



The X-20 Dyna Soar

by Andrew J. LePage
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Early Spaceplane Concepts

For the generation that grew up with the Space Shuttle, it is hard to imagine when near-panic swept the United States as a result of the Sputnik launches. But even 42 years ago, the basic technology needed for the Space Shuttle was already under development for some time. As early as April 17, 1952 Bell Aircraft - the makers of the famous X-1 rocket plane - proposed building an aerospace plane for the USAF.

Based on research done for Bell by German rocket experts Walter Dornberger and Krafft Ehricke, Bell's BoMi (for BOMber MIssile) concept called for a manned hypersonic glider to be launched on a large missile to deliver bombs to distant targets across the globe. BoMi borrowed heavily from the "Antipodal Bomber" concept first openly published on December 15, 1933 by German rocket expert Eugen Sanger. While Germany ceased development of Sanger's bomber in 1942, the needs of the Cold War gave the concept new life.

BoMi studies continued with varying degrees of support (and occasionally only with Bell's own funds) over the next four years. But the USAF was also interested in other types of missions for a long range hypersonic glider. In September of 1955, the USAF gave Bell a contract to apply its BoMi technology to a hypersonic reconnaissance aircraft known as System 118P. On March 20, 1956 the USAF combined Bell's BoMi and System 118P efforts and issued a contract for Reconnaissance System 459L also known by the code name "Brass Bell".

Even though BoMi was redirected into a reconnaissance system, the USAF was still interested in a rocket boosted hypersonic bomber as a logical combination of its strategic bomber and ICBM efforts. On December 19, 1955 the USAF formally asked industry to study the idea. Six aircraft companies responded and undertook internally

funded studies: Boeing, Convair, Douglas, McDonnell, North American, and Republic. On June 12, 1956 three of the companies - Convair, Douglas, and North American - were awarded six-month contracts for further studies under the name RoBo (ROcket BOMber).

But the USAF was not the only player in the field of hypersonic aircraft development. NASA's predecessor, NACA (National Advisory Committee on Aeronautics) had teams of scientists and engineers working on the problem of flight above 50 miles (80 kilometers) altitude and speeds in excess of Mach 10 as a result of a decision made by their Executive Committee on July 14, 1952. The first step meeting this mandate led to NACA participation in the X-15 program along with the USAF and US Navy (see **The First Reusable Spaceship** in the June 1, 1999 issue of *SpaceViews*). Because of their key role in technology development, in March of 1956 the USAF invited NACA to participate in their "Manned Glide Rocket Research System" under the aegis of the USAF's ARDC (Air Research and Development Command). Concurrent NACA participation in ARDC's parallel effort called "The Manned Ballistic Rocket Research System" later led to NASA's Mercury program in late 1958 (see **The Beginnings of America's Man in Space Program** in the October 1998 issue of *SpaceViews*).

By October 1, 1956 NACA scientists formally started examining X-15 follow-on concepts. The following month NACA reviewed hypersonic research at Bell and Boeing at the request of the USAF. In order to develop the technologies needed to support the Brass Bell and RoBo programs, on November 6, 1956 ARDC initiated a more generic research program called System 455L or "Hywards" (HYpersonic Weapon And Research and Development System). To support these initiatives, on February 14, 1957 NACA established the "Round Three" Steering

Committee (with "Rounds One" and "Two" being the early X-plane and X-15 efforts respectively) to study a hypersonic boost-glide research system as an X-15 follow-on.

Birth of Dyna Soar

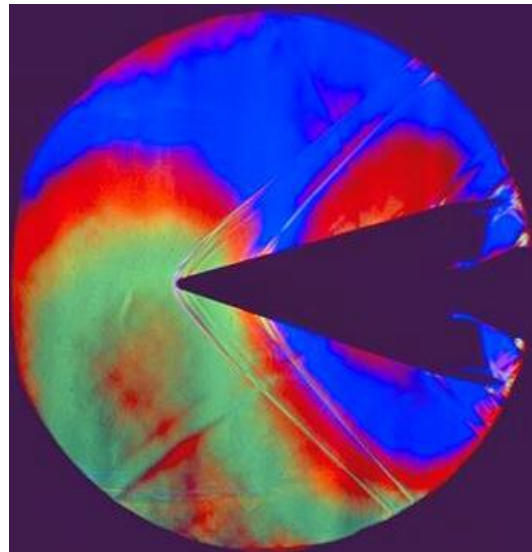
The launch of Sputnik on October 4, 1957 had an impact on all of the nation's space-related programs including the USAF hypersonic spaceplanes. Already aware for the need to consolidate its efforts, Sputnik spurred a review of hypersonic aircraft studies by the USAF and NACA on October 14, 1957. It was decided to combine Hywards, RoBo, and Brass Bell into one research program. Called Dyna Soar (for DYNAMIC SOARING), this was the long needed program to explore the questions of high altitude hypersonic flight. The following day the USAF approved the program and the NACA Hypersonic Research Steering Committee met at Ames Aeronautical Laboratory (now NASA Ames Research Center) to determine future direction of the new program.

On December 21, 1957 ARDC issued the requirements for the first step of Dyna Soar called System 464L or simply "The Hypersonic Boost Glide Vehicle". On New Year's Day 1958 the USAF requested proposals for System 464L from 13 potential bidders. Finally in March of 1958 the Source Selection Board received proposals from nine of these companies - a Boeing-Vought team, Convair, Douglas, Lockheed, McDonnell, North American, Northrop, a Martin-Bell team, and Republic. Of these, the Boeing- and Martin-led efforts were deemed as most favorable. On June 16, 1958 these teams received Phase I development contracts to further refine their designs for Dyna Soar I.

Part of the reason for selection of Boeing and Martin was because of NACA input. A NACA team lead by John Becker of the Langley Aeronautical Laboratory (now NASA Langley Research Center) had determined that a small, relatively simple, radiatively cooled glider presented the least development risk. The Boeing and Martin concepts were the best match for this recommendation. In order to formalize NACA participation in the Dyna Soar program, a Memorandum of Understanding was signed with the USAF on May 20, 1958. A further agreement with NASA signed on November 14 stated that NASA would provide only technical advice and assistance. The fledgling space agency would put most of its effort into the Mercury program leaving the USAF with Dyna Soar.

But there still was much disagreement in the Department of Defense (DoD) and USAF about what Dyna Soar was. The Dyna Soar project office saw it becoming a viable military system for long range weapons delivery or reconnaissance but outside views differed. On April 23, 1959 DoD Director of Research and Engineering, Dr. H.F. York, proposed that Dyna Soar I should be considered as nothing more than a research and development tool. Contrary to the USAF vision for the program, York believed that Dyna Soar should be restricted to using existing rockets for sub-orbital tests only.

Over the coming months other divisions of the USAF weighed in with their opinions. In August the USAF Ballistic Missile Division decided that Dyna Soar I should be launched into orbit using the proposed Titan C. Based on the Titan I ICBM, this heavy lift version would evolve into the SOLTRAN (Solid Titan) or Titan III concept. With the Titan C still in the study phase, this proposal was largely rejected. This desire to eventually send Dyna Soar into orbit was reinforced by a USAF Space Division review completed on October 29.



NACA and later NASA have been active in developing hypersonic glider concepts since the 1950s. Here we see a wind tunnel test of a proposed X-20 Dyna Soar configuration. (NASA)

On November 1, 1959 (40 years ago this month) Dyna Soar's three-step development plan was completed. The first step would use the Titan I to boost the glider on sub-orbital test flights. In the next step, a yet to be developed launch vehicle would boost Dyna Soar into orbit. Already this configuration would possess some minimal military capability. Full military capability would be

provided in the third step. Here a Titan III was proposed to be used to launch a payload-laden Dyna Soar into orbit for an extended mission.

When this plan was approved by the USAF Weapons Board the following day, the Dyna Soar program quickly came into focus. On November 9 Boeing was selected as the prime contractor of the glider. On November 17 the USAF formally designated the program System 620A. While the Martin-Bell team lost, Martin did not totally lose out. The Martin-Bell proposal to use the Martin's Titan I as the launch vehicle for the Dyna Soar sub-orbital test flights was accepted. On December 11, 1959 Martin was formally selected to provide modified Titan rockets for the program.

The Plan

The a more detailed development plan was released by the Dyna Soar program office on April 1, 1960. Step I would start with 20 air-launched test flights from a modified B-52 starting in July 1963. A series of five unmanned sub-orbital test flights using the Titan I would follow starting in November 1963. The last part of Step I called for 11 manned test flights launched from Cape Canaveral and landing at four different sites as far away as Brazil. Step II would gather data on orbital operations eventually leading to an interim reconnaissance and satellite inspection capabilities. A fully operational system was still the goal of Step III. After passing its first design review on October 27, 1960, the USAF signed a contract ordering 10 "production" aircraft with deliveries starting in 1965.

But throughout 1960 the delta-winged Dyna Soar design continued to gain weight - up to the 3600 to 4500 kilogram (8000 to 10,000 pound) range. With still more weight added from required modifications to the Titan I, it was becoming apparent a more powerful launch vehicle was needed. In October the larger Titan II (in development since 1959) was proposed as the new sub-orbital booster for Dyna Soar. On January 13, 1961 the USAF approved the change. But even more changes were still in store for the program.

With the launch of Yuri Gagarin into orbit on April 12, 1961, efforts were made to streamline the Dyna Soar program to get into orbit as soon as possible. This included making drastic changes to the development schedule and consideration of other boosters including NASA's Saturn I. But a consensus was quickly reached that the Titan III was the best choice. Since the Titan III was a Titan II with a pair

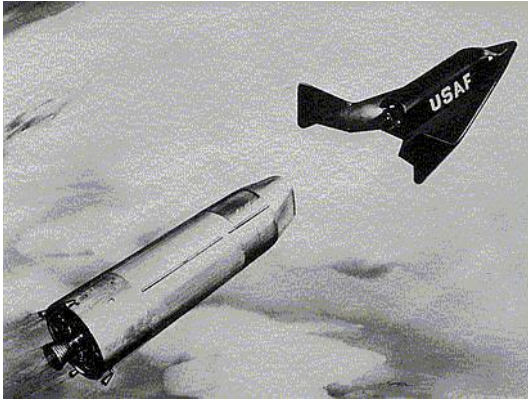
of 120-inch (3-meter) solid motors attached, the switch required minimal design changes for Dyna Soar. The Titan III also included an extra stage called the Transtage which would provide Dyna Soar with some impressive orbital capabilities.



Early plans for the X-20 Dyna Soar called for sub-orbital tests using a modified Titan I ICBM. (USAF)

On September 11, 1961 USAF and NASA officials reviewed Boeing's full scale mockup of Dyna Soar. They were satisfied with the design and ordered only minor changes. The final design had a total length of 10.8 meters (35.3 feet) and was 3 meters (10 feet) across at the base of its conical adapter where it was connected to the Transtage. The highly swept delta wings had a wing span of 6.4 meters (20.8 feet) and a maximum thickness of 51 centimeters (20 inches). Most of the aircraft structure was made of Rene 41 steel that could withstand temperatures of 980 C

(1800 F). Other exotic alloys and ceramics protected selected parts of the aircraft such as the leading edges and nose. The cockpit was large enough for a single pilot although the 2.1 cubic meters (75 cubic foot) cargo compartment behind him could be adapted to carry a passenger in the future. Carrying a maximum payload of 450 kilogram (1000 pounds), the Dyna Soar would weigh 5170 kilograms (11,390 pounds) at launch.



After being released from its booster, the X-20 Dyna Soar would investigate dynamic hypersonic reentry for the first time in hopes of developing a glider with military applications. (USAF)

On September 29 the USAF awarded contracts to Boeing and other contractors to accelerate the program. A restructured plan released on October 7 officially eliminated all the sub-orbital test flights and cut the number of air-launch tests to 15. The first unmanned orbital mission was planned for November 1964 with the first piloted flights in May 1965. These 107 minute long flights would be launched from Cape Canaveral, reach a peak speed of 26,820 kilometers per hour (16,670 mph), and return to Earth at Edwards AFB experiencing maximum temperatures of 1650 C (3000 F) during reentry. Use of the Transtage would allow longer missions to be performed in the future. Finally on December 28, 1961 the Titan III was officially selected as the launch vehicle. On October 27 the whole program was officially accelerated.

This restructuring of the program also changed its nature - Dyna Soar was now seen as a research and

development program which could evolve into a military system. On February 23, 1962 Secretary of Defense Robert S. McNamara approved the changes. In keeping with its new status, a more suitable designation was sought. On June 19 the USAF selected "X-20" - a moniker that would be used in conjunction with the original name, "Dyna Soar" . With great expectations for the future, six pilots for the X-20 were selected on September 19, 1962. All were USAF pilots save for NASA's Milt Thompson who had been previously involved in the X-15 program.

Despite the progress made in the X-20 program, trouble loomed on the horizon as 1963 approached. Too many started comparing the one-man X-20 to NASA's two-man Gemini then under development. Some began to view the X-20 as an expensive alternative to other manned systems that should be eliminated. As a result, 1963 would prove to be a fateful year not only for Dyna Soar but the future USAF presence in space.

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