LIFE PREDICTION AND CONSTITUTIVE BEHAVIOR -- OVERVIEW

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One of the primary drivers that prompted the initiation of the HOST Program was the recognized need for improved cyclic durability of costly hot section components. All too frequently, fatigue in one form or another was directly responsible for the less than desired durability and prospects for the future weren't going to improve unless a significant effort was mounted to increase our knowledge and understanding of the elements governing cyclic crack initiation and propagation lifetime. Certainly one of the important ingredients was the ability to perform accurate structural stress-strain analyses to determine the magnitudes of the localized stresses and strains since it is these localized conditions that govern the initiation and crack growth processes.

Consequently, the programs that evolved included high-temperature cyclic constitutive behavior work as well as cyclic life prediction methods development. Figure 1 lists the areas for which funding was sought. Our initial intent was to fund four programs, Life Prediction and Constitutive Modelling for Isotropic Materials and Life Prediction and Constitutive Modelling for Anisotropic Materials. The latter two have been combined into a single program for a number of technical and managerial reasons. Another change to our plans is the possibility of funding two contracts for the Constitutive Modelling of Isotropic Materials. This is largely because of the relative newness of this research area and the proliferation of competing theories.

Furthermore, additional funding has permitted us to pursue programs in the area of high temperature cyclic crack growth. Three such programs are in the planning stages: a contractual effort aimed at the problem of high temperature crack growth; and two University Grant activities, one being directed at the micromechanisms of high temperature crack growth, and the other involving an interdisciplinary approach to the overall problem of crack initiation, crack growth, and final fracture. Only the proposed contractual program will be discussed today. The University Grant programs will be reviewed next year. A milestone chart is shown in Figure 2 for the six contract and grant programs.

While the details of test programs will be given by the individuals that are intimately involved, I would like to emphasize the underlying objective of these programs: The development and verification of workable engineering methods for the calculation, in advance of service, of a) the local cyclic stress-strain response at the critical life governing location in typical hot section components, and b) the resultant cyclic crack initiation and crack growth lifetimes.

A contract has been in existance with Pratt & Whitney Aircraft since the first of June 1982, and the P&WA Project Manager, Vito Moreno, will be making the presentation covering that work. The other efforts will be described by the individuals responsible for creating the Request for Proposal Packages.

A Grant has been awarded to Professor H. W. Liu of Syracuse University for studies of the mechanisms of high temperature crack growth.

In addition, to the contract and grant programs, we are up-grading our in-house High Temperature Fatigue Laboratory capabilities as indicated in Figure 3.

FIG. 1

OVERVIEW

LIFE PREDICTION & CONSTITUTIVE BEHAVIOR

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- CYCLIC CRACK INITIATION
- CYCLIC CRACK GROWTH
- CYCLIC CONSTITUTIVE BEHAVIOR
- LeRC FATIGUE FACILITY UP-GRADING

FIG. 2

LIFE PREDICTION & CONSTITUTIVE MODELLING-CONTRACTS &GRANTS

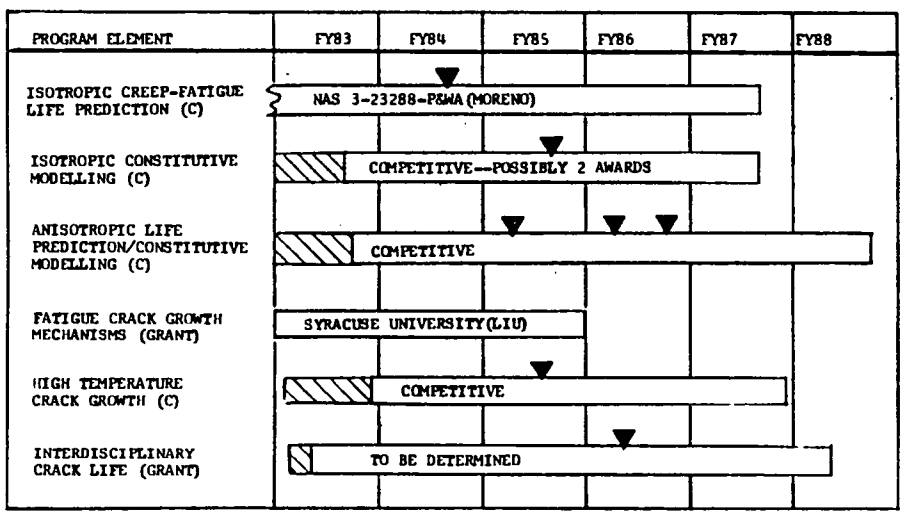

FIG. 3 FATIGUE FACILITY ENHANCEMENT

- Servo-Controlled Testing Machine/Hi-Temp Crack Growth
- Servo-Controlled Tension/Torsion Machines(3)-Biaxial Studies
- Host/Satellite Computer Installation
  - Data Acquisition/Processing/Storage/Retrieval
- HCF/LCF Machines-Cumulative Damage Studies