

LIFE PREDICTION AND CONSTITUTIVE BEHAVIOR

G. R. Halford
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135

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 factors is the ability to perform accurate structural stress-strain analyses on a routine basis to determine the magnitudes of the localized stresses and strains since it is these localized conditions that govern the initiation and crack growth processes. Developing the ability to more accurately predict crack initiation lifetimes and cyclic crack growth rates for the complex loading conditions found in turbine engine hot sections is of course the ultimate goal of the life prediction research efforts.

It has been found convenient to divide the research efforts into those dealing with nominally isotropic and anisotropic alloys; the latter for application to directionally solidified and single crystal turbine blades.

I do want to emphasize the underlying thrust of these programs: The development and verification of WORKABLE engineering methods for the calculation, in advance of service, of the local cyclic stress-strain response at the critical life governing location in hot section components, and the resultant cyclic crack initiation and crack growth lifetimes.

In attacking the problems, we are utilizing the talents of industry, universities, and the government. Figures 1 to 4 display the specific programs that have been initiated and funded by the HOST Project Office. Those programs that have been on-going long enough to permit progress to be reported will be presented by the respective principal investigators. The remaining programs will be briefly touched upon either by the NASA Lewis Technical Program Manager or by myself.

CRACK INITIATION LIFE PREDICTION AND CONSTITUTIVE MODELING

(NOMINALLY ISOTROPIC MATERIALS)

- CREEP-FATIGUE LIFE PREDICTION FOR ENGINE HOT SECTION MATERIALS (ISOTROPIC)

G. HALFORD, LERC TECHNICAL PROGRAM MANAGER

NAS 3-23288, PRATT & WHITNEY AIRCRAFT

V. MORENO, PRINCIPAL INVESTIGATOR

STARTED JUNE 1982

2 YEAR BASE PROGRAM/3 YEAR OPTIONAL PROGRAM

- CONSTITUTIVE MODELING FOR ISOTROPIC MATERIALS

A. KAUFMAN, LERC TECHNICAL PROGRAM MANAGER

DUAL AWARDED PROGRAM

NAS 3-23927, GENERAL ELECTRIC COMPANY

J. LAFLIN, PRINCIPAL INVESTIGATOR

STARTED MAY 1983

2 YEAR BASE PROGRAM/3 YEAR OPTIONAL PROGRAM

NAS 3-23925, SOUTHWEST RESEARCH INSTITUTE

U. LINDHOLM, PRINCIPAL INVESTIGATOR

STARTED MAY 1983

2 YEAR BASE PROGRAM/3 YEAR OPTIONAL PROGRAM

IN-HOUSE HOST PROGRAMS

- FATIGUE LABORATORY UPGRADING PROGRAM

M. MCGAW, LERC PROGRAM MANAGER

MULTIYEAR EFFORT

- REMODELING OF LABORATORY

- MASTER/SLAVE COMPUTER SYSTEM

- BIAXIAL FATIGUE FACILITY

- LCF/HCF FACILITY

- SINGLE CRYSTAL DURABILITY PROGRAM

G. HALFORD, LERC PROGRAM MANAGER

MULTIYEAR EFFORT

JOINT EFFORT WITH MATERIALS DIVISION

CRACK PROPAGATION LIFE PREDICTION MODELING

- HIGH TEMPERATURE CRACK PROPAGATION
T. ORANGE, LERC TECHNICAL PROGRAM MANAGER

2 YEAR BASE PROGRAM/2 YEAR OPTIONAL PROGRAM

- CRACK GROWTH MECHANISMS
J. SHANNON, LERC TECHNICAL PROGRAM MANAGER
NAG 3-348, SYRACUSE UNIVERSITY
PROF. H. LIU, PRINCIPAL INVESTIGATOR
STARTED OCTOBER 1982
3 YEAR GRANT PROGRAM

CRACK INITIATION LIFE PREDICTION AND CONSTITUTIVE MODELING (ANISOTROPIC MATERIALS)

- LIFE PREDICTION AND MATERIAL CONSTITUTIVE BEHAVIOR FOR ANISOTROPIC MATERIALS
R. BILL, LERC TECHNICAL PROGRAM MANAGER

5 YEAR BASE PROGRAM/2 OPTIONAL PROGRAMS PARALLEL WITH BASE

- THEORETICAL CONSTITUTIVE MODELING OF ANISOTROPIC MATERIALS
R. THOMPSON, LERC TECHNICAL PROGRAM MANAGER
DUAL AWARDED PROGRAM
NAG 3-XXX, UNIVERSITY OF CINCINNATI
PROF. D. STOUFFER, PRINCIPAL INVESTIGATOR
STARTED AUGUST 1983
3 YEAR GRANT PROGRAM

NAG 3-XXX, UNIVERSITY OF CONNECTICUT
PROF. E. JORDAN, PRINCIPAL INVESTIGATOR
STARTED SEPTEMBER 1983
3 YEAR GRANT PROGRAM