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Dear Subscriber:

"Space America" Announced by Space Services, Inc.

SSI, the American Science and Technology Corp., and Aeros Data Corp. have formalized their joint remote sensing satellite venture under the project name "Space America". The project itself has been under development for some time now (C.S.R., July 1982, p. 3; Nov. 1982, pp. 1-2; May 1983, p. 4), and has as its major goal the launch of a series of three remote sensing satellites. The satellites will be launched by SSI's Conestoga II rocket into a 500 nautical mile orbit. The first satellite launch is scheduled for sometime in 1986, with the other two following at two-year intervals. The system is intended to provide low-cost earth resources data to a wide variety of users.

Space America also seeks to manage and commercialize NOAA's Landsat program, and will submit a formal proposal to the Department of Commerce for this purpose.

Other companies involved in Space America are: Morton Thiokol, which will build the solid rocket motors; Ball Aerospace, which will build the spacecraft "bus" and instrument module for the satellites; and Honeywell, which will design and fabricate the sensor package and related instrumentation.

No Titan Bid For Intelsat VI

Martin Marietta did not make the August 8 deadline for Intelsat bids. The company had intended to bid its Titan 34D (originally in a joint venture with FEDEX SpaceTran), but is still in the process of negotiating with the Air Force for the use of those Air Force facilities required for Titan launches. Until this is concluded, Martin Marietta cannot officially submit a competitive bid.

Intelsat has the option of delaying final selection until November. If they do, Martin expects to be ready to submit a bid by then.

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Truax Engineering: More Details

The June, 1983 issue of the Report contained an overview of Robert Truax's program to develop low-cost, reusable heavy lift launch vehicles. In this article, more information on Truax's concepts is presented.

Truax developed the idea for a low cost booster while working as Director of Advanced Developments for the Aerojet-General Corporation in the 1960's. This vehicle, called "Seadragon," was envisioned as being a practical solution to transporting very heavy payloads to orbit. The concept was extensively evaluated in 1963 by Aerojet-General and TRW, and its basic technical soundness was confirmed.

Seadragon Design:

The baseline Seadragon launch vehicle is a two-stage, pressure-fed rocket. The first stage is fueled by LOX and RP-1, and the second by LOX and liquid hydrogen. Each stage is powered by a single large engine, operating at very low chamber pressures (300 psi for the first stage and 60 psi for the second).

The upper stage uses a unique expandable engine nozzle. In a vacuum, where an upper stage operates, the efficiency of a rocket engine can be increased by increasing its expansion ratio (the ratio of the nozzle's exit area to its throat area). So, a very large nozzle can be a plus for an upper stage engine. However, the weight of such a nozzle (as well as the weight of the interstage required to enclose such a nozzle during first stage boost) can easily negate the performance advantage. To get around both problems, Seadragon uses an enormous corrugated nozzle, made of thin, heat-resistant sheet metal. This nozzle is pleated and wrapped snugly around the outside of the first stage. When the first stage drops off, and the second stage fires, the nozzle snaps open like an unfolding umbrella to its full diameter. Internal gas pressure holds it rigid, and, at the low pressures used in the upper stage engine, radiation is sufficient to keep the nozzle cool. Such nozzles were successfully tested at Aerojet in versions up to six feet in diameter.

Most of Seadragon is built of high-strength heavy-gauge steel, using construction techniques similar to those utilized in shipbuilding (more on this later), rather than the lightweight, high-tech construction normally used for spacecraft.

Seadragon's most outstanding feature is its enormous size. The total vehicle is 75' in diameter, and over 500' long. Gross liftoff weight (GLOW) is over 40 million lbs., and the payload to low earth orbit is over 1.5 million lbs. Engine thrust is 80 million lbs. for the first stage and 11.3 million lbs. for the second stage (by comparision, a Saturn V is 33' in diameter and about 360' long, with a GLOW of 6.4 million lbs., a payload of about 240,000 lbs., and a first stage thrust of 7.7 million lbs.)

A large spacecraft can be more efficient than a smaller one of the same design. This "economy of scale" is due to basic geometry: In a chemical rocket, which is mostly propellant tanks, propellant and structural weights correspond approximately to the vehicle's volume and surface area, respectively. As a rocket is enlarged, its volume (propellant weight) will increase at a greater rate than its surface area (structural weight). The basic rocket equations state that, all else being equal, the total weight injected into a given orbit increases at the same rate as the propellant weight. However, since the vehicle's structural weight increases less rapidly than its propellant weight, a larger rocket can devote a greater percentage of its injected weight to payload instead of structure.

For a vehicle like Seadragon, large size is essential, not just more efficient. A low-pressure, heavily-constructed system cannot easily attain orbit without the performance gained from economy of scale. (This is why designs for "big dumb boosters" are seen more often than designs for small ones.)

Enormous vehicles generate enormous handling problems. Seadragon surmounts these by taking to the sea, hence its name. The vehicle would be built in a drydock using the aforementioned shipbuilding techniques, and launched into the water in the same way an oceangoing ship would be. All subsequent handling would be a matter of treating it like a huge barge. Assembly, maintainence and repair procedures could be done in drydock, or in a harbor. Fueling would be accomplished by docking next to a shore facility or a fuel ship. Thus a gigantic rocket becomes only a medium-sized ship--its fully fueled 20,000 ton displacement less than that of a typical passenger cruiser.

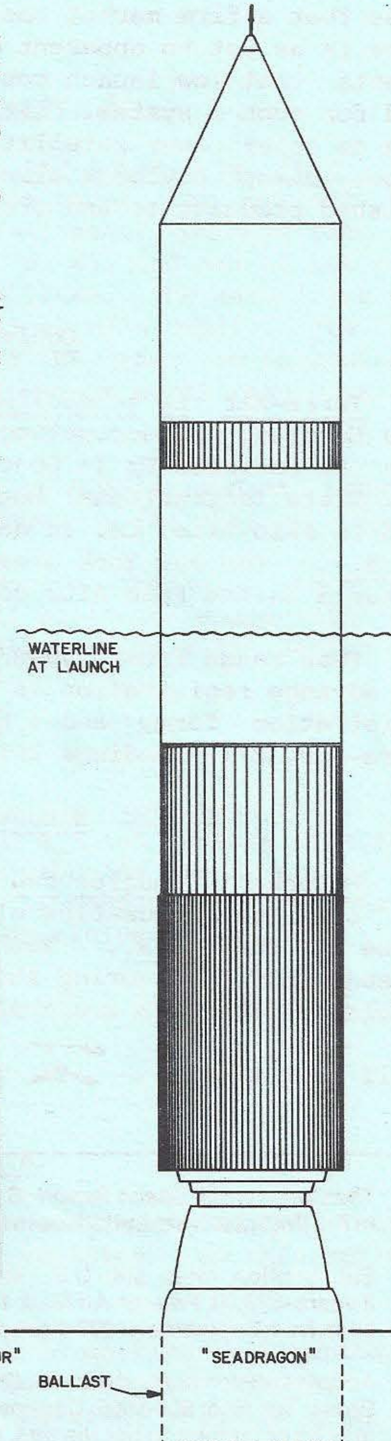
Flight procedures would begin by towing Seadragon to an ocean launch point, erecting it to launch position by means of a huge ballast assembly on the tail, and backing away to a respectable distance. After the launch, the first stage would drop back into the ocean, slowed by a simple drag device. The upper stage, after delivering its payload, would reenter and be recovered in a similar manner. Both stages would be towed to shore facilities for refurbishment and reuse.

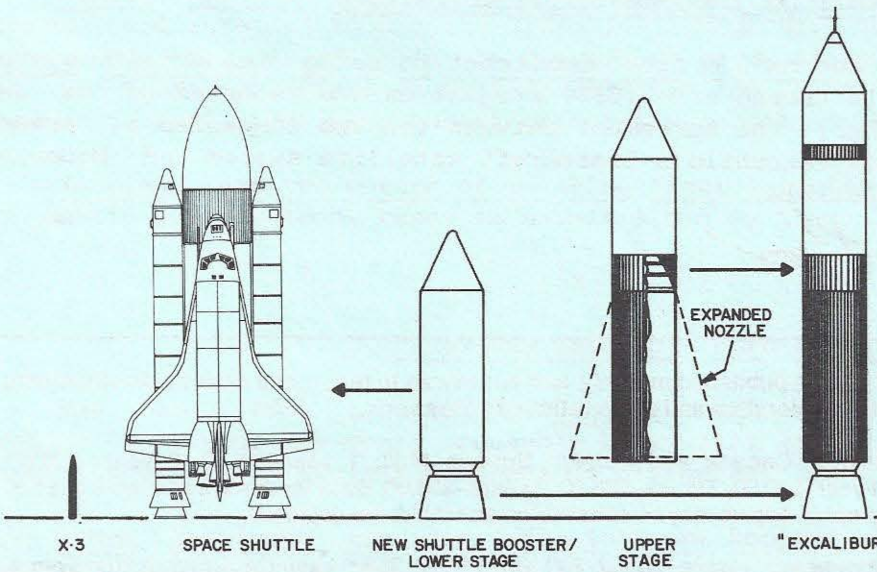
NASA rejected the Seadragon launch vehicle concept in the sixties. Truax, since retired, has reintroduced the idea as a long-range goal for Truax Engineering. To finance its development, a bootstrapping plan was created.

Development Plan:

The plan involves a step-by-step progression (depicted in Figure 1) from the tiny X-3 rocket being built for Truax Engineering's Project Private Enterprise manned flight demonstration (C.S.R. July 1980, pp. 1-2) to the giant Seadragon. It is estimated that the total endeavor may take from 10 to 20 years, with each step being a potentially profitable project in itself.

Project Private Enterprise is intended to finance a new strap-on booster for the Space Shuttle, built along the same low-cost design guidelines proposed by Truax for Seadragon. This will be done via revenue earned on public interest generated by the X-3, along with capital generated by a public stock offering. The 2.5 million lb. reusable, liquid-fueled booster is intended to replace the existing solid rocket motors as part of a performance upgrade of the Shuttle system. In this, Truax's booster will have to compete with a new, larger solid rocket motor in the areas of efficiency and cost. Truax feels that the high cost of solid propellant compared to liquids (a $3.00/lb. margin, according to Truax) more than makes up for the higher initial production costs of a liquid system (estimated to be about $20 million per booster).





TRUAX ENGINEERING DEVELOPMENT PLAN

FIGURE 1

Profits from this booster will be used to develop an upper stage using LOX/hydrogen propellant and an expandable nozzle. This stage, mounted on the booster, will form the Excalibur launch system--essentially a small prototype of Seadragon. Excalibur would be 261' long with a GLOW of 3.6 million lbs., and would deliver a payload to low earth orbit of about 150,000 lbs. Excalibur will also test ocean launch and recovery techniques. If all goes well, the next phase would be development of the Seadragon.

Markets:

Excalibur competes directly with the Space Shuttle, at a cost of about $150.00/lb. compared to the Shuttle's 600 - 1500.00/lb. Truax Engineering anticipates that a firm market base exists for this vehicle. As for Seadragon, although there is as yet no apparent market for 1.5 million lb. payloads, Truax Engineering expects that low launch costs (about $20.00/lb.) will generate a rapidly expanding need for such a system. Primary marketing targets include large space structures, such as solar power satellites, space communications centers, and space factories. Large, cheap payloads also enhance the viability of transporting raw materials and finished products to and from space processing facilities.

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Conference on Space Commercialization

Terra-Mar is scheduling a second space business conference in cooperation with Main Hurdman, an accounting firm. Again titled "Space Commercialization: Getting Down to Business Up In Space," the conference will be held October 17-18, 1983 at the Vista International Hotel in New York City. Much more extensive than the one held in Palo Alto, Ca. in January (partially covered in the February and March 1983, C.S.R.), the New York presentation will include some of the subjects and speakers featured in the Palo Alto conference, along with a number of new ones.

Fees range from $300-$350 for attendees, and $150-$200 for spouses. Deadline for advance registration is Oct. 3, 1983. For further information, a conference registration form, and a hotel reservation form write: Donn Walklet, President, Terra-Mar, 2113 Landings Drive, Mountain View, CA 94043, tel.:(415) 964-6900.

McDonnell Douglas/Leasecraft Correction

McDonnell Douglas has not made a firm commitment to using Leasecraft systems for its continuous-flow electrophoresis (CFE) project as was reported in the July issue of the C.S.R.. Rather, the agreement between the two companies at present extends only to ensuring that Fairchild's Leasecraft satellite system and McDonnell Douglas' CFE system are compatible.

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 the exploration and exploitation of space.

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