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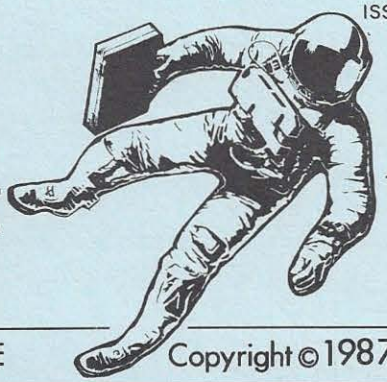

A MONTHLY NEWSLETTER ON FREE ENTERPRISE IN SPACE

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Soviet Union Launches Saturn 5 Class Booster

On May 15, the Soviet Union successfully launched its heavy-lift launch vehicle, which is designed to carry either unmanned payloads or the Soviets' version of a manned space shuttle into low earth orbit. The launch vehicle has been designated the "Energia" (Energy) by the Soviets. With a gross lift-off weight of 4.4 million lbs., a take-off thrust of 6.6 million lbs., and a payload to low earth orbit of over 200,000 lbs., the Energia is now the world's most powerful operational launch vehicle (the U.S. Saturn 5 was slightly more powerful, with a payload of about 240,000 lbs.)

The test payload for this flight was an unmanned cargo pod, reported by the Soviets to be a full-sized mockup satellite (it is not known whether the satellite weighed the full hundred tons that the Energia is capable of launching). The Soviets reported the launch to be a success, although the payload failed to achieve its intended orbit and splashed down in the Pacific. The launch followed close on the heels of a static engine test which took place earlier this year (C.S.R., Mar. 1987, pp. 3-4).

Apart from its greater size, the Energia's configuration is quite similar in outward appearance to the configuration of the U.S. Space Shuttle's launch assembly. This is particularly true for the manned shuttle version of the Energia (see illustration on page 3).

However, the Energia's basic design is actually quite different.

The U.S. Space Shuttle consists of a large cryogenic External Tank containing liquid oxygen (LOX) and liquid hydrogen. These propellants flow from the External Tank through connecting pipes to the Shuttle's winged orbiter, which burns the propellants in three reusable Space Shuttle Main Engines (SSMEs) mounted on the aft end of the orbiter itself. Additional thrust at launch is provided by two solid-fueled outboard boosters. In theory, the main advantage to this configuration is that the expensive SSMEs can be returned to earth after each flight and reused.

The Soviet Energia also consists of a central propellant tank containing LOX and hydrogen, along with outboard boosters, but here the similarity ends. The Energia's tank fuels four main engines mounted at the base of the tank itself. These engines--the first operational Soviet engines to burn LOX and hydrogen--are discarded after each flight when the tank is jettisoned. The Soviet orbiter has no main engines of its own, only small orbital maneuvering engines to finalize the vehicle's insertion into orbit (the U.S. orbiter also has such engines in addition to the SSMEs).

The Energia's outboard boosters (there are four, compared to the Shuttle's two) differ from the Shuttle's outboard boosters in that they are liquid-fueled instead of solid-fueled. The engines of the Energia's outboard boosters, unlike its core

engines, burn LOX and kerosene. (Observers of the launch, which was televised, could see that the outboard engines burned with a brilliant yellow flame--one signature of a LOX/hydrocarbon engine. LOX/hydrogen engines burn with a nearly invisible blue flame).

Why did the Soviets design their system the way they did? The details of the Soviet decision-making process, as well as the engineering and structural details of the Energia launch system, are not available to us. Still, we can make some educated guesses:

By mounting the main engines on the propellant tank rather than on the orbiter, and making the engines expendable, the Soviets are trading the long-term cost savings of increased reusability for short term decreased development costs and increased payload flexibility. To elaborate:

Low development costs: Obviously, all else being equal, less development time and money are required up front to make expendable cryogenic engines as opposed to reusable ones. In addition, the Soviet winged orbiter, which has no major onboard propulsion systems, can afford to devote more of its empty weight to structure than the American orbiter and still match or even exceed the payload capacity of the American Shuttle. This permits the Soviet orbiter to get by with fewer of the high-technology design solutions (composites, lightweight tiles, etc.) that were necessary to bring the U.S. Shuttle orbiter in under its weight targets.

The decision to use liquid-fueled boosters also helped keep Soviet development costs at a minimum. The Soviets have extensive liquid-fueled rocket experience, but little background in the kind of large solid motors used on the U.S. Shuttle. The agonizing problems the U.S. has been having with the Shuttle solid boosters have probably thoroughly convinced the Soviets that they made a wise decision in this regard (in fact, even NASA is taking a look at the possibility of replacing the Shuttle's solid boosters with liquid-fueled versions).

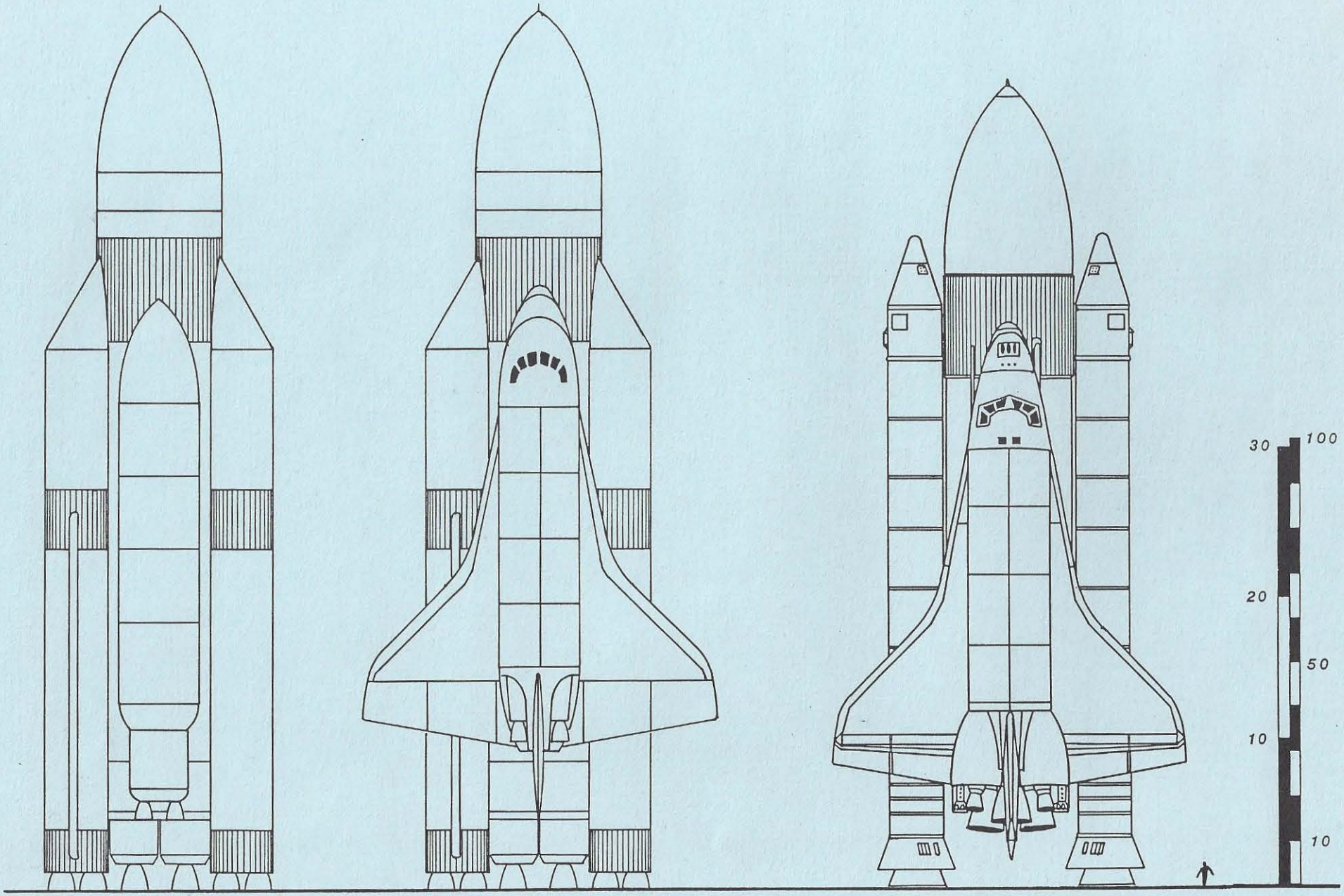
Flexibility: Mounting the main propulsion system on the main vehicle rather than on the payload allows the Soviet orbiter to be easily replaced by an unmanned, expendable, wingless cargo pod, as it was for this first test flight. The cargo pod, like the orbiter, has its own small engines for orbital insertion (apparently it was a problem with these auxiliary engines that resulted in the failure of the payload to achieve orbit--hence the Soviets assertion that the main launch vehicle itself performed successfully).

The U.S. Shuttle currently has no such flexibility. In the past, a number of concepts have been proposed for the American Shuttle system that would allow it to carry heavy cargoes by replacing the Shuttle orbiter with some form of wingless, expendable cargo pod. These concepts include configurations with the SSMEs mounted on the cargo pod in the same way as they are mounted on the orbiter, and configurations which mount the SSMEs on the base of the External Tank.

Such designs are among those being proposed by aerospace companies for an American heavy-lift booster (more on this later). Unfortunately, most of these designs either require that the expensive SSMEs be discarded, or that some form of ballistic reentry system be designed to bring the engines back. All of these ideas would require a major development effort, and the resulting vehicle would still only have a payload of about 150,000 lbs. as compared to the 200,000 lbs. which can be launched by the larger Energia.

The Energia will greatly enhance Soviet operations in space. Unmanned payloads could include large space station modules, deep space probes, solar power

(Text Continued On Page 4)



ENERGIA WITH CARGO POD

ENERGIA WITH ORBITER

U.S. SPACE SHUTTLE

satellites, and elements of a space-based missile defense system. Manned missions, using the Soviet shuttle, will supply personnel for these space operations, and enhance the Soviets' capability to bring payloads from space back to earth.

The Soviets have an eye on Mars, with a number of automated probe missions planned for the 1990's. These missions (including landers, rovers, aerostat balloons, and the return of samples from the Martian surface) will be launched on the Soviets' Proton booster, but manned missions are likely to follow--missions that almost certainly would rely on the Energia's huge launch capacity.

In the nearer future, it is likely that the Soviets will attempt to use the Energia to launch the Soviet shuttle before the U.S. Space Shuttle flies again. It is not known exactly when the Energia will carry the first Soviet shuttle orbiter into space--naturally, the Soviets will probably announce the event after the fact. Still, I believe that the opportunity for the Soviets to score a coup on the U.S. by beating the American Shuttle into orbit is too strong to resist. Our Shuttle will not fly until mid-1988 at the earliest (see article later in this issue).

Soviets Lose Another Proton

The Energia success was welcomed in the Soviet Union--it took much of the sting out of the second failure this year of a Proton heavy launch vehicle.

On April 24, the Proton suffered a fourth stage failure similar to the Proton failure which caused the loss of a Soviet communications satellite in January (C.S.R., Feb. 1987, pp. 1-2). Three navigation satellites were lost, placed in unusable orbits when the fourth stage shut down prematurely.

After the January incident, the Soviets originally claimed that no problem had occurred. They later stated that the problem had been fixed, and carried off a successful Proton launch of a communications satellite on March 19.

After the April 24 launch, the Soviets again initially claimed that no accident had occurred, going so far as to argue the point with the Space Commerce Corp., the U.S. company representing the Soviets in their attempts to sell commercial Proton launches to U.S. customers.

Space Commerce Corp. had to find out about the failure from Aviation Week and Space Technology. Telegrams to the Soviet Union brought only terse replies claiming that the three satellites were launched successfully.

Apparently the Soviets eventually came around to admitting the latest failure, but they lost no time in attempting to forestall any concerns that commercial customers might now have about the Proton. The Soviets claimed that the vehicle's problems occurred because of an experimental fuel control computer in that version of the fourth stage that was used on the unsuccessful flights. They are assuring potential customers that no such experimental system will be used on commercial flights.

To punctuate their confidence in the Proton, the Soviets successfully launched another communications satellite into geosynchronous orbit on May 11, only three weeks after the April failure and just four days before the launch of the Energia.

U.S. Space Shuttle Launch Date Pushed Back

NASA has formally rescheduled the first post-Challenger Shuttle flight for June of 1988. This is a surprise to no one--when the new date was announced, only NASA was still trying to pretend that they could still meet the original February, 1988 deadline.

In fact, a more realistic date for the first Shuttle launch would probably be late 1988 or early 1989. Testing is proceeding more slowly than NASA could wish. In addition to this, some sources believe that the launch may be postponed until after the November 1988 election for political reasons--the idea being to avoid another possible disaster on Reagan's watch.

The rescheduling means that only three launches will take place in 1988 rather than the six that were originally planned. NASA will announce later which payloads will be bumped. On the original schedule, the first and fourth missions were to carry tracking and data relay satellites. The second and third missions were military. The fifth mission was to carry the long-delayed Hubble Space Telescope.

Air Force, NASA Seek Advanced Launch Vehicle

The United States Department of Defense wants to develop a low cost launch system to meet both military and civilian needs in the 1990s. The Pentagon's initial concept called for a heavy-lift launch vehicle (HLV) to meet military launch needs, particularly for the Strategic Defense System. Now, the concept has been broadened to appeal to a wider user base.

The new concept is referred to as the Advanced Launch System (ALS). The design objectives emphasize low operating cost-per-pound into orbit, austere launch operations with quick turnaround, and flexibility in adapting to a variety of payloads.

The ALS would not only be used for military missions, such as Strategic Defense, but would also be designed to meet civilian needs as well. NASA is examining the possibility of using the ALS for launching, and later supporting, the U.S. Space Station.

In comparison with early HLV studies, the ALS concept seems to be a real effort to find new solutions to the space transportation problem. The HLV, as first envisioned by the Air Force, was to be a large launch vehicle in the 150,000 lb. payload range (C.S.R., Mar. 1987, p. 4).

In response to the Air Force, a number of HLV concepts were submitted by members of the aerospace industry. North American Rockwell, United Technologies, Boeing, and General Dynamics all proposed launch systems based in part or in whole on Space Shuttle technology. Martin Marietta proposed a system based on a growth version of the Titan 4.

However, as the HLV studies continued, it became obvious that the Air Force, which already was less than enamored of the Shuttle system, wanted to pull away from the stock answers and open the search to new ideas. The Air Force wanted, above all, low-cost routine space transportation, even backing away from the "heavy lift" aspect of the design--the 150,000 lb. payload requirement--and renaming the project the Advanced Launch System.

The Air Force, in cooperation with NASA and the Strategic Defense Initiative Organization, issued a Program Research and Development Announcement (PRDA) asking the aerospace industry to submit ideas for the ALS. The PRDA approach, incorporating a general statement of goals, was deemed to be more conducive to fresh ideas than the Request For Proposals (RFP) approach, which would incorporate more specific vehicle design requirements.

Industry proposals will be submitted over the next several weeks. It will be interesting to see if the aerospace industry can pry itself away from the same bloated space transportation concepts that helped put the United States space program into its current state of stagnation. Some companies may simply continue to push the same Shuttle-derived comcepts that they developed for the HLV. Others may

start from scratch. One factor which may influence the content of the proposals is the Soviet Energia launch. It is likely to steer the proposals in the direction of very large vehicles, possibly even larger than the HLV concepts which the aerospace industry has already submitted.

Some wistful glances have even been cast in the direction of the old Saturn 5, but little is likely to come of it. There is nothing the U.S. government space program seems to loath more than the idea of using "Old Technology" to do a job (a trait not shared by the Soviets--most of their rockets are decades-old designs). In addition, much of the old tooling has been scrapped as part of a regular government disposal program, and many of the blueprints have been either lost or squirreled away somewhere in the bowels of the aerospace industry.

Still, the Saturn has its fans--even inside NASA. Dr. J. R. Thompson, director of the Marshall Space Flight Center (where the Saturn 5 was designed), has said that the Saturn could be resurrected and ready for engine test firings in as little as four to six years. Joseph E. Erbs, an engineer at Rockedyne (where the Saturn's huge F-1 engines were built) asserts that, despite the missing plans and tools, Rocketdyne has "everything needed to get started again."

As far as I know, no actual studies have been done comparing the cost of resurrecting the Saturn assembly lines with the cost of the government developing a completely new launcher with similar capabilities. Such a comparison might be instructive. Comparing the launch cost of a Saturn 5 rocket fresh off a full-scale production line with the $250 million that the Shuttle currently eats every time it flies (carrying only one-fifth the Saturn payload) might also be instructive--and possibly more than a little embarrassing. It just might turn out that old technology is the best technology after all.

I for one would be glad to see the Saturn 5 return, and not just because it might be able to improve America's position in space without excessively mauling the taxpayers. Unlike many others, I never got to see a Saturn 5 launch in person--especially at night--and I would really love to have another chance at it.

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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