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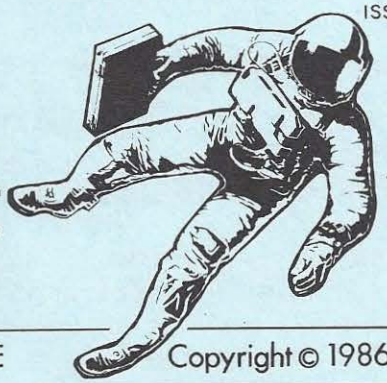

A MONTHLY NEWSLETTER ON FREE ENTERPRISE IN SPACE

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Air Force Seeks Commercial Vehicle For Military Navigation Satellite Launches

With the current launch vehicle shortage, commercial enterprises have been looking for opportunities to get into the market and fill the space transportation gap. However, many potential commercial customers and investors are still recovering from the recent shocks in the launch industry. They have lost confidence in existing launch organizations, and are even more nervous about new and untried approaches in space transportation. Funding has not been easy to come by.

Now, the U.S. Air Force Space Division has entered the scene as a potential customer, with a proposal that could help spur the commercial launch vehicle industry onward.

The Air Force is developing a navigation system called the Global Positioning System (GPS), which requires the launch of at least 12 Navstar satellites beginning in January 1989. To get around the launch slot backlog created by the current Space Shuttle delay, the Air Force has proposed the construction of a launch vehicle called the Medium Launch Vehicle, or MLV. The MLV would be required to place these satellites (which weigh about 4,000 lbs. including the apogee kick motor) into a 10,898 mile orbit, either with or without using a PAM-D2 upper stage.

The Air Force will be holding an open bidding competition for these lucrative satellite contracts. The money and prestige that go with these contracts would be of great help to the contract recipient in gaining a foothold in the wider commercial launch market. Recognizing this, and wishing to encourage the commercial launch industry, the Air Force is specifically stating that the MLV should be designed not only to meet the Air Force's requirements, but also for use as a commercial launch system competitive with Europe's Ariane.

An initial request for proposals for a Phase I study contract, issued in June, met with a wide response. Phase I contracts will be awarded in August, and may be awarded to more than one company. Phase II contracts, for hardware, should be awarded by Feb. 1987, in order to meet the schedule which calls for launches to begin in 1989.

A number of companies have expressed interest in the MLV contract:

General Dynamics, like all of the bidders, was naturally reluctant to divulge details at this stage of the competition. Still, some information was available. General Dynamics will most likely propose the Atlas/Centaur as its MLV, although a version called the Atlas K, a stretched Atlas G, could also be a candidate.

Martin Marietta has no current vehicle in the MLV payload range. The Titan II is too small. The Titan 34D could carry three Navstars, but the Air Force may not want to risk that many on a single flight. Martin's solution remains to be seen. Meanwhile, Martin Marietta continues to work on the Titan Complementary Expendable

Launch Vehicle (CELV) for the Air Force. The company now refers to this vehicle as the Titan 4.

McDonnell Douglas also has no current vehicle in the required payload range. A stretched Delta is one possibility.

Hughes Space and Communications Group, along with its parent company General Motors, is a surprise entrant in the launch vehicle field. Hughes, a major manufacturer of satellites of all types, has probably seen one too many of its birds go up in smoke and decided that if you want something done right, you do it yourself.

Although, like the others, Hughes is releasing no information officially, the magazine Aviation Week and Space Technology has stated that Hughes is considering an expendable launch vehicle using the F-1 and J-2 rocket engines that were used on the Saturn 5 moon rocket. Hughes is reportedly approaching Rocketdyne for information on building these engines again, and Boeing Aerospace for help building the vehicles themselves. In addition, Hughes is said to be examining a possible launch site in the Pacific. The major candidate is Johnston Island, which has been used by the U.S. military in the past.

Hughes, according to the magazine reports, may name their launch vehicle "Jarvis," after Gregory Jarvis, the Hughes payload specialist who died in the Challenger disaster.

Pacific American Launch Systems is the company designing the Phoenix single-stage-to-orbit launch vehicle. However, the Phoenix, under the most optimistic conditions, would not be available until the early '90s, too late to meet the initial Navstar launch schedule. Pacific American is therefore proposing an expendable launch vehicle which could be developed rapidly and inexpensively. Called "Liberty," this vehicle would be designed not only for the Navstar mission, but to fill the commercial launch vehicle gap until more advanced systems like the Phoenix can come on line. No other details have been released.

Space Services, Inc. (SSI), designers of the Conestoga solid-fueled launch vehicles, proposes a larger version of its Conestoga 2 system to perform the MLV mission. Called Conestoga 5, the current design for this version has seven Castor 5 solid boosters (not yet developed) clustered at its base. Atop this cluster are the upper stages. One upper stage configuration incorporates two more solid motors, a Castor 4A topped by a Star 48. (More on SSI later in this issue.)

Who will win the Navstar contract? The smart money is on General Dynamics and the Atlas/Centaur. General Dynamics is the only company which can offer a vehicle right off the shelf without any further design changes. Still, I would not bet the farm either way. None of the other launch vehicle companies are slouches, and Hughes/General Motors, although new in the game, is an organization not to be taken lightly, especially with help from Boeing.

If the Air Force really wants to help out the commercial launch industry, the best way would be for them to not give all the Navstar launches to a single company, but spread a few of them around. Even one or two launches would be a major shot in the arm for a small company, and the more companies that are in the business, the healthier the industry will be.

Military Shuttle Launch Site At Vandenberg To Be Put In Mothballs

The Air Force is recommending closing down the Shuttle launch facility at Vandenberg Air Force Base in California until at least 1991. Several reasons are given for this move:

First, the reduction of the Shuttle fleet to three orbiters makes it more difficult, logistically, to spread Shuttle operations between two coasts. Even with four orbiters, turnaround operations were difficult. Also, NASA has now decided to land Shuttles exclusively at Edwards Air Force base in California, at least for the forseeable future (NASA and the astronauts believe that the margin of safety at the Kennedy Space Center runway in Florida is a little too narrow until problems with winds and landing gear are resolved). This decision, requiring moving orbiters from California to Florida after each flight, makes the already tight turnaround schedule even worse.

Second, the current problems with the Shuttle's solid rocket motors and other systems make military operations out of Vandenberg more risky. Vandenberg Shuttle launches would often involve very heavy payloads which must be launched into high-inclination orbits. Such missions would have frequently required main engine thrust levels above 100%, and special, filament-wound solid rocket booster cases. Right now, the military feels this is no time to be pushing the limits of the Space Shuttle.

Third, there are safety questions with the huge exhaust duct system near the recently-constructed Vandenberg Shuttle launch pad. These ducts are intended to carry launch gases away from the pad. The current design of the ducts can apparently allow hydrogen gas to build up inside the ducts and possibly detonate, damaging the Shuttle while it is still on the pad.

Military Shuttle payloads affected by this shutdown are those requiring polar orbits. These are primarily reconnaissance satellites such as the new KH-12.

The military has two basic alternatives it can use to launch at least some of these satellites: First, they can be launched from the Kennedy Space Center. Although the Shuttle cannot be launched into a polar orbit from Kennedy (at least not without dropping hardware on an unsuspecting Atlantic coast), it can be launched into high-inclination orbits which still cover much of the Soviet Union. Second, the military can launch Titans from Vandenberg, both existing versions and, eventually, the Titan 4.

At present, plans call for the facility to be reopened once the Shuttle can make the grade again and the pad is certified as safe. On the other hand, some sources say that the pad, which cost $3.3 billion, may never reopen. Instead, the new Titan 4 may be able to handle all of the military's polar orbit launch needs once it becomes available in 1988.

Shuttle Version of Centaur Cancelled

NASA has cancelled the Shuttle version of the General Dynamics Centaur upper stage. The cancellation was ordered in the face of safety fears and cost overruns, and took place a month after two Shuttle flights with Centaurs aboard (carrying the Galileo and Ulysses space probes) were originally scheduled to have been launched. Those flights, like all the other Shuttle flights, were scrubbed after the Challenger disaster. The Shuttle/Centaur cancellation does not affect Centaurs which are used on expendable launch vehicles such as Atlas and Titan.

The safety issues involved the Centaur's unique propulsion system. The Centaur uses liquid hydrogen and liquid oxygen as propellants. Whereas this creates no serious safety problems with a Centaur stacked on top of an unmanned launch vehicle, a Centaur completely enclosed inside the payload bay of the manned Space Shuttle is a different story. Centaur is the only upper stage to use cryogenic propellants on the Space Shuttle (other upper stages use solid rocket motors or non-cryogenic hypergolic propellants).

Concerns included propellant loading in the payload bay, venting from the payload bay, and Shuttle aborts with the loaded Centaur still aboard. The presence of liquid hydrogen and liquid oxygen created the potential for serious explosion and fire hazards under these situations.

There were also questions raised about the radioisotope thermoelectric generators (RTGs) carried aboard Galileo and Ulysses to provide the space probes with electrical power. The RTGs contain plutonium, and there was concern, some of it a little hysterical, about contamination of the pad area if the RTG casing were ruptured. Now, RTGs have been safely used in space for years. Satellites containing such generators were launched as early as 1965. Five manned lunar landers carried them in experiment packages. The Viking Mars landers, and the Voyager and Pioneer probes all carried RTGs. No problems ever resulted. Still, there were worries. Although the RTGs were designed to resist crashes or even a Challenger-type explosion, there were still fears that if the Centaur stage exploded, right next to a space probe containing an RTG, the RTG's casing might still be compromised.

The problem was not that these safety concerns could not be dealt with. Procedures were under consideration to fix most of the problems (additional armor for the RTGs, for example, was under development).

The problem was that these safety concerns were being dealt with haphazardly, and at ruinous cost. Key NASA personnel raised serious questions about the safety procedures that were being used in the Centaur program. Voices in Congress agreed.

The consensus seemed to be that many of the managerial problems that led to the Challeger disaster appeared as well in the Centaur program. These included a similar lack of communication on safety-related issues between various members of the Centaur team such as the contractors, the NASA Centers, and NASA Headquarters.

The consensus also seemed to be that the price of making the Centaur safe and operational was getting out of hand. Shuttle/Centaur overruns were projected to exceed $200 million in FY 1987. Since it will cost about $75 million to shut down the project, it was felt that shutting it down now might keep a lot more money from going down a rathole. It's a deep rathole too--cost of Shuttle/Centaur to date: almost $1 billion, including over $400 million for three sets of Centaur flight hardware. Some of this money may be salvaged--the flight hardware could still be used as upper stages for the Titan 4.

The cancellation of the Shuttle/Centaur puts another stupendous crimp in the plans of planetary scientists, already dented from the Shuttle shutdown. As mentioned, the Galileo Jupiter probe, and the Ulysses solar polar orbiter were to be launched by Shuttle/Centaur in May. In addition, the Shuttle/Centaur was to be used to launch the Magellan Venus radar mapper. All of these projects will now suffer serious, and expensive, delays. There has been little love between space scientists and the Shuttle program in the past. Now it has become even worse. Virulent denunciations of the NASA manned space program are heard throughout the space science community as their stranded experiments gather dust.

Also stranded are military payloads that were going to make use of the Centaur stage on Shuttle flights. These payloads would have been heavy satellites that were to be launched from Kennedy Space Center and placed into geosynchronous orbit, and include military communications and missile early warning satellites.

Fortunately, other methods of launch are available, and no payload is likely to be permanently scrapped just for lack of a launch vehicle.

Competition in the private sector is already heating up as companies rush to

offer alternative upper stages to NASA's beleaguered planetary programs.

Boeing Aerospace and Orbital Sciences Corp. (OSC) are offering their competing solid-fueled upper stages. Upgrades of Boeing's Inertial Upper Stage (IUS) and OSC's Transfer Orbit Stage (TOS) could both be used on the Shuttle to launch the Galileo, Ulysses and Magellan probes. Since the solid-fueled upper stages would not be as powerful as the Centaur, different planetary trajectories would need to be used that would increase travel times and reduce some mission objectives. Still, it's better than nothing.

The current launch dates for Ulysses, Magellan and Galileo are September, October, and December of 1989, respectively. If these launch windows are missed, the next ones won't roll around again for at least a year. Galileo, which would have arrived at Jupiter in 1988 had it been launched last May, will not now arrive there until 1994. Both Boeing and OSC say they can have their uprated stages ready to fly by 1989.

The new Titan 4, using a Centaur upper stage, could launch the space probes too. This combination, although more powerful than the Shuttle with solid-fueled upper stages, is still not as powerful as Shuttle/Centaur so the longer trajectories would still be required. Some space scientists claim to prefer the Titan 4, but this may only be a reflection of their anti-Shuttle sentiments (a few scientists, such as Thomas Donahue of the National Academy of Sciences and James Van Allen of the University of Iowa, have given the impression that they would rather eat worms than fly spacecraft on the Shuttle).

The problem with the Titan 4 for planetary missions is that it will be very hard to pry one loose from the Air Force. Best estimates are that a Titan 4 would probably not be available to NASA for science payloads until the early 1990s. This would add even more delays to the planetary programs, increasing both expenses and morale problems. As an added factor, the RTG power supplies aboard Ulysses and Galileo, already loaded and ready to go, are (like any battery) running down even now. If launch is delayed past 1989, there may not be sufficient power left by the time the spacecraft arrive at their destinations to perform their missions properly. These RTGs were the last of their kind produced, and the facility which built them has been shut down. It would take three to six years to reopen it. So, at present it looks like the science community has no real choice except to use the Shuttle.

The military launch alternatives are somewhat better. Although the Air Force had planned to use the Shuttle/Centaur for many payloads, none of these payloads is as demanding as NASA's planetary missions (which would have required every bit of propulsion energy the Shuttle/Centaur could deliver). So, the military needs can be easily met by either the Shuttle using the current version of the IUS (already available), or by the Titan 4 using either the IUS or Centaur upper stages. As mentioned above, the Air Force has the added advantage of having first claim on the Titan 4. Titan 4/IUS combinations would be ready for military launches by the end of 1988. Titan 4/Centaurs would probably be ready by early 1990.

* * *

Update: Space Services, Inc.

Space Services, Inc., of Houston, Texas, is continuing in its efforts to develop its Conestoga launch vehicle. The company is currently negotiating with a customer (as yet undisclosed) for five launches involving a navigation satellite system. The system would use small (300 lb.) satellites in geosynchronous orbit, apparently within the capabilities of an uprated Conestoga system. At $15 million per launch, this would be worth $75 million to SSI. SSI is planning to develop a launch site for Conestoga at Wallops Island, on the east coast of Virginia.

SSI is also pursuing government launch contracts, including work for the Strategic Defense Initiative (SDI) involving component tests and targeting. SSI recently acquired former presidential science advisor Dr. George A. Keyworth II as a member of its board, which will be invaluable to SSI in competing for these contracts. SSI is also doing work on radar satellites, having landed a preliminary contract for systems design.

As yet, no rocket hardware has been constructed, but the company is ready to go as soon as a customer signs up.

American Rocket Company Begins Engine Tests

The American Rocket Company (AMROC) has begun testing its hybrid rocket engines at a test site located at the Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, Calif. These tests are part of AMROC's development of low-cost expendable launch vehicles using hybrid technology (the hybrid engines use a solid, rubber-like fuel, which is burned by adding a liquid oxidizer from a separate tank).

AMROC is using government facilities for testing its engines and launching its vehicles, but is not a government contractor. Tests to date have been characterized by AMROC representatives as being "highly successful" (a photograph of a test which took place May 30 appears on page 20 of the June 16, 1986 issue of Aviation Week and Space Technology).

The tests involve single-port hybrid engines with thrusts up to 6,000 lbs. AMROC's full-scale vehicles would use multiple-port engines, and be capable of placing 2,000 to 4,000 lbs. into low earth orbit.

Outside sources estimate AMROC's development costs at approximately $40 million. Cost per flight is expected to be somewhere in the vicinity of $5 million for a one-ton payload. No date has been released for a first launch attempt.

AMROC is targeting a number of markets for its launch services, including communications and remote sensing satellites, and materials processing in space. Like Space Services, AMROC is also eying SDI testing contracts.

The company, currently located in Palo Alto, Calif., will be moving shortly to new facilities, apparently somewhere in the Ventura/Oxnard area of California. The American Rocket Company was formed by principals of the former Starstruck, Inc., which succeeded in launching a hybrid rocket on a short flight in August of 1984 (C.S.R., Aug. 1984, pp. 1-2).

Until next time,

Tom Brosz

The Commercial Space Report (C.S.R.) is published monthly, and endeavors to report and analyze developments in the field of private initiatives in space transportation and exploitation.

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