



Pacific Northwest Laboratories
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May 2, 1984

Mr. Mark Williams, TAPMG
Division of Licensing
Office of Nuclear Regulatory Commission
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Williams:

SUMMARY OF BATTELLE SUBCONTRACT B-B0195 WITH TRANSAMERICA DELAVAL, INC. (TDI)

Transamerica Delaval, Inc. (TDI) is under subcontract to Battelle to evaluate special silicon carbide (SiC)-impregnated cylinder liners and piston rings prepared by Laystall Engineering Company Ltd. of England for generic diesel service with heavy petroleum fuels. This effort does not involve dependability tests of TDI engines. The activity is supported by the Maritime Administration for Research and Development (MARAD) of the Department of Transportation, via the Department of Energy and its operating contract with Battelle for the Pacific Northwest Laboratory. The PNL staff supervising this effort are not involved in the NRC activity.

Battelle awarded the subject subcontract to TDI on 25 Nov 1981, at a firm fixed price of \$30,705. The completion date was September 30, 1983. In October 1983, the term of the subcontract was extended to December 31, 1984, and the fixed price was increased to \$32,985. Attached is a copy of the Statement of Work.

In our opinion, there is no real or apparent conflict between Battelle's work for NRC and that for MARAD associated with the subcontract described above.

Very truly yours,

Greg L. Turner
Contracting Officer

JBC/tal
WP0324C

cc: M. Plahuta, DOE/RL
C. Berlinger, NRC

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STATEMENT OF WORK

The Contractor shall conduct a test program to evaluate the feasibility of using silicon carbide (SiC) impregnated cylinder liners and piston rings in diesel engines operating on No. 2 diesel and heavy fuel. The work shall be divided into three phases as specified below:

A. Phase One

1. The Contractor shall provide and ship four (4) cylinder liners and four (4) sets of piston rings for the R-46 engine to:

Laystall Engineering Company Limited
10 Dixon Street
Wolverhampton, England WV2 2BU
Attention: Mr. Jack Tanner
Telephone: Area Code 902; Wolverhampton 51789

2. The Contractor shall arrange for the return shipment of the above engine components after the SiC impregnation work is completed by Laystall.
3. The Contractor shall completely blueprint the 4 liners and 4 sets of piston rings.
4. The Contractor shall install one of the liners and one set of the piston rings in a stationary R-46 laboratory engine for testing. The engine shall be run at 25-100 percent load on No. 2 diesel fuel.
5. Boroscope inspections shall be performed by the Contractor to check for compatibility between the liners and rings. The inspections shall be performed at the following time intervals:
 - a. After 1 hour of operation,
 - b. After 40 hours of operation,
 - c. After 120 hours of operation,
 - d. After 720 hours of operation.

If, after 720 hours, the liners appear normal, the Contractor shall commence the testing specified in Phase Two below.

B. Phase Two

1. The Contractor shall install one of the liners and one set of the piston rings in an R-46 engine operating in a municipal power plant in Glenallen, Alaska. The engine shall be run in a normal power plant mode on No. 2 diesel fuel.

- a. After 1 hour of operation,
- b. After 40 hours of operation,
- c. After 100 hours of operation,
- d. After 1,000 hours of operation,
- e. After 2,000 hours of operation.

If, after 2,000 hours, the liners appear normal, the Contractor shall commence Phase Two testing.

C. Phase Two

1. The Contractor shall install the remaining two (2) liners and (2) sets of piston rings in an M/V Gott Engine (RV-16) on-board an ore freighter operating on the Great Lakes. The fuel to be used for this phase of testing shall be heavy oil (1400-4000 Redwood) and will not contain emulsified water.
2. The Contractor shall perform boroscope inspections of the liners at the following time intervals:
 - a. After 1 hour of operation,
 - b. After 40 hours of operation,
 - c. After 100 hours of operation,
 - d. After 2,500 hours of operation.
 - e. After 5000 hours of operation, the Contractor shall remove the cylinder head and perform a thorough inspection of the liner to determine wear trends. The inspection will include physical measurements of the components.
3. If a normal wear pattern is found, the Contractor shall reinstall the cylinder head. The engine will then be operated for an additional 5000 hours. If unusual or excessive wear patterns are found, Phase Two testing shall be terminated.

D. Reporting Requirements

1. The Contractor shall submit to Battelle quarterly progress reports within two weeks of the completion of each respective quarter of performance under this Contract. The progress report shall briefly summarize the work completed in the quarter, results obtained, and any problems encountered.
2. The Contractor shall submit to Battelle a final report detailing the performance of the liners and rings within one month of the conclusion of the first 5000 hours of operation in Phase Two. This report shall also detail the performance of the liners during Phase One testing.

3. If a second 5000 hour testing operation is performed in Phase Two, the Contractor shall submit to Battelle a supplemental final report within one month after completion of the testing. This report shall discuss the results obtained by the Contractor in the second inspection of the marine engine.
4. If testing is terminated prior to the completion of Phase Three, the final report shall detail the performance of the liners up to the time of such termination and shall be submitted within one month of testing termination.
5. The Contractor shall submit one copy each of the above reports to:

Cheryl L. Cejka
Subcontract Administrator
Battelle
P. O. Box 999
Richland, WA 99352

Darrell D. Hays
Senior Development Engineer
Battelle
P. O. Box 999
Richland, WA 99352