SSC Project Recommendation for FY 2020

DIFFERENCES BETWEEN CORROSION FATIGUE AND FATIGUE OF CORRODING STRUCTURES TO DEVELOP AN UNDERSTANDING OF THE IMPACT ON LIFE

1.0 OBJECTIVE.

1.1 The objective of the present proposal is to evaluate the significance of corrosion fatigue and the difference between corrosion fatigue and fatigue of corroding structure. The project will aim to develop a better understanding of corrosion fatigue with the aim of answering under what conditions does the corrosion fatigue mechanism need to be considered explicitly; and do the applied stress ranges based on net scantlings using corrosion thickness reduction factor adequately address the fatigue of corroding structures in a marine environment.

2.0 BACKGROUND.

2.1 Corrosion fatigue crack propagation includes the effects of interaction between cyclic mechanic loading and the corrosive environment. The influence of a corrosive media in the presence of a cyclic stress can dramatically increase crack growth rates relative to a non-corrosive environment. A corrosion fatigue crack growth rate is dependent on the frequency of applied loading cycles, stress ratios, stress range as well as the factors that also effect aqueous corrosion (e.g. temperature, solution chemistry, protective coatings, cathodic protection, electrode potential).

2.2 Ship structure Class design rules generally consider fatigue in a corroding structure by completing fatigue design calculations using an S-N curve developed for specimens tested in a corrosive environment. These S-N curves may not include a corrosion fatigue crack growth mechanism, especially if the test data is based on the tests carried out at higher test frequencies (i.e. a test frequency high enough to permit the mechanical component of the corrosion fatigue degradation mechanism to dominate the crack growth rate). In these design calculations, the applied stress ranges are developed based upon structural analysis using local scantlings that include a corrosion thickness reduction factor.

3.0 REQUIREMENTS.

3.1 Scope.

3.1.1 The Contractor shall conduct the work required in this project in three phases:

(i) Literature review,
(ii) Data analysis and reporting, and
(iii) Sample fatigue life assessments of typical ship structural scenarios.

3.1.2 In Phase 1, the Contractor shall collect corrosion, corrosion fatigue and fatigue data under different conditions, i.e., air, fresh water and salt water. In addition, a summary of existing corrosion fatigue models will also be prepared. The success or completeness of the conclusions that will be drawn from this study will depend on the volume of data that can be collected in this task.

3.1.3 In Phase 2, the experimental fatigue test data and observations of corrosion rates gathered will be evaluated and the effect of environment and the effect of cyclic frequency on the fatigue lives and fatigue crack growth rates, if any, will be reported and discussed.

3.1.4 In Phase 3, a sensitivity study will be undertaken to analytically demonstrate the relative design lives for typical ship structural components in various spaces in a ship calculated based upon the fatigue design rules and corrosion fatigue models.

3.2 Tasks

Each Phase of the project shall be accomplished through one or more tasks

3.2.1 In Phase 1, the Contractor shall undertake a comprehensive literature review and develop a proposed plan for the work in Phase 2 including the following tasks:

3.2.1.1 Project Kick Off Meeting – Review project objective, scope and administration to ensure a common understanding of the project is held by the Contractor and the Project Technical Committee.

3.2.1.2 Literature Review - A review of literature to understand the state of the art in corrosion fatigue. The review will include a general review of corrosion fatigue, a discussion of the mechanisms of corrosion fatigue, the governing variables and proposed corrosion fatigue models. Data related to fatigue and corrosion rates will be collected.

3.2.1.3 Experimental Test Program Development – Based on the literature review an experimental test program with defined to fill any gaps in the collected data related defining the test program stress range, stress ratio and cyclic frequency to be undertaken in a subsequent testing program (Beyond the scope of this project).

3.2.2 In Phase 2, the Contractor shall

3.2.2.1 Review and analyze the test results collected in Phase 1 to understand the effect of environment on S-N generated fatigue life, to evaluate the effect of loading frequency on the S-N generated fatigue life.

3.2.2.2 Review and analyze the results generated in Phase 1 to understand the effect of environment on fatigue crack growth rates, to evaluate the effect of loading frequency on the fatigue crack growth rates.

3.2.3 In Phase 4, the Contractor shall

3.2.3.1 Undertake a sensitivity analysis for one or two typical ship structural components where fatigue lives will be calculated based on the different fatigue design rules using the fatigue data generated in the Phase 2 of the current test program.

3.2.3.2 Compile all the information and data generated in the project final report.

3.3 Project Timeline. The anticipated duration of this project is twelve (12) months.

4.0 GOVERNMENT FURNISHED INFORMATION.

4.1 Standards for the Preparation and Publication of SSC Technical Reports

5.0 DELIVERY REQUIREMENTS.

5.1 The Contractor shall provide quarterly progress reports to the Project Technical Committee, the Ship Structure Committee Executive Director, and the Contract Specialist.

5.2 The Contractor shall provide an interim report at the end of Phase 1, including a preliminary version of the results of the literature survey and final proposals for the testing program in Phase 2

5.3 The Contractor shall provide a print ready master final report and an electronic copy, including the above deliverables, formatted as per the SSC Report Style Manual.

6.0 PERIOD OF PERFORMANCE.

6.1 As noted above, this project will require approximately twelve (12) months to complete.

7.0 GOVERNMENT ESTIMATE. These contractor direct costs are based on previous project participation expenses.

7.1 Project Duration: *12* months.

7.2 Total Estimate: $95,000

7.3 The Independent Government Cost Estimate: To be provided with full proposal.

8.0 REFERENCES.

8.1 Ship Structure Committee Report SSC-409

9.0 SUGGESTED CONTRACTING STRATEGIES

9.1 Direct contracting with BMT Canada Limited (previously BMT Fleet Technology Limited)

9.2 BMT maintains an active GSA Schedule contract under the new Professional Services Schedule (PSS). Using the streamlined procurement procedures in FAR Subpart 8.4 Federal Supply Schedules, PSS offers federal agencies access to commercial professional services at "Most Favored Customer" pricing. SSC may use the simplified acquisition procedures to issue a Request for Quotation (RFQ) using GSA's eBuy solicitation system, or directly to contractors according to governing agency procedures. Special Item Number (SIN) 871-1 (Strategic Planning for Technology Programs/Activities) or SIN 871-2 (Concept Development and Requirements Analysis) would be appropriate classifications for the proposed project.