<table>
<thead>
<tr>
<th>EVENT</th>
<th>DATE</th>
<th>LARC DIRECTOR</th>
<th>AERO DIV.</th>
<th>OAST</th>
<th>NASA DEP. ADMIN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCEPTUAL STUDIES OF HI RN WIND TUNNELS</td>
<td>1967-1973</td>
<td>CORTRIGHT</td>
<td>L.JONES</td>
<td>JACKSON</td>
<td>LOW</td>
</tr>
<tr>
<td>LOCATION STUDY INJECTOR TUNNEL-ARC vs LARC</td>
<td>9/25/72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPROVAL TO BUILD PILOT CRYO TUNNEL</td>
<td>2/5/73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PILOT CRYO TUNNEL OPERATIONAL</td>
<td>9/73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LARC PROPOSAL FOR CRYOGENIC RESEARCH TUNNEL PER FUNDING</td>
<td>1/74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/19/74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AACB AERONAUTICAL FACILITIES SUBPANEL ESTAB.</td>
<td>11/1/74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NASA RTAC ENDORSEMENT OF THE NTF</td>
<td>11/21/74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AACB AERONAUTICAL FACILITIES SUBPANEL REPORT</td>
<td>5/10/75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOU NASA/DOD</td>
<td>6/21/75</td>
<td>HEARTH</td>
<td></td>
<td>LOVELACE (ACT)</td>
<td></td>
</tr>
<tr>
<td>NASA APPROVAL OF NTF AS $65M PROJECT</td>
<td>6/74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONGRESSIONAL APPROPRIATION OF FIRST INCREMENT OF FUNDING - FY 77</td>
<td>3/22/76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NASA REVIEW OF NTF PROJECT COST &amp; MANAGEMENT</td>
<td>3/77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NASA APPROVAL OF NTF AS $85M PROJECT</td>
<td>3/77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A/E COMPLETION OF PHASE III DESIGN</td>
<td>5/77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LOVELACE 8/25/78
CRYOGENIC WIND TUNNEL CONCEPT

HISTORY

1945

Theoretical investigation by R. Smelt, R.A.E., Farnborough, England, suggested that use of air at cryogenic temperatures would permit large reductions in tunnel size and drive power in achieving a given Reynolds number. (State-of-the-art precluded application of concept at that time.)

October 1971

M. Goodyear, past doctoral resident research associate at NASA-Langley, here from the University of Southampton, England, suggested the use of cryogenic test temperatures (while engaged in study of ways to increase test Reynolds number for tunnels of modest size using Magnetic Suspension and Balance Systems).

Theoretical study was continued at NASA-Langley to extend the analysis of Smelt.

November 1971

Under the direction of Harleth G. Wiley, Head of the Vehicle Dynamics Section of NASA-Langley, an experimental verification study was undertaken as a small joint venture of the research aeronautics group and the SE&O Directorate. The purpose was to verify theoretical advantages of cryogenic using a low speed existing 1/24-scale model of the Langley V/STOL Tunnel.

The tunnel has a 7" x 11" closed-throat test section, Mach no. range from 0 to 0.2 and was constructed of wood and plexiglass with fan blades of aluminated wood.

June 1972

The low speed (7" x 11") closed circuit wood tunnel had demonstrated theoretical advantages of the cryo tunnel concept over the 0 to 0.2 Mach no. range and over a temperature range from 140°F to -316°F.

September 1972

M. Goodyear and R. Kilgore, NASA-Langley, reported on the Low Speed High Reynolds Number Cryogenic Wind Tunnel Studies at the AIAA Seventh Aerodynamic Testing Conference held in Palo Alto, CA.

Langley Center Director presented a Special Achievement Award to the Cryogenic Tunnel Development Team of the High Speed Aircraft Division and the SE&O Directorate (Wiley, Goodyear, Kilgore, Adcock, Davenport, Hamlet*, Abbott*, and Moore*) *SE&O personnel.

Meanwhile NASA-Langley had for several years been involved with design studies of a High Reynolds Number Tunnel concept based on a high pressure blowdown configuration utilizing an ejector drive. This configuration was in close competition with a similar pressurized design concept being proposed and studied at Ames. AEDC was also proposing construction of a High Reynolds Number Tunnel based on the Ludwig tube concept. Even though a latecomer to the...
national competition for a High Reynolds Number Tunnel, the cryo tunnel had the clear advantages of long run time and in particular reduced model loading (dynamic pressure). Proposals were made at Langley to switch our position from the ejector drive to cryogenic. However, Langley research scientists were reluctant to switch approaches because actual test results had not been obtained under cryogenic conditions in the transonic speed range.

SE&O began investigating methods to provide further proof of concept. Several existing facilities were considered for conversion and various sizes were under consideration for new construction; however, all had the problem of long lead funding.

During discussions at the Ames Research Center, on Langley's and Ames' progress toward an ejector driven HRNT, the Director, SE&O concluded that immediate construction of a Pilot Model Cryogenic Tunnel was of sufficient importance to warrant a rather large expenditure of SE&O in-house manpower. Negotations between research personnel and SE&O resulted in a test section size compromise of 12" representing about the smallest size with which valid proof of concept data could be achieved and about the largest size that could be built in a timely manner and within the dollar and manpower constraints of LaRC.

November 1972 Go ahead given by Center Director to proceed with in-house Pilot Cryo Tunnel Project.


August 1973 LaRC submitted FY 1976 program to NASA Headquarters including High Reynolds Transonic Tunnel at $20M.

September 1973 Startup of Model Cryogenic Wind Tunnel.

Fluidyne Engineering Corporation completed a study on the "Application of Cryogenics to the Proposed High Reynolds Number Tunnel."
November 1973  Harlett Wiley reported to the LaRC Center Director on research test data obtained in the Pilot Cryo Tunnel that experimentally verified the theoretical advantages of the Cryogenic Tunnel concept. Ambient and cryogenic temperature tests were made in the same tunnel, on the same model, at identical Mach and Reynolds numbers. The pressure distribution along airfoil chord (of the model) was identical under both conditions, therefore, proving the cryogenic concept.

December 1974  Decision was made by NASA Headquarters to build High Reynolds Number Tunnel at LaRC.

January 1974  Decision was made to build closed circuit cryogenic tunnel.

The Ralph M. Parsons Company, in association with the FluiDyne Engineering Corporation was selected as the A/E for the PER, final design and construction management for the TRT.

April 1974  FluiDyne Engineering Corporation completed the study on "Insulation and Model Handling Conceptual Studies for the NASA Langley Research Center Proposed Cryogenic High Reynolds Number Tunnel."

Design of Transonic Diffuser Apparatus was started.

Contract was awarded to the A/E for PER and preliminary engineering.

July 1974  LaRC submitted FY 1976 program to NASA Headquarters including Transonic Research Tunnel at $25M.

September 1974  Contract was awarded to the A/E for Phase I of the contract for "A/E Services for Design of High Reynolds Number Transonic Research Tunnel." Phase II and III were negotiated as future options.


<table>
<thead>
<tr>
<th>HIRT and/or TRT</th>
<th>Location</th>
<th>Capability</th>
</tr>
</thead>
</table>

Industry Users Meeting on Transonic Tunnels at LaRC.

December 1974  Phase IA was awarded to the A/E to supplement Phase I with some work from Phase II.

A change was made to the A/E contract for an "Alternative Facilities Study on the High Reynolds Number Transonic Research Tunnel" to support the AACB.

February 1975  Operational checkout started on Transonic Diffuser Apparatus.

March 1975  The Facilities Review Subpanel of the AACB agreed to recommend to the AACB that the National Transonic Facility be constructed at Langley Research Center.

June 1975  Memo of Understanding between DOD and NASA for NASA to build the NTF at LaRC.

June 1975  Go-ahead given to A/E to update the PER for the NTF.

September 1975  NASA submittal to OMB for first years construction funds for $65M project.

October 1975  Go-ahead given to A/E to start Final Design for NTF.

November 1976  First construction contract (Demo, Piles & Foundations) awarded.

February 1977  NASA approved NTF as a $85M project.

June 1977  BX concurred with $85M project.

June 1978  A/E completed Phase III Final Design.