NASA to Analyze Requirements For Manned Round Trip to Planets

By Irving Stone

Los Angeles—Requirements for the first manned round-trip mission to Mars and Venus, projected for the 1970-1972 time span, will be analyzed in a six-month, 6,000-manhour industry study for National Aeronautics and Space Administration's Marshall Space Flight Center.

Proposals in the competition for the study were submitted under Procurement Request No. TP-2-74-011 at the end of March by eight aerospace industry members. Contract award was scheduled for the end of this month.

This mission for manned reconnaissance for the nearest planets is seen as a step beyond Apollo, and involving definition of more advanced techniques and vehicles such as new operational concepts, the Saturn C-5 or Nova vehicle, and operational nuclear engines. The same advances are seen necessary for supplementing lunar exploration beyond the Apollo stage. Successful achievement of the mission probably would involve these conditions:

- **Mission duration should be** relatively short. Approximately one year is the shortest duration which reasonably can be expected.
- **Over-all mission profile** should be simple. The swing-around type of mission appears to meet this approach.
- **Close encounter** with Mars and/or Venus should occur.
- **Mission should serve** as a development and training exercise for follow-on goal of manned planetary landing.
- **Requirements generally** should not exceed substantially the state-of-the-art development for the Apollo mission and, if possible, no fundamentally new requirements should be involved beyond those necessary for the Apollo follow-on.

These five demands apparently can be met using a Crocco round trip for the mission profile, utilizing an earth-to-orbit transport vehicle no larger than Nova, injecting from earth orbit with a nuclear high-thrust propulsion system and, possibly using upon return, a direct entry technique into earth's atmosphere. Crocco profile, formulated in 1956 by Italian scientist Gen. G. A. Crocco, would allow passing in vicinity of Mars and Venus in one round trip. The spacecraft would depart from earth, pass in the vicinity of Mars, use that planet's gravitational field to redirect the spacecraft's path toward Venus, then use the gravitational field of Venus to redirect trajectory to earth.

Initial earth parking-orbit could accommodate launch windows for the round trip, or permit rendezvous with another element of the spacecraft or another spacecraft if a convoy arrangement were used. Also, the parking-orbit usually would employ a low-altitude launch path and a low burnout angle in contrast to the steep burnout angles and associated high altitude required for a direct departure path.

Detailed study areas include:

- **Crocco profile mission** will be analyzed to determine if a better approach is available, and how to proceed from this first mission to follow-on missions leading to manned planetary landings.
- **Nuclear propulsion systems** will be studied to determine what additional demands will be made on the Nerva engine if this thrust-level powerplant is utilized. Second-generation nuclear propulsion systems also will be considered to determine applicability for the mission, but the study contractor will be required to weigh these developments against projected mission time period.
- **Chemical propulsion systems** also will be considered to determine if applicable systems already exist or can be obtained by modification of existing systems, or whether new systems are required. Development of large chemical engine systems is to be avoided.
- **Procedures for orbital** operations, in-flight rendezvous, and mission staging will be investigated.
- **Subsystems will be evaluated** to determine which major installations, such as communications, power supplies, guidance and control, life support, cryogenic storage, rescue, radiation shelter will have to be developed.
- **Earth-return mode** will be studied for direct atmospheric entry, combination of rocket braking and direct atmospheric entry, and establishment of an earth orbit and then return to earth's surface. For an operational aspect involving rocket braking, consideration will be given to the advisability of restart of the nuclear launch engine or to include an additional nuclear or chemical system for the task.
- **Estimates will be made** for the number of astronauts required to man the interplanetary vehicle, the number of vehicles to start the mission, and how the vehicles would assist each other.
- **Development plan will be outlined,** including requirements for special ground facilities, unmanned (and, if required, manned) test and development flights, crew training and data collection.
- **Funding plan will be developed** for hardware and operations, deriving maximum advantage of developments which already are part of the national space program. Research and development costs for Saturn or Nova vehicles, Apollo capsule, and Nerva engine, etc., will not be included, but appropriate modification and procurement costs will be determined.
- **"Coarse-look" trajectories** will be included as a minimum requirement for test flights, and an exact trajectory included for the mission flight, incorporating realistic launch time variables, injection errors, mid-course corrections, and related data.
- **Scientific aspects** of the mission, including scientific payload requirements, will be investigated in detail.
- **Life support system,** vehicle ecological system, environmental protection system, and cryogenics handling system will be delineated.
- **Guidance and control,** internal power supply, and associated electronic systems will be outlined.
- **Checklist of the most probable** emergency situations will be outlined, together with details on how to cope with these emergencies.

156-in. Solid Proposals

Requests for proposals for development of a 156-in.-dia. solid propellant motor may go to industry this week if the contract for the 120-in.-dia. motor is awarded. Defense Department wants to award the 120-in. contract before proposals are sent on the larger motor.

The 156-in. motor program will be managed by USAF Systems Command's Space Systems Division. SSD and officials from National Aeronautics and Space Administration recently completed the final work statement for the project.

Gemini Rockets

Small maneuvering rockets for Gemini two-man spacecraft to use in orbital rendezvous flights are to be developed by North American Aviation, Rocketdyne Division under subcontract to McDonnell Aircraft Corp.

Small storable liquid propellant engines will be of two sizes and will be used in various combinations to control attitude and propel the National Aeronautics and Space Administration spacecraft in small orbit changes. It is scheduled to fly late in 1963 or early in 1964.

Engine nozzles and chambers are to be cooled by ablation and propellants will probably be in the nitrogen tetroxide-hydrazine family of combinations, though no final decision has been reached.

The small engines are pulsed and total burning time is used to control the energy increment they supply. Rocketdyne has developed fast acting valves capable of starting and stopping the engines up to 100 times per second.