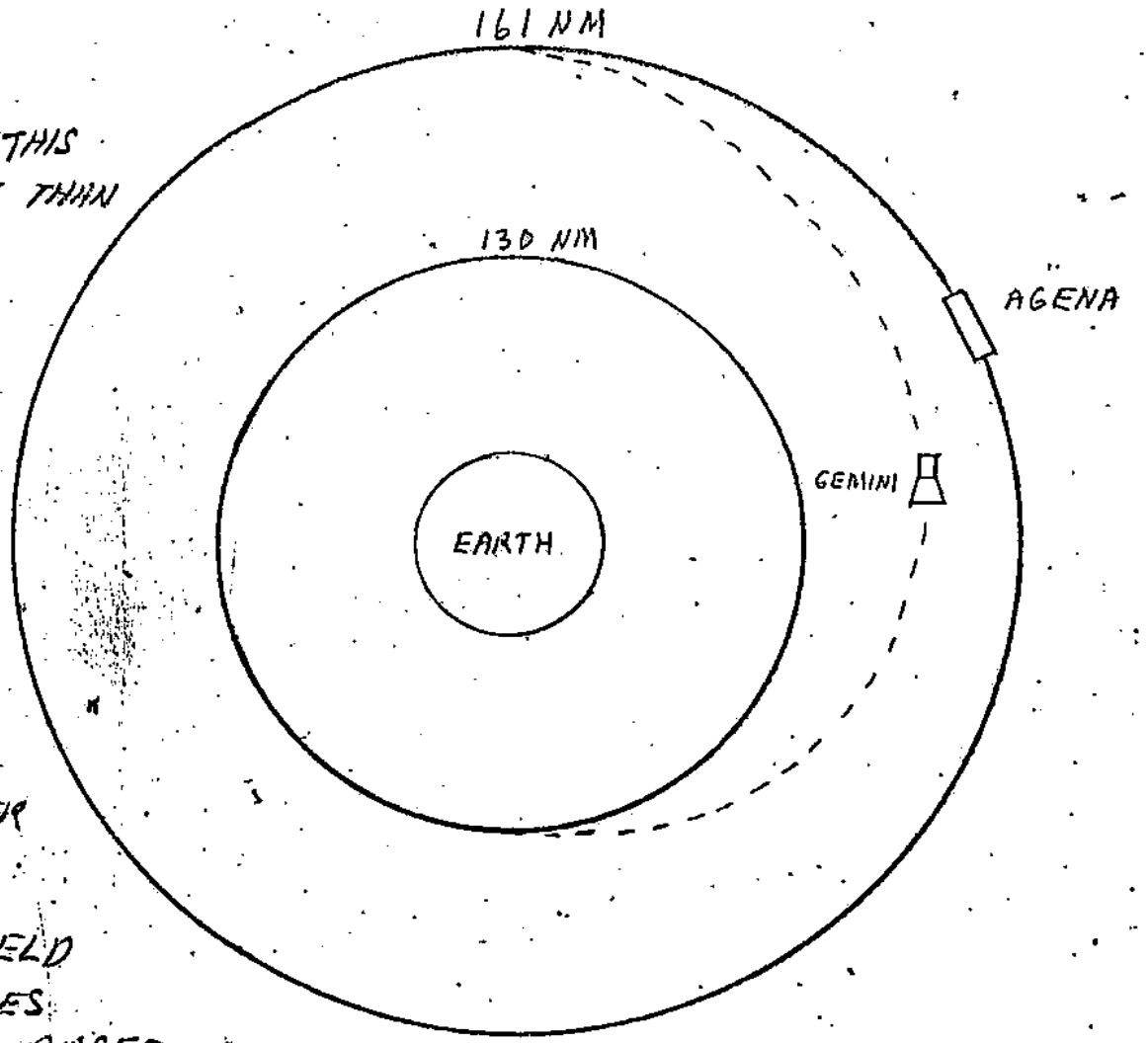
PILOT SOLUTION OF ORBITAL MECHANICS

OBJECTIVE:

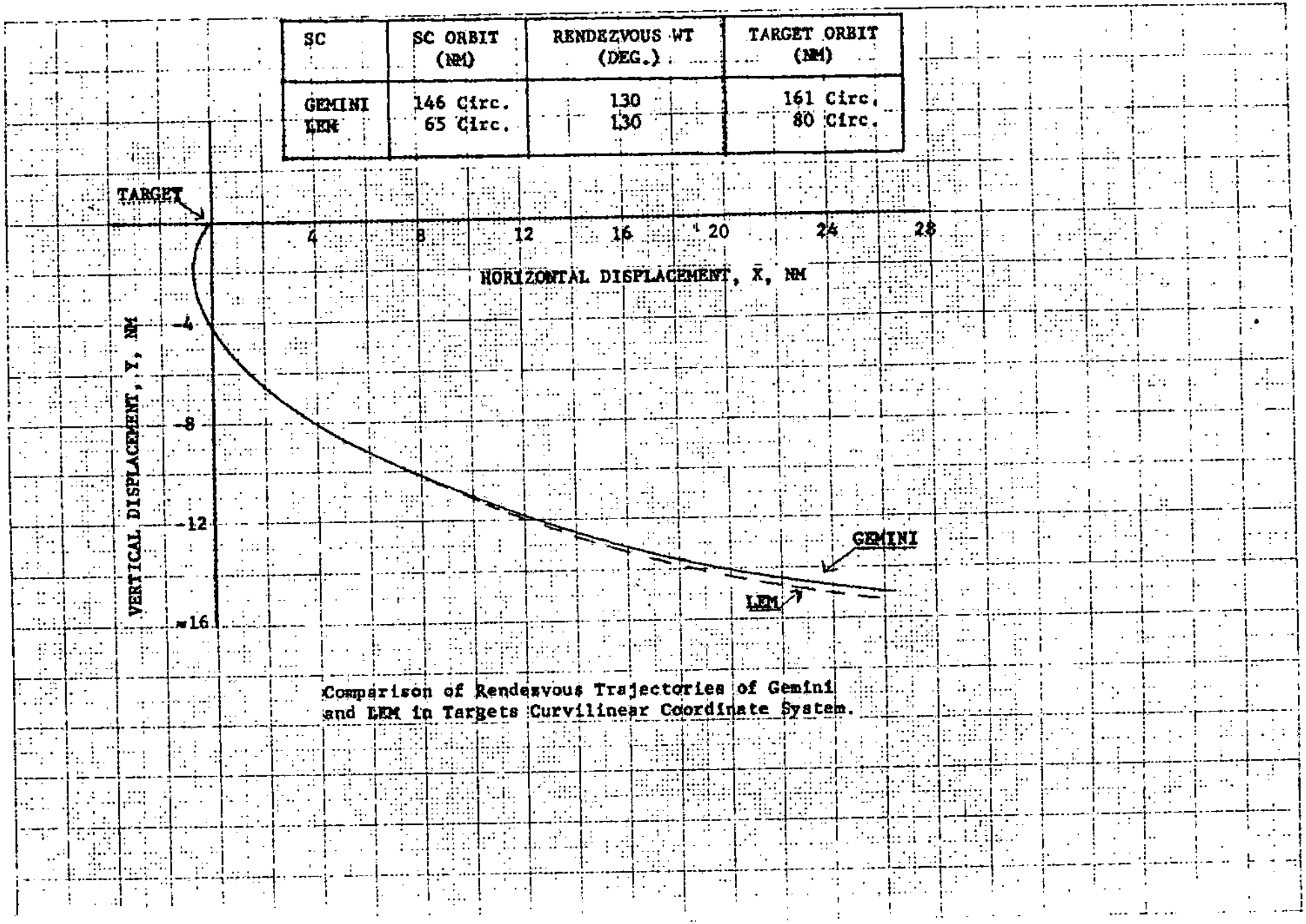
DEVELOP ALTERNATE RENDEZVOUS MODE IN THE EVENT OF COMPUTER LOSS OR FAILURE. THIS MODE SHOULD BE MORE EFFICIENT THAN LOS RENDEZVOUS MODE

FLIGHT PLAN

1. AGENA PLACED IN 161 NM CIRCULAR ORBIT
2. GEMINI PLACED IN 130 NM CIRCULAR ORBIT
3. AT APPROPRIATE RANGE AND/OR BEARING ANGLE, GEMINI IS PLACED INTO ELLIPTICAL TRANSFER ORBIT
4. USING A SIMPLE HAND HELD COMPUTER, PILOT DETERMINES MID COURSE CORRECTIONS BASED ON OPTICAL AND RADAR SIGHTINGS OF AGENA



SC	SC ORBIT (NM)	RENDEZVOUS WT (DEG.)	TARGET ORBIT (NM)
GEMINI	146 Circ.	130	161 Circ.
LEM	65 Circ.	130	80 Circ.



Comparison of Rendezvous Trajectories of Gemini and LEM in Targets Curvilinear Coordinate System.

Gemini Rendezvous with Pegasus

1. Pegasus in 270 (210) n.mi. circular orbit, Inclination = 28.9°
2. Place Agena in 161 (185) n.mi. circular orbit, Inclination = 28.9°
3. Place Gemini spacecraft into 87 - 146 (100 - 168) n.mi. orbit, Inclination = 28.9°
4. Raise Gemini spacecraft perigee to 146 (168) n.mi. using OAMS (CIRCULAR ORBIT)
5. Rendezvous Gemini with Agena using OAMS (130° TRANSFER TO 161 (185) NM ORBIT)
6. Raise Gemini Agena orbit to 255 (293) n.mi. circular using Agena PPS
7. Rendezvous Gemini/Agena with Pegasus C (130° TRANSFER TO 270 (310) NM ORBIT)
8. Decrease Gemini altitude to 185 (215) n.mi. circular using SC OAMS or Agena propulsion
9. Reenter from 185 (215) n.mi. circular orbit using retrorockets