THE ALTITUDE WIND TUNNEL PROJECT

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The need for a large, subsonic, propulsion wind tunnel with the capability to simulate adverse weather first began to surface in the late 1970's. NASA Lewis then undertook to further define the research requirements and to look at means to satisfy those requirements. NASA Langley, NASA Ames, and the Arnold Air Force Arnold Engineering Development Center (AEDC) assisted Lewis in evaluating alternative approaches. Along with conversion of existing facilities, one of the alternatives considered was the use of flight tests in lieu of ground-based facilities. Ground facilities are much preferred in that they reduce risk, allow more extensive measurements, provide reproducibilty of test conditions, and afford higher productivity. As an illustration, the French recently certified one of their helicopters for use in icing conditions -- the first in the free world to do so. It has taken them eight years and considerable funds to acquire the necessary data under naturally occurring conditions. The Lewis Research Center is currently advocating the rehabilitation of its Altitude Wind Tunnel (AWT) as a cost effective way to provide a facility with all the necessary capabilities. This assessment is concurred by the other participating centers.

Future new aircraft and propulsion systems will require wind tunnel test facilities with unique capabilities that currently are not available in this country. These advanced aircraft and propulsion systems are characterized by an unprecedented degree of integration and interaction between the airframe and the propulsion unit. This requires a facility capable of conducting research on the entire system, rather than on each component separately as has been done in the past. Examples of future, highly integrated systems are: high speed turboprops, highly maneuverable and/or short take-off and landing (STOL) aircraft, and convertible rotorcraft. In addition, emphasis will also be placed on increased aircraft operational capabililties, which means flying in bad weather conditions. These factors will require wind tunnel facilities that are large, simulate true altitude conditions (both pressure and temperature), permit the operation of a propulsion system, and can simulate adverse weather conditions (cold temperatures and injecting water). There is no large scale wind tunnel in the United States or the free world that provides these capabilities. The current design of the modified AWT being proposed by Lewis would provide all these capabilities. The AWT can also be used to perform some of the more traditional wind tunnel experiments and thus, can be utilized to relieve some of the burden on existing facilities. Further explanation of some of the future aircraft, their propulsion systems, and the need for a facility with these capabilities is included in the attached brochure. The brochure also contains a brief description of the proposed AWT design.

The need for the AWT and its capabilities has been endorsed by a significant number of knowledgable organizations including:

- Aeronautics and Space Engineering Board (ASEB)
- Aeronautics and Astronautics Coordinating Board (AACB)
- Federal Aviation Administration (FAA)
- Army
- Helicopter Association International (HAI)
- General Aviation Manufacturers Association (GAMA)
- Aerospace Industries Association of America (AIA)
- Civil Aviation Community
- Advisory Group for Aerospace Research and Development (AGARD)

In addition, the National Research Council (Aero Technology 2000 Report) has identified the need for "... a large variable density test facility specifically tailored for propulsion related testing. Such a facility should also be capable of meeting general testing requirements in other disciplines from acoustics to icing." The rehabilitated AWT would meet all these requirements. Many visits have been made to the members of the aeronautics industry discussing with them the proposed capabilities of AWT and the efforts underway at Lewis to ensure a technically sound design. These interactions have been beneficial to Lewis in that the industry needs and test requirements have been factored into the planning for the AWT. Letters of support have been received from a large number of these companies.

The construction or modification of a major facility entails certain risks -- uncertainties in the cost to complete and uncertainties that the facility will perform as intended. Lewis has adopted a two-pronged approach to control these risks. First, a very comprehensive Preliminary Engineering Report (PER) has been accomplished. This provides the basis for the cost of construction as well as the basis for final design. Recent experience with the development and construction of other major national facilities has been incorporated into the PER through the creation, by Lewis, of an interagency Technical Oversight Committee comprised of facility experts from the other NASA centers and the AEDC. Secondly, the risks are being controlled by an extensive in-house analytical and physical modeling effort drawing upon Lewis' expertise in internal computational flow analysis, dynamics and controls, aerodynamics, noise, and icing. The in-house efforts are very carefully planned so as to provide final design input in a timely fashion.

At this point, it is critical that a long-term commitment to this project be provided if the current impetus and orderly pace are to be maintained. Lewis is advocating a fiscal 1987 CoF (Construction of Facility) new start. Final design efforts would begin immediately after budget approval and construction would begin later in the year. As currently planned construction would take four years and be completed in 1991.