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THE COMMERCIAL SPACE REPORT

A MONTHLY NEWSLETTER ON FREE ENTERPRISE IN SPACE

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Update: Space Legislation

"Commercial Space Act":

The Senate version of a bill on private launch vehicles is being moved rapidly through Congress. The bill, S-2931, was introduced by Sen. Paul S. Trible (R.-Va.) and is called the "Commercial Space Act." S-2931 is essentially identical to the House version, HR-3942 (C.S.R., Nov. 1983, p. 5). The Senate Space Subcommittee held hearings early in September, and is working on getting the bill through Congress and into the White House before the end of the current session.

The bill designates the Department of Transportation (DoT) as the lead agency for launch vehicle commercialization, as per President Reagan's Executive Order signed earlier this year (C.S.R., Mar. 1984, p. 3).

The main purpose of the bill is to create a requirement that all private launch operations be licensed, and specifies that a procedure be developed where private launch companies could obtain the necessary license through the DoT. The DoT would also have considerable authority in other areas of commercial launch operations, such as the use of government property by private launch services, the requirements for liability insurance, and the setting of penalties for violations of the Act.

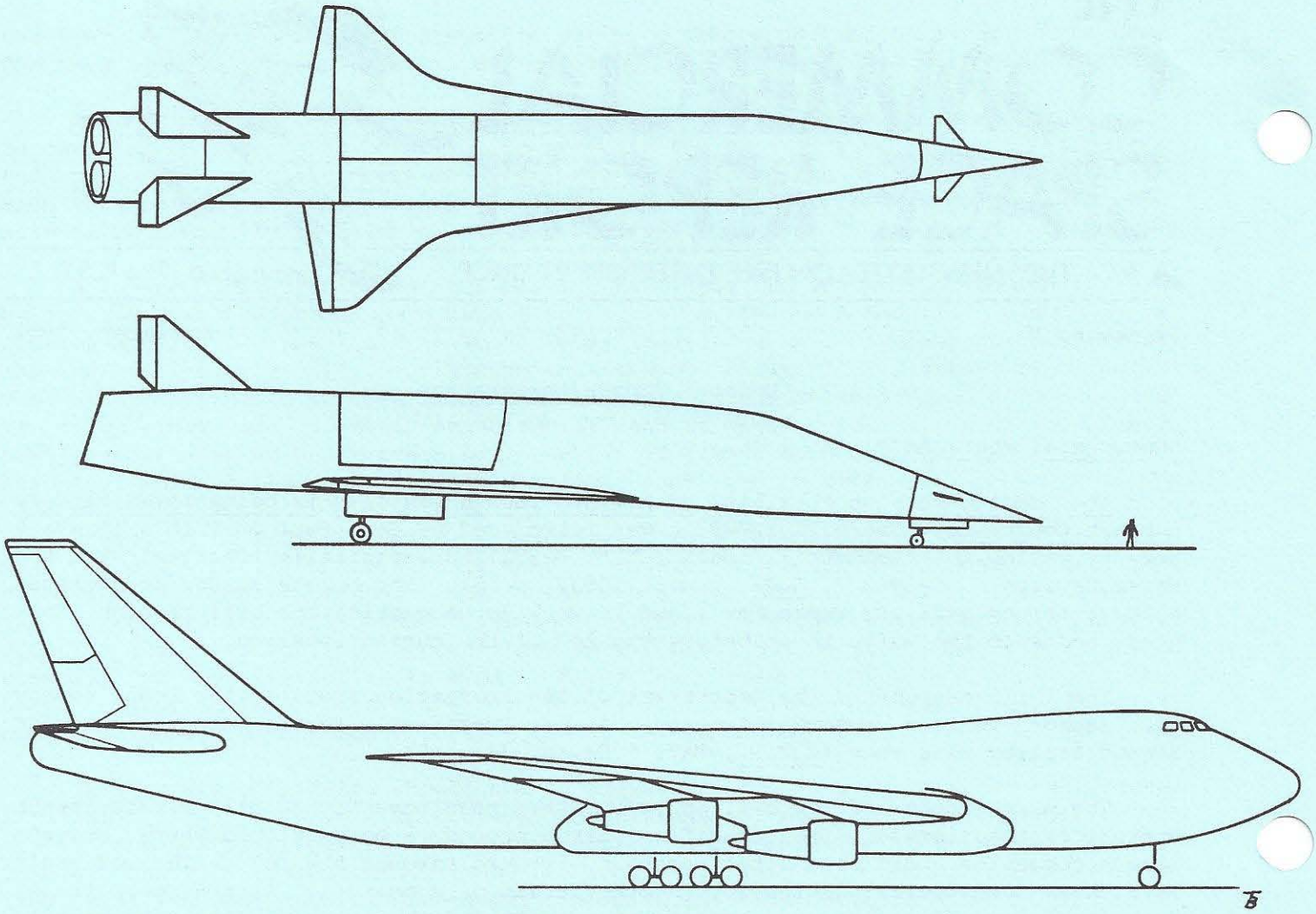
As one interesting feature, the bill removes the definition of a space launch as an "export" under the Arms Export Control Act. In the past, this definition has been a point of aggravation for several private launch firms, since it would have obligated the firms to obtain separate export licenses in order to perform a launch.

"Tax Status of Space Act"

A bill which seeks to provide some tax incentives for commercial space activities was introduced in the House last June by Rep. Herbert H. Bateman (R.-Va.). The bill, HR-5975, is called the "Tax Status of Space Act." The Act would allow certain space activities and articles manufactured in space (by U.S. companies, individuals, or government) to be treated for tax purposes as activities conducted or products made in the U.S.

Unfortunately, the road for this bill is not quite as smooth as it seems to be for the Commercial Space Act, and it is unlikely to be acted on until next January. Reasons for problems apparently include insufficient lobbying from industry, and a hesitation to pass a tax bill that touches only on one area of space tax law. The White House supports a number of different space-related tax reforms (C.S.R., April 1984, p. 4), which some people say ought to be incorporated into more comprehensive legislation next year.

Meanwhile, Sen. Trible stands ready to introduce corresponding tax legislation in the Senate.



British Studying Advanced Launch Vehicle Concept

British Aerospace Dynamics is studying a reusable, single-stage-to-orbit launch vehicle as a possible competitor to the U.S. Space Shuttle * in the early 21st century. The spacecraft (shown above in relation to a Boeing 747) is winged, and would take off and land horizontally on any runway capable of accommodating the Concorde supersonic transport. In fact, it is called the "HOTOL," a rather uninspired name standing for HOrizontal Take Off and Landing launcher.

The HOTOL would be powered by rocket engines using liquid oxygen (LOX) and liquid hydrogen, along with advanced air breathing engines for use during the atmospheric portions of the launch. No portion of the vehicle is expended during flight. Payload capacity is about 15,400 lbs. into low earth orbit. The payload bay, about 27 ft. long and 14 ft. in diameter, could accommodate most existing payloads. It is estimated that the cost of orbiting a payload would be about half that of the Shuttle. The vehicle as presently designed is not manned. One hopes that this would be corrected soon after the vehicle becomes operational.

(TEXT CONTINUED ON PAGE 3)

* Note: in this newsletter, the term "Space Station," when capitalized, refers to the official NASA manned space facility as opposed to, say, a Soviet, European, or privately operated space station. Similarly, the term "Space Shuttle," when capitalized, refers specifically to the NASA reusable launch vehicle.

NASA's Space Station: Meeting Scientific Needs?

Early in August, a group called the NASA Task Force on the Scientific Uses of the Space Station held a week-long meeting at Stanford University. The meeting was chaired by Prof. Peter Banks of Stanford, and attended by a wide variety of scientists and engineers representing a number of different countries and many different fields. Representatives from the National Aeronautics and Space Administration (NASA), included John Hodge, Deputy Associate Administrator for the Space Station, and Burton Edelson, Associate Administrator for Space Science and Applications.

The official purpose of the meeting was to allow the scientific community an opportunity to make their needs known to NASA's Space Station group. However, to some observers, the meeting primarily served to highlight some of the weaknesses of NASA's Space Station program as NASA responded to scientific concerns and questions in a number of different areas. Areas which raised questions included:

Unmanned Orbital Platforms:

A major problem arose immediately with NASA's basic concept for accommodating scientific experiments. NASA's original plan called for two large, unmanned, free-flying space platforms in addition to the permanently manned Space Station. One of these platforms would be in a 98 degree polar orbit, while the other would be in the same 28 degree orbit as the Space Station. These platforms were intended to accommodate, among other things, a multitude of scientific experiments.

Scientists pointed out that many experiments on the same platform would be incompatible with each other. Many experiments could have conflicting spacecraft attitude requirements for pointing instruments. Additionally, some experiments could emit heat, magnetic fields, or other interference that could ruin other nearby experiments. A single platform in polar orbit might be okay, since it would contain primarily earth-pointing instruments which could co-exist on the same structure. However, a single platform in the Space Station's orbit did not look workable.

The scientists recommended instead a series of smaller free-flying platforms, with fewer experiments on each rather than a single, large platform. The fewer the experiments on a given platform, the more flexibility the platform would have in responding to the needs of a given experiment.

NASA's Space Station department took a dim view of this approach. The agency could see where the desire for smaller platforms would lead. If they are small enough, and numerous enough, such scientific platforms are called "satellites"--a concept which has had some success in the past, and requires little in the way of new NASA development. Therefore, John Hodge was diplomatic, but essentially told the scientists to take it or leave it as far as the large platform was concerned. If the scientists proposed small platforms, they would not fit into NASA's Space Station concept and Space Station funds would not be made available to support them.

Other voices were more sympathetic, even some from within NASA. Dr. Richard Johnson, Director of the Office of Science and Technology Policy for the White House, stated that he was aware of Hodge's opinion, that Hodge was not the only voice in the discussion, and that the White House was aware of the concerns of the scientific community. NASA's Edelson also agreed that smaller platforms would be more useful, and claimed that efforts were being made to get Space Station funding for them. However, Edelson urged scientists not to rock the boat too much at this time since negotiations on the subject were politically sensitive.

Crew Size:

Another concern of the scientists involved the Space Station's complement of

personnel, presently sized at six crew members. Originally, it was planned to have the first operational phase of the Space Station support a complement of eight to twelve, but NASA cut this to six, of which four are required to operate the Station (two "pilots" along with the equivalent of a mission specialist and a payload specialist). This leaves two crew members (four, at most, if the two specialists help) to handle the entire load of scientific experiments throughout a typical 90-day Space Station mission.

Spacelab I, which flew aboard the Shuttle last year, also had a crew of six: two pilots, two mission specialists and two payload specialists. They were split into two groups of three in order to work constantly in twelve-hour shifts. Therefore, at any given time the experiments aboard Spacelab were handled by only two people (the mission and payload specialists). There is no reason to assume that a similar two-shift system would not be required aboard the Space Station, so that again, even if four crew members are assigned to research, only two of them at a time would be handling the entire load of experiments.

Spacelab, a facility considerably smaller than the Space Station (and, presumably, containing far fewer scientific experiments), demanded the constant attention of two crew members. In fact, there were complaints about overwork. How then could two people handle all the scientific equipment aboard the Space Station, even assuming that both are dedicated only to science operations as opposed to, say, a commercial operation taking place at the same time? It does not seem feasible. Under the circumstances, it goes without saying that the luxury of having a scientist on board dedicated to a single experiment (an ideal situation from the scientist's point of view) is out of the question. Scientists at the meeting realized this, and suggested raising the Space Station's crew complement to ten, allowing at least six crew members to be available as research personnel. This is not likely to happen.

Extended Operation Space Shuttle:

The controversy of an "extended-operation" Shuttle orbiter vs. the Space Station came up as well. If the initial Space Station was going to accommodate only a crew of six, then why couldn't many of the Station's missions be accomplished equally well by a Space Shuttle orbiter/Spacelab equipped to stay on orbit for a longer period of time than the present seven days (and, incidentally, capable of accommodating seven people, not just six).

A Shuttle orbiter can be equipped to remain on orbit for at least 30 days. Several modifications are needed, but the major requirement is a source of additional electrical power to supplement the orbiter's fuel cells. There are several ways of doing this. One way involves adding a package of additional cryogenic LOX/hydrogen tanks inside the Shuttle's cargo bay, permitting the Shuttle's fuel cells to operate throughout a 30-day mission. Other methods involve power packs using large solar cell arrays. One type, the Power Extension Package, could be carried aboard the Shuttle on each trip, while another type, the free-flying Power Module, could be parked in orbit where the Shuttle would dock with it and "plug in."

NASA is discouraging the extended orbiter option as a space station. For one thing, like small space platforms, it would require far less new technology than the Space Station. Also, the NASA Space Station group, which is rapidly becoming the major driving force within the agency, is hostile to any concept that might even appear to make the Space Station look like a boondoggle...even if that concept involves NASA's own Shuttle. No time was wasted in shooting the idea down.

One way this was accomplished was to attach stupendous costs to the modifications required to extend the Shuttle's orbital stay time. For example, the development and construction of one cryogenic tank package, consisting of existing, tested Shuttle cryogen tanks bolted into an aluminum frame and fitted with plumbing, is

priced at up to $100 million. The free-flying Power Module, with two large "wings" of solar arrays, would, it is estimated, cost nearly $1.37 billion(!)

Dr. Owen K. Garriott, an astronaut veteran of both Spacelab 1 and Skylab 3, was unable to see how NASA could spend this much money. He pointed out that each of the two solar array wings on the free-flying module was essentially equivalent to the solar array wing just tested on the last Shuttle flight (although the test wing was not completely outfitted with solar cells). The test wing flew for about $8 million.

One participant at the conference later pointed out another interesting fact. Apparently, it is estimated that assembling the Space Station would require about 1500 hours of extra-vehicular activity (EVA). NASA mission rules state that an EVA can last only six hours. Any one crew member can only do one EVA per day, and only every other day. In addition, the crew member is restricted to three EVAs during one seven-day mission. If you assume four astronauts switching off every other day, with each pair doing three six-hour EVAs, you arrive at a figure of 72 hours of EVA work per mission. To build the Station would require at least 21 Shuttle flights under these conditions. EVAs from the Station itself are not a factor since the Station is not scheduled to become habitable until relatively late in the construction cycle. If 21 separate Shuttle flights are not feasible, NASA may, ironically, have to develop an extended duration Shuttle anyway to build its Space Station.

Cost of the Space Station:

It was confirmed at the meeting that the NASA Space Station cost would actually greatly exceed the original $8 billion estimate. The $8 billion does not include launch costs, the cost of equipping the Station, or the cost of transporting personnel and equipment to and from the Station. These reportedly could add up to $11 billion to the cost, bringing the grand total up to at least $19 billion. Potential scientific users (not to mention taxpayers) find these costs somewhat unnerving.

The major reason for the high cost is that NASA is using the Space Station as a "technology driver," that is, as an opportunity to stretch technology as far as possible whether or not it is actually necessary to meet the needs of the supposed users (C.S.R., Feb. 1984, pp. 2-3). NASA is specifying new, advanced technologies for every part of the Space Station, such as exotic structures, life support systems, power supplies, and, in particular, advanced computer systems.

In this area, NASA wants to design its own computer network architecture, machine architecture, and operating systems. Artificial intelligence expert systems programs are intended to be incorporated into the Space Station operations systems. NASA seems to be taking every opportunity to make such a system as complex as possible. As one example, the Johnson Space Center has taken advanced work done on chemical life support systems and decided it is to be the lead technical item in an artificially intelligent expert controls system. One prime contractor to Johnson stated, only half in jest, that the eventual goal was to have nothing but two lights in front of the Station commander: one red and one green.

There is evidence that NASA may have selected the Space Station's design configuration to further increase the need for advanced technology. One candidate configuration was called the "Delta" configuration. It was characterized by a strong, rigid structure. With one side always pointed toward the sun, and the rest of the Station shaded by cell arrays, thermal stresses were minimized as well.

On the other hand, the configuration that was finally selected, the "Power Tower," is non-rigid, and somewhat flimsy. It also possesses dynamics which have been described as "bizarre," requiring advanced adaptive control systems to maintain stability. In fact, these advanced control systems may be required simply to keep

the Shuttle from crushing the structure during a simple docking maneuver. The need for this advanced control system, a "technology driver," was just what NASA wanted.

As has been stated before in these pages, NASA's purpose in constructing its Space Station appears to be solely to preserve the existence of NASA and its multitude of bureaucrats, engineers and contractors. The meeting of NASA with scientists made this painfully clear, as NASA sidestepped the requests and suggestions of the scientific community in favor of its own programs.

A number of attendees at the meeting felt that the scientific community was being led down the garden path like they were with the Space Shuttle. In 1972, a similar meeting had been held in Woods Hole, Mass. Then, NASA won the support of the scientific community by claiming that the Shuttle would fly every two weeks; that scientists would personally be able to hop aboard with their grad students and HP calculators and do their experiments; and it would be cheap, with no fancy requirements and no heavy training. Well, it didn't turn out that way. As one scientist said at the Space Station meeting, "they lied to us."

According to NASA, it will be "different" this time around--the Space Station will be everything that scientists need. However, I would not suggest that the scientists hold their breath. NASA's concern is for NASA, not for the end users of the Space Station. The scientists and engineers left the meeting having largely accepted the situation, not because they were fooled, but because none of them could conceive of any alternative to NASA to serve their needs. They will hope for the best. Unfortunately, they are not alone--it goes without saying that potential commercial users of the Space Station are in the same boat.

This state of affairs should not be allowed to continue. To set the record straight, I am a fervent advocate of large-scale, long-term human activities in space, and have frequently expressed concern over the Soviet lead in this area. However, an "Official National Space Station," resulting from bureaucratic centralized planning and wasteful government expenditures while ignoring the requirements of potential users, is not the answer. Although new technologies generally repay the costs they incur many times over in the long run, they do so only when the technology is a response to a real need on the part of the users of that technology. Using exotic technologies only for their own sake when existing technologies can do the job better and cheaper, is impractical in the private sector, and immoral when the taxpayer is picking up the bill.

The challenges of inhabiting space should be the left to the private sector, which would address the space station problem with the needs of the users uppermost in mind, stretch technology only when appropriate, and retain the flexibility required to accommodate the new developments that will begin when space begins to be exploited on a large scale.

Until next time, Tom Barry

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