EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE

OVERVIEW

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This program concentrates on analyzing a limited number of hot corroded components from the field and the carrying out of a series of controlled laboratory experiments to establish the effects of oxide scale and coating chemistry on hot corrosion life. This is to be determined principally from the length of the incubation period, the investigation of the mechanisms of hot corrosion attack, and the fitting of the data generated from the test exposure experiments to an empirical life prediction model. It is a six task program.

GENERAL SCOPE OF WORK

Task I involves the analysis of six field components which were removed from service. The hot corrosion condition of these six will vary from slight to massive attack. Concurrent with the metallurgical analysis of field components in Task I, specimens of bare and coated alloys will be subjected in Task II to exposures in a high velocity burner rig (under conditions specified by NASA-LeRC) for not more than 1000 hours or until hot corrosion occurs. In Task III, the Contractor shall age specimens (bare and coated) in an inert atmosphere, in furnace oxidation (cyclic and isothermal), and in cyclic high velocity burner rig oxidation at 1100C (2012F) for 100, 300, 600, and 1000 hours. In Task IV, the Contractor shall determine the effect of the various aging treatments on the hot corrosion mechanisms involved under the burner rig conditions specified in Task II.

Throughout Tasks I through IV, the results should be viewed not only in terms of identifying a model for the actual materials and test conditions run, but from the point of view of identifying a methodology whereby a life prediction model for other materials can be developed based on the results of one or more simple laboratory tests. After all the test exposures, the Contractor will review all the data and provide: (1) a preliminary hot corrosion life prediction model and (2) a recommendation of other test parameters to be evaluated so that simple laboratory tests can be used to predict hot corrosion life. The methodology to develop a hot corrosion life prediction technique shall be submitted to the NASA Project Manager for review and approval.

In Task V, based on NASA Project Manager's approval, the Contractor shall complete an experiment to determine the capability of the suggested methodology to predict the hot corrosion life of selected alloys and coatings.

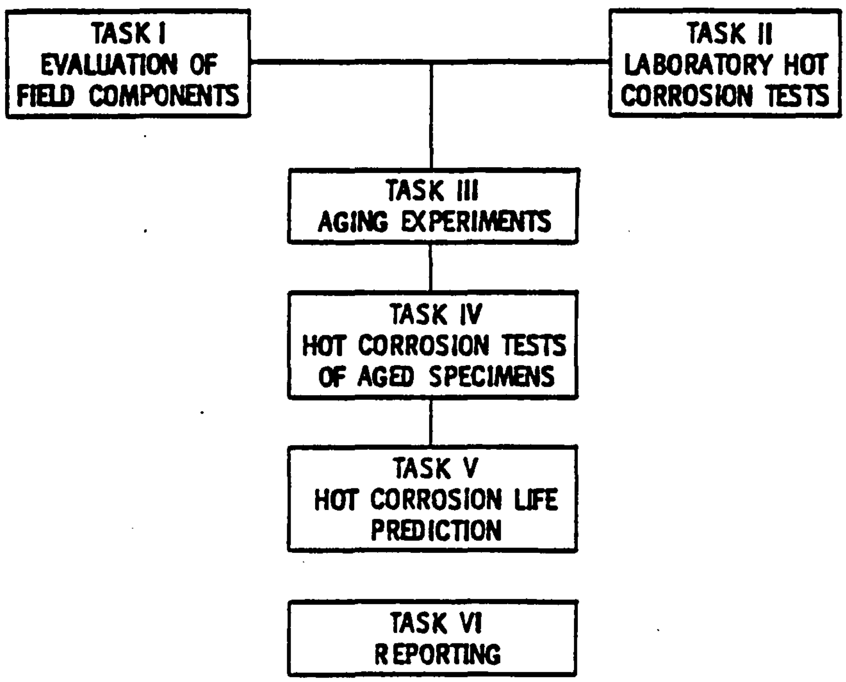
The last Task, VI, covers the reporting requirements.

RFP 3 - 412777

OBJECTIVE: DETERMINE EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE

BACKGROUND: PRIMARY MECHANISMS OF HOT CORROSION - FLUXING OF OXIDE SCALES BY LIQUID SALTS

- RIG TESTS GIVE INCONSISTANT RESULTS
- NEW TECHNIQUE DEVELOPED TO
  - DETERMINE THE INCUBATION/THRESHOLD PERIOD
  - CARRY OUT REPRODUCIBLE HOT CORROSION TESTS



- ANALYSIS OF HOT CORROSION COMPONENTS FROM THE FIELD
- CONTROLLED LABORATORY EXPERIMENTS TO ESTABLISH EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE
- DEVELOPMENT OF EMPIRICAL LIFE PREDICTION MODEL BASED ON DATA GENERATED

EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE

TASK I EVALUATION OF FIELD COMPONENTS

SIX FIELD COMPONENTS (LITTLE TO MASSIVE CORROSION)
EVALUATION (METALLURGICAL AND CHEMICAL)

TASK II LABORATORY HOT CORROSION TESTS

BURNER RIG CONDITIONS: 0.3 MACH, PRE-CONDITIONED AIR

MATERIALS: U700 AND CONTRACTOR'S CHOICE - BARE AND COATED (DUPLICATES)

COATINGS: RT21 ALUMINIDE, LOW PRESSURE PLASMA NiCoCrAly, CONTRACTOR'S CHOICE

CYCLE: 60 min HOT, 6 min AIR BLAST COOL

SPECIMEN SURFACE TEMPERATURE: 900C (1750F)

TIME: 1000 HOURS OR UNTIL HOT CORROSION OCCURS

RUN ADDITIONAL SPECIMENS 100, 300, 500 HOURS: TIME NOT TO EXCEED 2/3rds OF THE TIME IN WHICH HOT CORROSION OCCURS

MONITOR: VISUAL AND INDUCTANCE EVERY 20 CYCLES

EVALUATION: METALLURGICAL AND CHEMICAL (OXIDE, ALLOY AND COATING COMPOSITION AND STRUCTURE)

TASK III AGING EXPERIMENTS

TEMPERATURE: 1100C (2012F)

MATERIALS: AS IN TASK II (TRIPLICATES)

AGING CONDITIONS:

- TIME: 100, 300, 600, AND 1000 hrs
- ENVIRONMENT: INERT; ISOTHERMAL FURNACE OXIDATION; CYCLIC FURNACE OXIDATION; CYCLIC BURNER RIG OXIDATION

MONITOR: INDUCTANCE CHANGES AND WEIGHT CHANGES AS APPROPRIATE

CHARACTERIZATION: ONE SPECIMEN PER CONDITION AS IN TASK II

EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE

TASK IV HOT CORROSION TESTS OF AGED SPECIMENS

TEST CONDITION: AS IN TASK II, UNTIL HOT CORROSION OCCURS (DUPLICATES)
MONITOR: VISUAL AND INDUCTANCE EVERY 20 HOUR PERIOD
HOT CORROSION OCCURS: VISUAL SIGNS FOR THREE 20 hr PERIODS.
EVALUATION: (METALLURGICAL AND CHEMICAL)
PROPOSE: PRELIMINARY HOT CORROSION LIFE PREDICTION MODEL
SUGGEST: METHODOLOGY TO PREDICT HOT CORROSION LIFE BASED ON LAB EXPERIMENTS

TASK V HOT CORROSION LIFE PREDICTION

- VERIFY LIFE PREDICTION MODEL
- TEST METHODOLOGY

TASK VI REPORTING REQUIREMENTS

FINANCIAL
MONTHLY
ANNUAL
FINAL
ORAL PRESENTATIONS