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TURBINE ENGINE HOT SECTION TECHNOLOGY (HOST) PROJECT

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The Hot Section Technology (HOST) Project is a NASA-sponsored endeavor to improve the durability of advanced gas turbine engines for commercial and military aircraft. Through improvements in the analytical models and life prediction systems, designs for future hot section components -- the combustor and turbine -- will be more accurately analyzed and will incorporate features required for longer life in the more hostile operating environment of high performance engines.

Started in 1981, the project has activities presently planned through 1989 with an estimated total cost of $50-million. While the focused research activities are necessarily analytical in nature, significant experimental testing is required for benchmark quality assessments as well as model verifications. The efforts are being conducted in-house at the NASA Lewis Research Center, under contracts at major domestic turbine engine manufacturers, and under grants to qualified universities. Currently, the contract and grant funding equals about 60-percent of the total.

At NASA Lewis Research Center, the HOST project is the major element in a project management and coordination office and serves as the focal point for advocacy, funding, technical coordination, and information exchange. This workshop serves as the primary vehicle for this last function; that is, to disseminate information and elicit the exchange of ideas among participants.

The activities of the HOST project are accomplished within six disciplines as shown in Figure 1. Management of the project's efforts is delegated to six Subproject Managers (Figure 2) in the following areas: Structural Analysis, Fatigue & Fracture, Surface Protection, Combustion, Turbine Heat Transfer, and High Temperature Instrumentation. Structural Analysis includes research into thermal mechanical load models, component geometry specific models, and 3-D inelastic analysis methods development. Fatigue and Fracture includes constitutive model development for both isotropic and anisotropic materials, including single crystal and directionally solidified forms. It also includes research in life prediction methods for creep-fatigue interactions, and elastoplastic crack propagation. The Surface Protection research includes studies of corrosion and oxidation phenomena, environmental mechanics models, and metallic and thermal barrier coating analysis method developments. The

Combustion work includes aerothermal model assessment and development, dilution jet modeling, high pressure flame radiation/heat flux testing, and development of a thermal structural cyclic test facility. The Turbine Heat Transfer area is studying 2-D and 3-D flow and heat transfer on airfoil external boundaries, emphasizing boundary layer transition and viscous modeling. It also investigates coolant passage heat transfer, including midchord jet impingement cooling and rotational passage effects. Instrumentation is being developed to obtain high temperature, benchmark quality data to develop and verify the analysis methods. These include flow sensors (LDV), heat flux sensors (thin film), strain sensors (1800^{o}F static thin film), gas temperature sensors (frequency compensated), and hot section optical viewing systems.

Schedules for activities under each discipline are shown in Figures 3-8. Because of the nature of the problem of durability, interdisciplinary cooperation is often required and the synergistic effects have proven to be beneficial. For example, researchers in combustors, high temperature instrumentation, and structural analysis are jointly investigating combustor liner behavior, modeling, and life prediction.

Workshop publications and most contractor final reports carry the label "For Early Domestic Dissemination" (FEDD) to protect national interests and, thus, are available only to qualified U.S. citizens. While several contractor final reports have been published recently, they represent initial phases of multi-phased work. Thus, aside from this annual workshop report, only a few reports are available at this time.

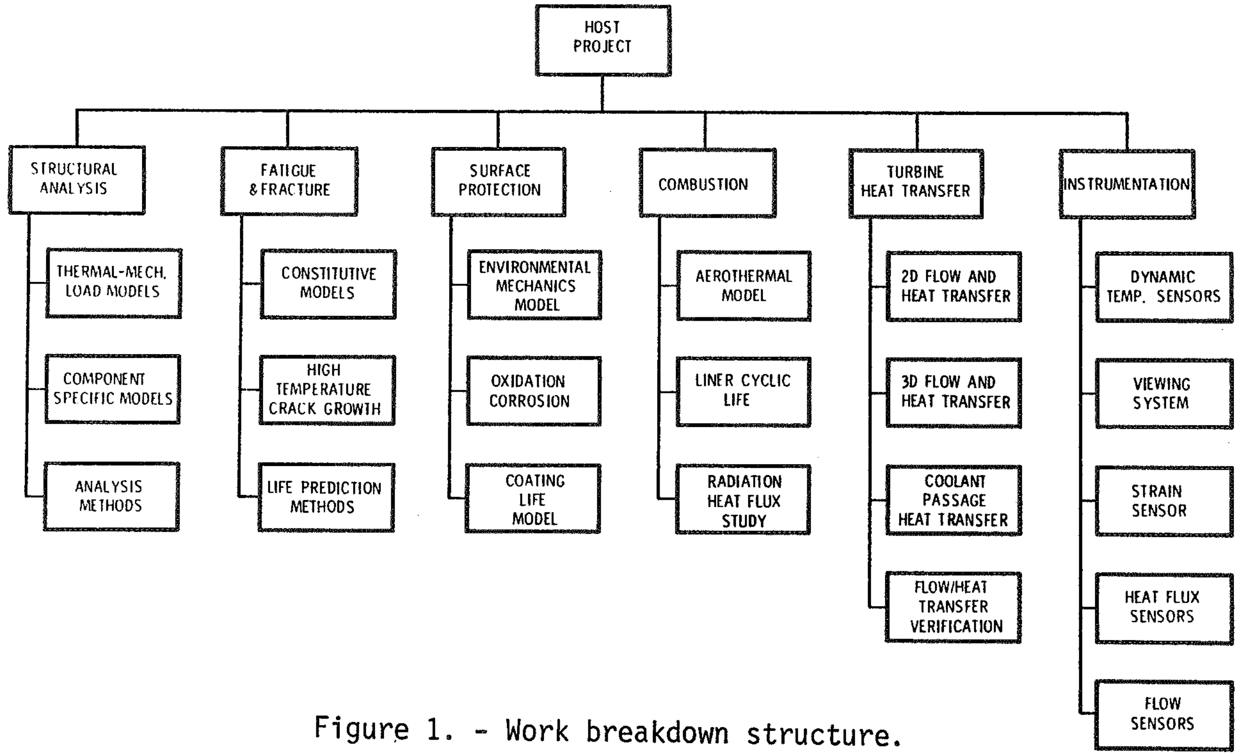

Figure 1. - Work breakdown structure.

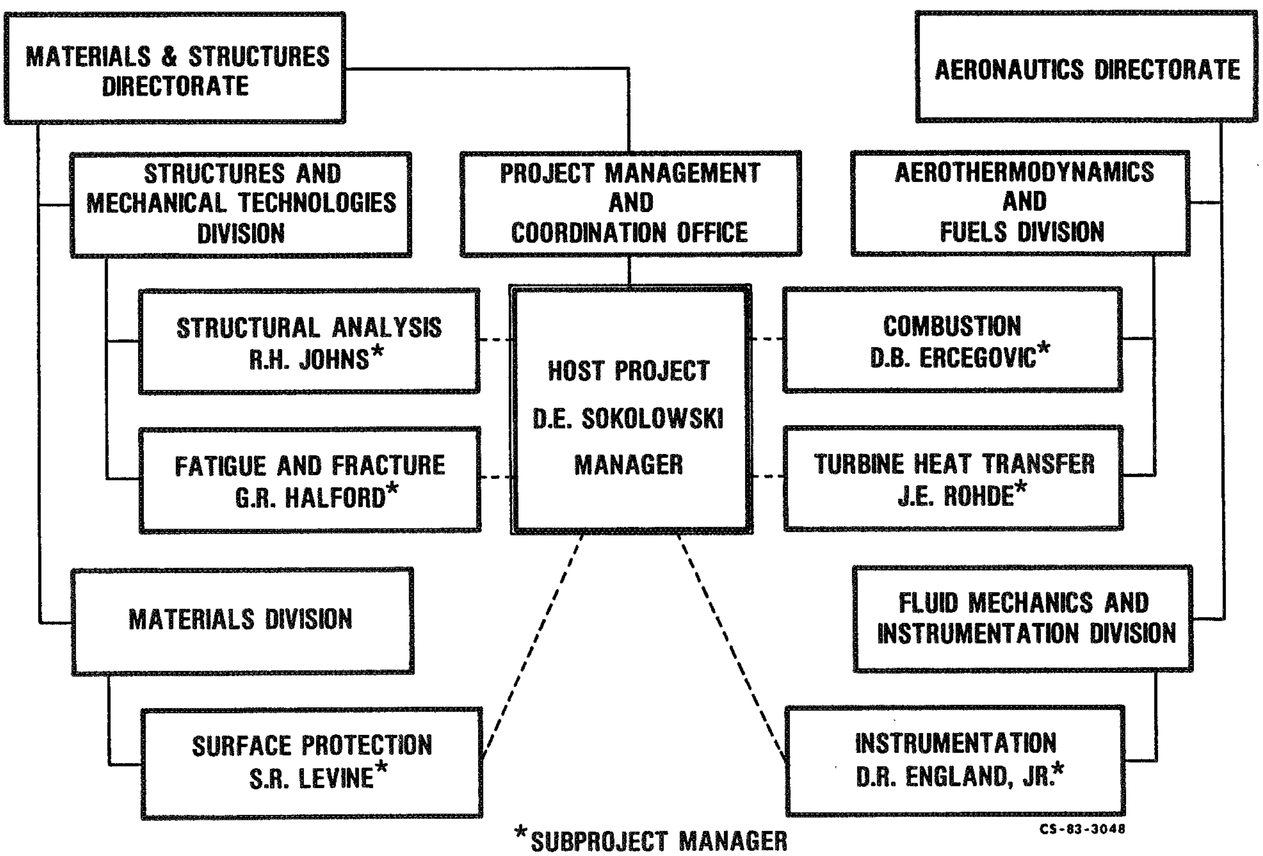

Figure 2. - Project office organization.

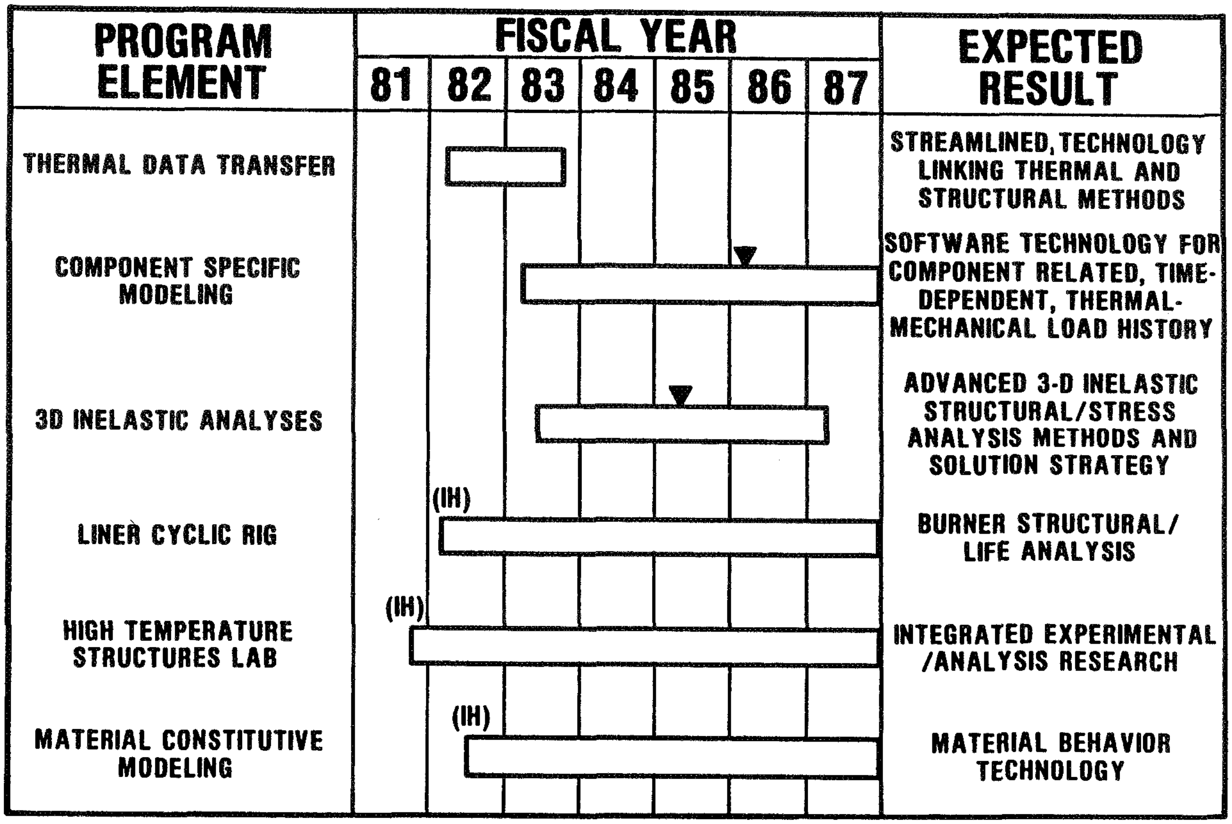

Figure 3. - Structural analysis.

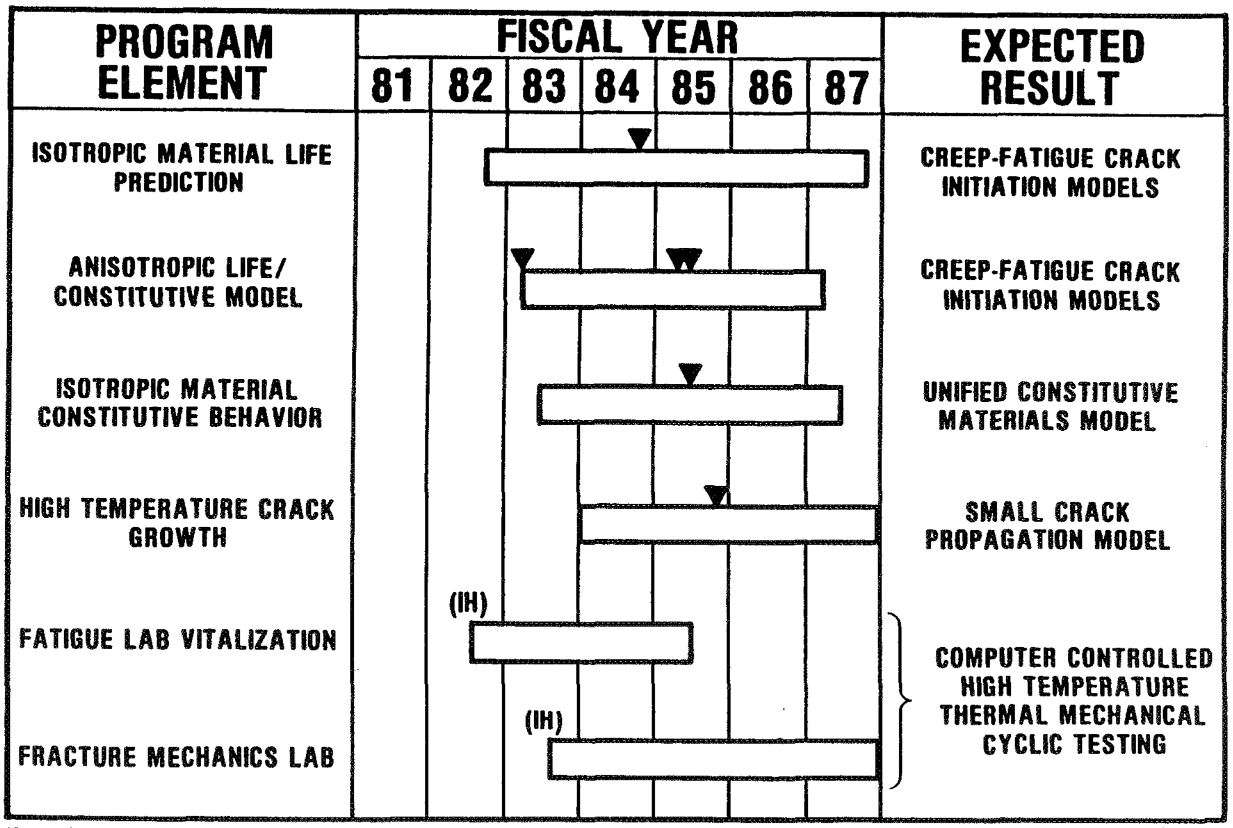

Figure 4. - Fatigue and fracture.

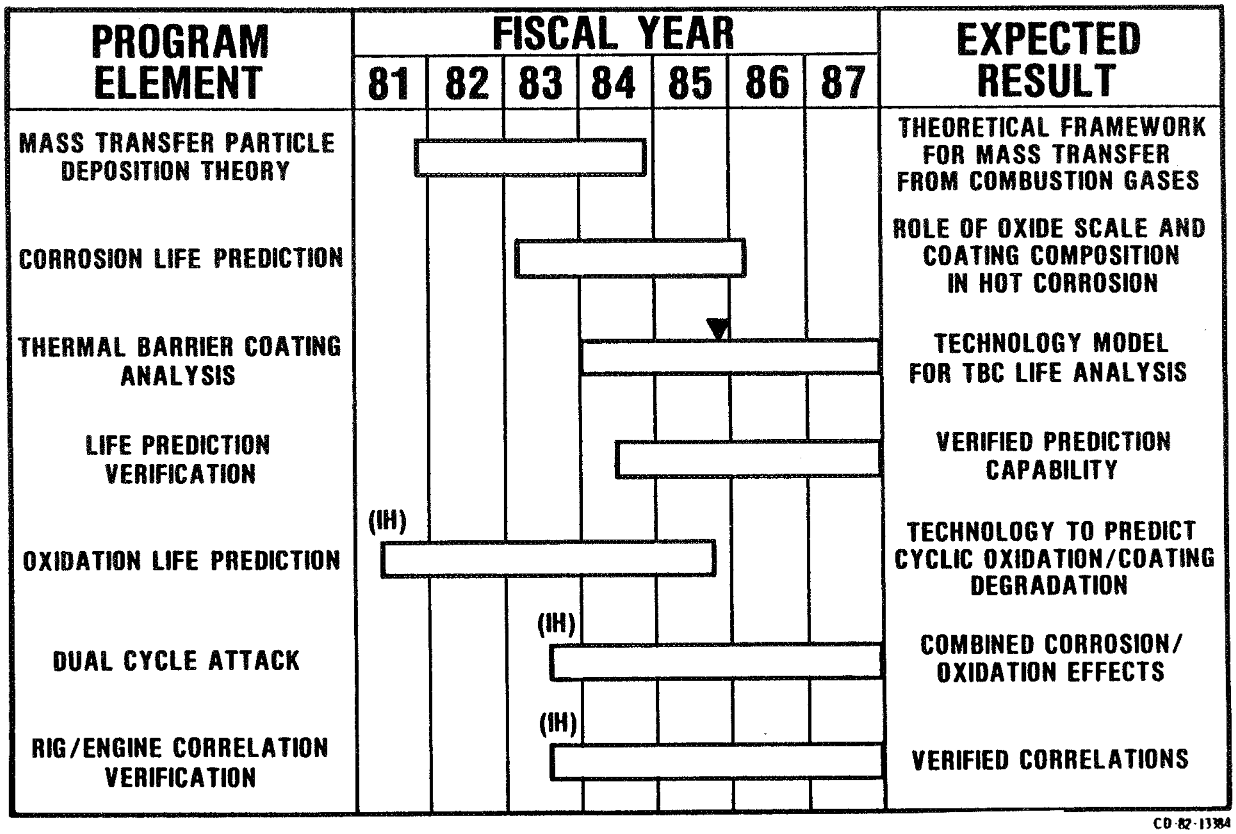

Figure 5. - Surface protection.

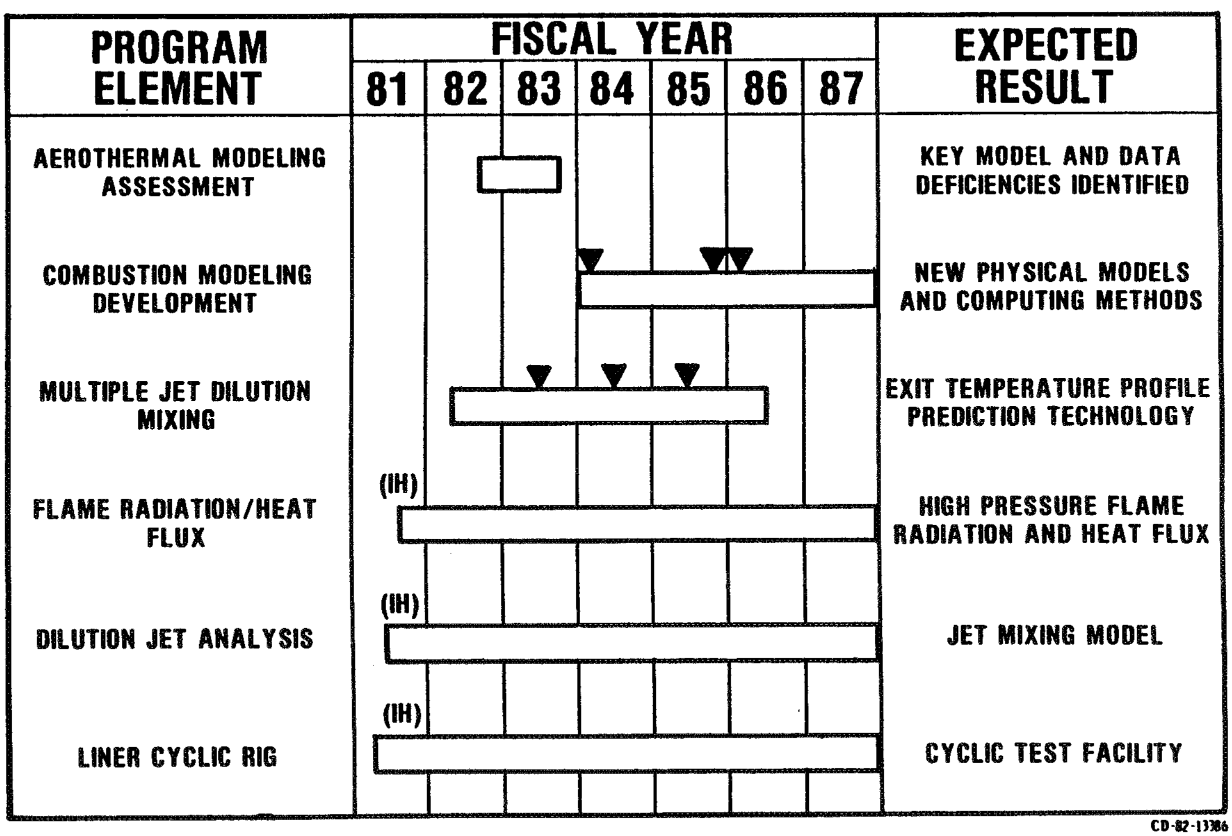

Figure 6. - Combustion.

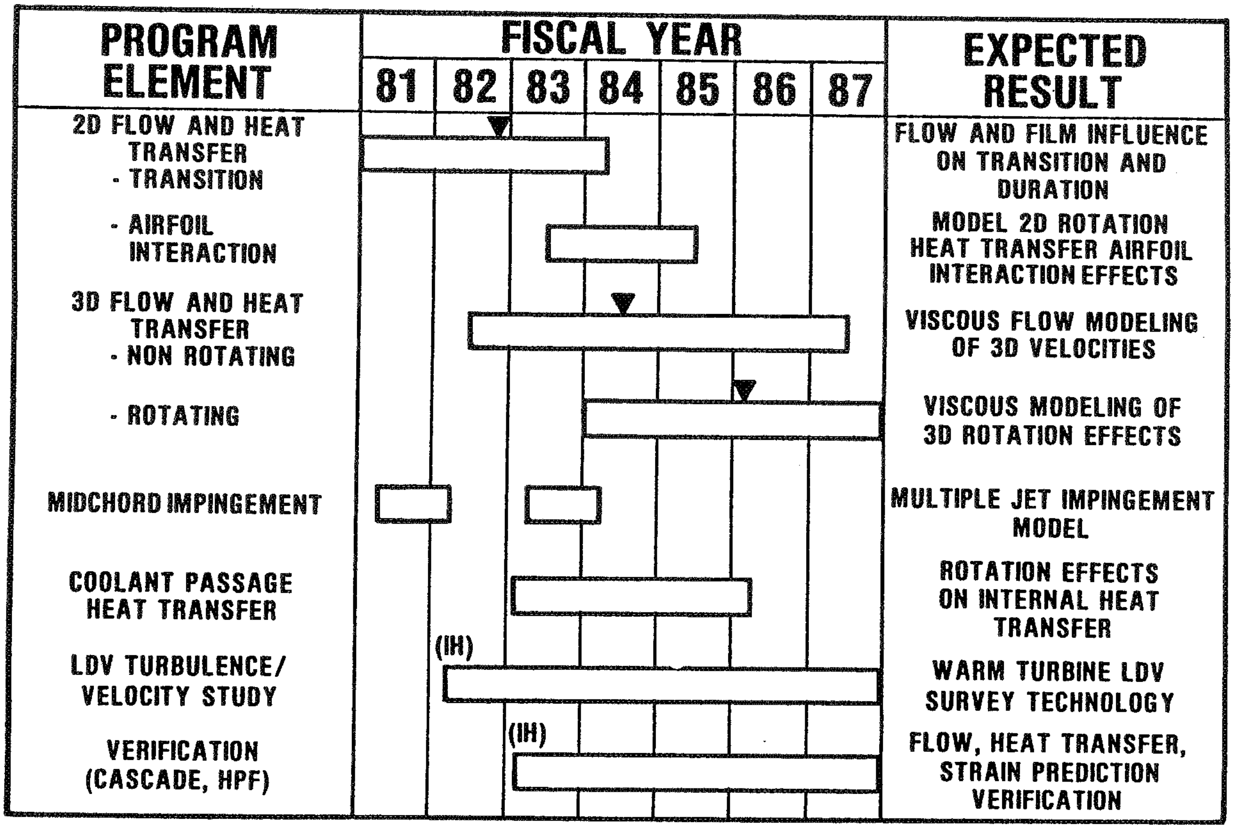

Figure 7. - Turbine heat transfer.

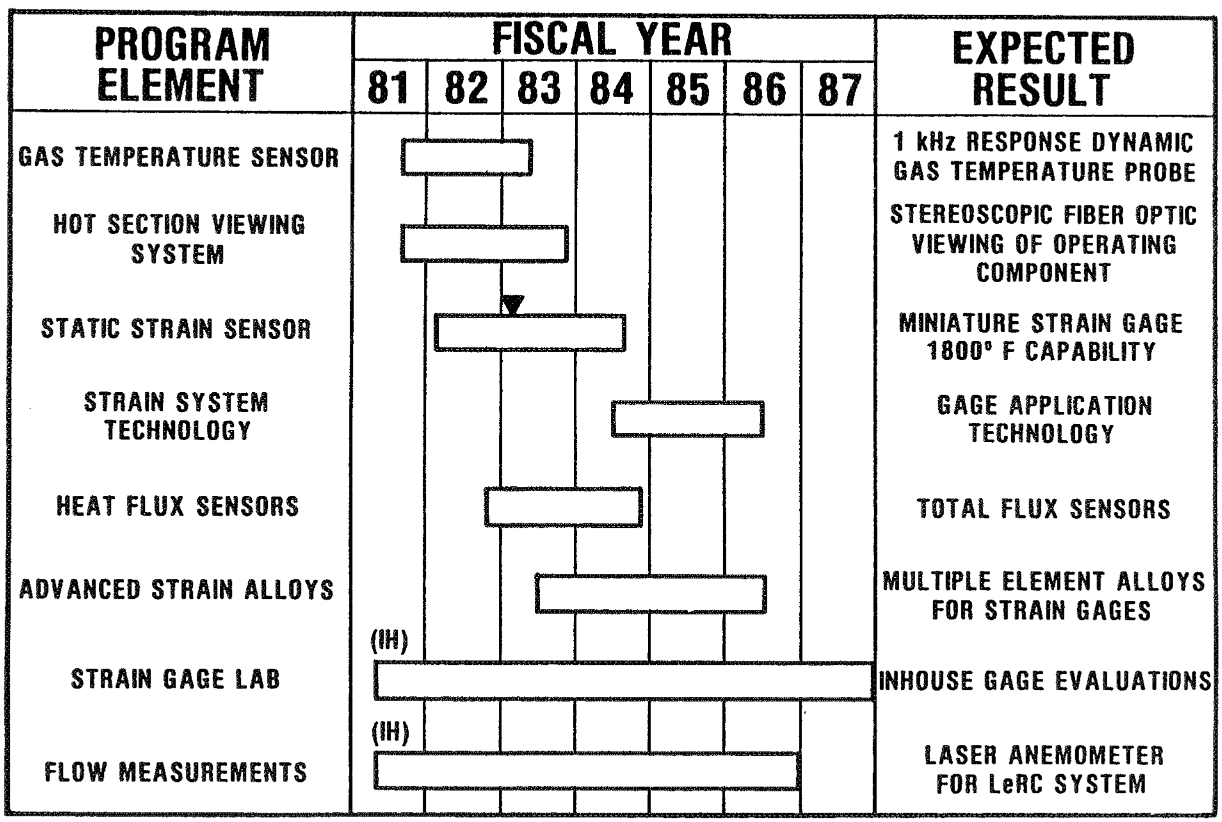

Figure 8. - Instrumentation.