DYNA-SOAR PROGRAM STATUS

By Col. W. L. Moore, USAF
Wright Air Development Division

This conference has thus far been devoted to the presentation of results of generalized research in a broad field of lifting, manned, hypervelocity, and reentry vehicles. For the rest of the conference, discussions will be focused on Dyna-Soar. This joint U. S. Air Force-NASA program is the embodiment of the general scientific knowledge available to date in terms of a specific system development effort. In order to set the stage for the ensuing presentation of the engineering foundation derived from the Dyna-Soar program, a brief review will be given of the overall program objectives, the Dyna-Soar system requirements, and the program status. As is well known, considerable scientific thinking and interest were generated in boost glide and lifting reentry by such projects as ROBO, BRASSBELL, BOMI, and HYWARDS. Many of the ideas and objectives of these programs were incorporated in the Dyna-Soar program, and in January 1958, a large section of industry was involved in preliminary proposals for doing the job. In July 1958, the competitive field was narrowed to two companies - Martin and Boeing. This phase I competition continued through an Air Force-NASA source-selection evaluation which was completed in June 1959. For several reasons, the results of the source-selection activity were not made known until November 1959. Now, at this point the project itself will be discussed and subsequently further remarks as to its status will be made.

The fundamental objective of the Dyna-Soar program is to establish a technological basis for the development of future military weapon systems. The particular nature of these future systems is not presently fully known. Considerable research effort has already gone into the problem of space military application and will continue throughout the program. Dyna-Soar, as a military test system, will help crystallize the mission characteristics of these future weapon systems. These future systems operating in the hypersonic and orbital regimes should exploit the inherent potential of the atmosphere and the intrinsic capability of man used in an active role in the judgment and command loops. The desired technological basis, which is needed as a springboard to achieve future military capabilities, has placed certain specific requirements on the nature of the Dyna-Soar system, as follows:

[redacted]

(1) It must be piloted. The term "piloted" is used in opposition to "manned" to denote the active role that the operator would play in the operation of the system.

(2) Dyna-Soar must be capable of a controlled landing. This requirement stems from operational considerations - the necessity to return from orbit to touchdown on a routine basis.

(3) The system must be capable of exploring a sufficiently large spectrum of hypersonic regimes in order to provide data which can be extrapolated for the design of future systems.

(4) Dyna-Soar must be maneuverable not only for providing flexibility of operation but also as a corollary to its data acquisition capability.

(5) Dyna-Soar must be able to test military equipment and the man-machine relationship.

(6) Dyna-Soar must achieve orbital capability.

The last-mentioned item is underlined to separate the requirements listed in items 1 to 5, which are illustrative of what can be done now in terms of available booster capability, from that of item 6, which will be done in the future when larger boosters become available.

The overall Dyna-Soar program can be viewed as consisting of three major steps:

(1) Step I is the development and test of the glider in conjunction with a modified Titan ICBM. The test program in Step I would consist of, first, air drops at Edwards Air Force Base, then ground launches on the Atlantic Missile Range, unmanned initially, then manned.

(2) During Step II, the same glider boosted by a larger booster would achieve global and orbital flight. At the end of Step II, an interim operational capability could be realized through the use of available equipment.

(3) Step III is the development of a fully operational weapon system based on the technology derived from the Dyna-Soar program in view of existing military requirements.

As of November 1959, the configuration shown as figure 1 is the one planned for use in Dyna-Soar Step I. Shown is the Boeing glider with a lift-drag ratio L/D of about 2 mounted on the modified version of the SM-68 Titan booster. The modifications consisted primarily of the fins for stability and increased wall thickness to withstand increased bending moments caused by the glider.

[redacted]

The status of Dyna-Soar since November is shown in the following table:

PROGRAM STATUS

Program approved, November 1959

Contractors selected, November 1959
- Boeing
- Martin

Further study directed by USAF
- Phase Alpha

Aero-Space vehicle panel briefed, December 2, 1959
- Dyna-Soar program
- Proposed Phase Alpha study

Phase Alpha started, December 11, 1959

Aero-Space vehicle panel briefed, March 28, 1960

Report study results to ASAF, April 8, 1960

After the three-step program was approved by Headquarters, U. S. Air Force, source-selection results were announced. Based on the preliminary design competition between two teams of contractors, the Boeing Airplane Company was selected in November 1959 as the major contractor responsible for the glider and The Martin Company as the associate booster contractor. Then, in consonance with direction from Headquarters, USAF, a preliminary study phase, Phase Alpha of Step I, was initiated on December 11, 1959, and was completed on March 11, 1960. Note that the Aerospace Vehicle Panel of the Scientific Advisory Board was briefed concerning the Phase Alpha study before it began and then again at the end of March on the study results. The results of the study and a recommended program plan were presented to the Assistant Secretary for Research and Development April 8, 1960. The objectives of Phase Alpha are as follows:

(1) To identify the technical problem areas associated with the development of Dyna-Soar.

(2) To formulate a systematic plan of attack to cope with these problem areas.

[redacted]

(3) To define the developmental test program which would be required. Particular emphasis was placed on the areas of aerodynamics, structures, and materials.

In order to analyze these general problems in terms of required specifics, various system designs were studied with an assessment for each of the degree of technical risk involved, the nature of the developmental tests which would be required, the value of that design with respect to the program objectives, and the time and cost of such programs. On the basis of these various system design studies, the best system approach could then be selected in terms of a general configuration and an associated program plan. The scope of the effort comprising Phase Alpha is illustrated in the following list of the organizations that were involved:

Configuration studies by:		
Contractors		Air Force
AVCO Bell Boeing	Chance Vought Lockheed McDonnell	WADD/ASC

Technical assistance from:
NASA General Electric Goodyear

Booster application studies by:
Boeing BMD/STL Martin Aerojet

Specific system design studies were completed by the contractors named in the first block, as well as by the Air Force. Technical assistance was provided by NASA in all of these endeavors and in certain specific areas by the two contractors named. Under the direction of the Air Force Ballistic Missile Division and Space Technology Laboratories, Boeing, Martin, and Aerojet have completed booster application studies.

[redacted]

Phase Alpha has resulted in the selection of a general configuration and the establishment of a preliminary program plan. The Air Force has selected a configuration having a medium L/D - that is, an L/D of 1.5 to 2.5 - and a wing loading of less than 30 pounds per square foot. The program plan as of this date is up for approval in the Pentagon.

The plan for the remainder of the Dyna-Soar presentation at this conference is as follows: Phase Alpha results will be presented by Boeing personnel, then Boeing, Air Force, and NASA personnel will discuss pertinent information on the Phase I design evolution. After this there will be an Air Force summation of the selected approach for Dyna-Soar and the program plan.

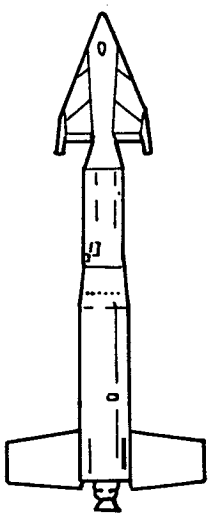
Before these discussions are begun, two points should be made clear:

(1) The Dyna-Soar program is not intended to advance the state of the art in boosters; so most of the discussions will concern the glider.

(2) Even though major contributions to Dyna-Soar have been made by others in industry - Chance Vought, Martin, Bell, for example - presentation sources have been restricted to the Air Force, NASA, and Boeing in deference to subcontractor competitions yet to come.

[redacted]

DYNA SOAR
STEP I



WEIGHT
236,500 LBS

THRUST
300,000 LBS

Figure 1

[redacted]