United States General Accounting Office

GAO Testimony

For Release
on Delivery
Expected at
9:30 a.m. EST
Wednesday
August 2, 1989

Investment in Foreign Aerospace Vehicle Research and Technological Development Efforts

Statement of
Harry R. Finley, Director, Air Force Issues
National Security and International Affairs
Division

Before the
Subcommittee on Transportation, Aviation, and
Materials
Committee on Science, Space, and Technology
and the Subcommittee on Research and Development
Committee on Armed Services
House of Representatives

Chairman Valentine, Chairman Dellums, and Members of the Subcommittees:

I am pleased to be here today to discuss the preliminary results of our review of foreign aerospace investment.

In our April 1988 report, National Aero-Space Plane: A Technology Development and Demonstration Program to Build the X-30 (GAO/NSIAD-88-122, Apr. 27, 1988), we concluded that the $3.3 billion National Aero-Space Plane (NASP) Program is technologically challenging and a high-risk program. However, the potential payoffs are also high. We noted that although the program's schedule and milestones may ultimately be achievable, they are ambitious and leave little room to accommodate potential design and integration problems or test failures. If any one of the enabling technologies does not mature as quickly as expected, the entire program could be delayed. We also reported that the United Kingdom, France, West Germany, the Soviet Union, and Japan are each developing technologies for their own concept of an operational aerospace plane.

As a result, the Chairman of the House Committee on Science, Space, and Technology asked us to collect information on foreign government and industry investment in aerospace vehicle research and technological development efforts. Our review included France, West Germany, the United Kingdom, the Soviet Union, and Japan,

since each of these countries is developing technologies for various concepts of operational aerospace vehicles. In addition, we obtained information on aerospace test facilities (such as wind tunnels) in the Netherlands, Belgium, Italy, and Australia. Although these countries do not have national programs to develop and build air-breathing aerospace vehicles, their test facilities are being used to conduct research and development of such vehicles.

During our review work in Europe, Japan, and Australia, we met with U.S. Embassy; international organization; and foreign government, industry, and university officials to obtain information on aerospace goals and objectives, current aerospace vehicle programs, technological challenges, government and industry funding, test facilities, future air-breathing aerospace vehicle efforts, and prospects for international cooperation. We also visited key test facilities (such as wind tunnels; shock tunnels; air-breathing propulsion test cells; advanced materials research, development, production, and fabrication laboratories; and supercomputer facilities) in each country. We are presently analyzing the information. At this point I would like to summarize our preliminary observations regarding Europe, Japan, and Australia. Since we have not progressed far enough on our assessment of aerospace investment in the Soviet Union, we are not including the Soviet Union in our preliminary observations.

PRELIMINARY OBSERVATIONS

We found the following.

-- Foreign countries are developing the technologies needed for various concepts of operational aerospace vehicles to secure independent access to space, reduce the costs of launching payloads into orbit, and ensure a competitive role in future high-speed commercial transport markets.

-- No European or Japanese aerospace technology development program is as technologically challenging as the NASP Program in terms of a single-stage-to-orbit space launch capability and an air-breathing propulsion system using a supersonic combustion ramjet (scramjet). No European or Japanese program compares to the scope of the NASP Program. However, foreign countries are making progress in the development of enabling technologies (particularly in advanced propulsion and advanced materials).

-- No European country or Japan has officially approved any plan to build a spaceplane. The United States also has not approved such a plan. Foreign aerospace vehicle programs are concept or system studies and consist of fundamental research on enabling technologies.

-- Levels of investment in aerospace vehicle research and technological development by European and Japanese governments and industry to date are significantly less than U.S. government and industry investment in the NASP Program. Planned U.S. government and industry funding levels also appear to be substantially greater than planned European and Japanese government and industry funding levels.

-- According to foreign government officials and industry representatives, test facilities (such as wind tunnels and air-breathing propulsion test cells) are adequate for fundamental research and the current level of effort in Europe and Japan, but the facilities are not adequate for large-scale testing or development of a spaceplane.

-- No European country or Japan appears likely to develop and build a spaceplane by itself because of the extensive technology and funding requirements. Building a future European spaceplane will probably be an international effort, most likely under the European Space Agency (ESA). Any future Japanese spaceplane will also probably be an international effort.

-- Foreign government officials and industry representatives expressed interest in cooperating with the United States on the NASP Program, but they also expressed reservations about cooperative ventures with the United States. These include

their past experiences with the United States in other programs (such as the planned U.S. space station), the perception that NASP is a military program, potential military applications of a future NASP-derived operational vehicle, a reluctance by the United States to share its technology, strict U.S. export controls on the transfer of technology, and Japanese constitutional prohibitions against the military use of space. According to U.S. government and industry officials, areas in which foreign technology might be incorporated in the NASP Program include advanced propulsion and advanced materials as well as the use of foreign test facilities.

Let me now summarize our principal findings by country.

FRANCE

The Hermes spaceplane program, originally a French national program, was adopted by ESA. Hermes is being developed as a manned reusable shuttle-like reentry winged vehicle, which would not use an air-breathing propulsion system. Hermes would be launched by the Ariane 5 rocket booster, also under development, from ESA's Kourou Space Center in French Guiana. According to an ESA official, Hermes development costs are expected to total about $5 billion. French space agency officials told us that France plans to contribute approximately 45 percent of the $605 million Phase I (1988 to 1990) development cost. According to ESA and

French government officials, ESA plans to review the Hermes program before committing funds for Phase II development (1991 to 1998). Until Hermes becomes operational, France does not plan to develop an air-breathing aerospace vehicle.

According to French government officials, the French space agency provided about $10 million for a low-level, 3-year concept study (1986 to 1988) to assess various spaceplane concepts and technological requirements. These officials indicated that the French space agency may provide an additional $3 million to $4 million in 1989 to extend this technical evaluation by 1 year. In 1989 or 1990 France may decide on an initial 3-year (1990 to 1992) technology maturation program for an air-breathing aerospace vehicle--as long as it does not interfere with Hermes' budget.

As part of the French space agency's 3-year concept study, Avions Marcel Dassault-Breguet Aviation conducted a system study, known as STAR-H, to identify the most promising concepts and most critical technologies for a future air-breathing transportation system. STAR-H is not a spaceplane project, but rather an effort to build a reliable database. Aerospatiale also conducted a concept study of reusable space transportation systems called STS-2000. Two French propulsion companies and the National Office for Aerospace Studies and Research are currently conducting propulsion studies. French propulsion firms do not plan to begin evaluation of a scramjet until 1990.

FEDERAL REPUBLIC OF GERMANY

The West German Federal Ministry for Research and Technology provided about $8.5 million between 1982 and 1987 to conduct concept studies of a spaceplane. In 1988 West Germany initiated a Hypersonic Technology Program funded by the Federal Ministry for Research and Technology, which involves Dornier, Messerschmitt-Boelkow-Blohm (MBB), and Motoren- und Turbinen-Union. Phase I (1988 to 1992) is a West German national effort consisting of conceptual and technology studies. Phase II (1993 to 2000) will be an international effort to develop a flight demonstrator. Phase III (2001 to 2005) will involve flight tests of the demonstrator. MBB's Sanger II, a two-stage-to-orbit space launch vehicle using an air-breathing turboramjet, is the leading concept. West German officials hope that Sanger II will be adopted by ESA as a follow-on program to Hermes.

Phase I is expected to cost about $233 million, of which $174 million has been obligated. West German government officials said the Federal Ministry for Research and Technology plans to contribute about $125 million, and the German Aerospace Research Establishment, also a government agency, plans to provide about $49 million by 1992.

Universities in West Germany are also conducting research in hypersonics in a project coordinated with and complementary to the Hypersonic Technology Program.

West Germany is not considering scramjet propulsion because it is too expensive and too technologically challenging. West German industry representatives believe a two-stage-to-orbit vehicle using a turboramjet is the most efficient aerospace vehicle concept.

THE UNITED KINGDOM

The United Kingdom is also not developing an air-breathing aerospace vehicle. However, British Aerospace and Rolls-Royce are developing the Horizontal Takeoff and Landing (HOTOL) unmanned single-stage-to-orbit, fully recoverable, and reusable space launch vehicle. HOTOL would be launched by a rocket-powered wheeled-trolley or sled from a conventional runway. The British government believes industry should take the lead in conducting research and development of an aerospace vehicle.

The British National Space Centre funded a $3 million, 2-year (1986 to 1987) evaluation to prove the feasibility of HOTOL, but it withdrew all government funding for HOTOL as a British national program in 1988, citing HOTOL's cost and the need for international partners. The United Kingdom also withdrew its funding for ESA's Hermes spaceplane and Ariane 5 rocket booster programs because of

their costs. British space officials told us that they promised to reevaluate their participation in the HOTOL project in 1991 or 1992 "in a properly organized international venture" but stated that this is not a promise of renewed funding. British Aerospace is trying to obtain private funding within the United Kingdom and exploring opportunities for international cooperation in Europe and the United States.

JAPAN

Japan's objectives are to become a central player in world space development by establishing manned, permanent facilities in space and developing a space transport system. Japan does not have an established national research development plan to build a spaceplane. However, a coordinated advanced research effort by the Japanese government is being conducted on enabling technologies. The National Space Development Agency of Japan is developing a reusable, re-entry winged vehicle known as the H-II Orbiting Plane (HOPE), which will serve both as a technology demonstrator and operational vehicle. The Institute for Space and Astronautical Science is developing a reusable, single-stage, unmanned ballistic flight test vehicle called the Highly Maneuverable Experimental Space (HIMES) vehicle. This vehicle will serve as a recoverable sounding rocket and as a test bed for hypersonic flight and air-breathing engines. The National Aerospace Laboratory is

conducting fundamental research on single-stage-to-orbit and two-stage-to-orbit spaceplane concepts.

Japanese Ministry of International Trade and Industry officials estimate that all Japanese spaceplane activities over the next 15 years could total $2.34 billion to $3.12 billion. According to Japanese government and industry officials, test facilities in Japan are adequate for fundamental research but not for large-scale testing or development of a spaceplane. To increase their expertise, Japanese officials said that they duplicate past U.S. tests to gain experience in hypersonics.

Japanese officials view spaceplane development as an international effort and are primarily interested in cooperating with the United States. However, Japan wants to raise its technology level to international standards first. According to U.S. government and industry officials, potential areas for international collaboration are in advanced propulsion and advanced materials.

AUSTRALIA

Australia is developing expertise in selected subsystems for air-breathing aerospace vehicles. Australia has unique test facilities--the T-3 and T-4 shock tunnels--that have the capability to simulate actual flight conditions above Mach 5. The T-4 shock tunnel was built specifically to test scramjets. These facilities

are currently being used to test the United Kingdom's HOTOL, ESA's Hermes, West Germany's Sanger II, and scramjet combustion mixing for the National Aeronautics and Space Administration. The Australian government and industry funded a 15-month feasibility study of the proposed Cape York Spaceport, which will accommodate future spaceplanes. A consortium of business interests in Australia, the United States, and Japan recently announced that the international spaceport was "commercially viable" and that it plans to proceed with the project as soon as possible.

Over the next several months, we plan to issue a series of reports on aerospace investment in foreign countries. Our draft report on Foreign Aerospace Investment: Technical Data and Information on Test Facilities has been sent to agencies for comments. Subsequent reports will address aerospace investment in France, West Germany, the United Kingdom, Italy, the Soviet Union, Japan, and Australia, and our overall evaluation and conclusions.

This concludes my prepared testimony. We will be pleased to respond to any questions you may have.