UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

FEB 27 2001

Purdue Research Foundation
ATTN: Thomas Wright
1063 Hovde Hall, Purdue University
West Lafayette, IN 47907-1063

Dear Mr. Wright:

SUBJECT: MODIFICATION NO. 4 TO TASK ORDER NO. 9 ENTITLED "BWR MODEL DEVELOPMENT AND ASSESSMENT" UNDER CONTRACT NO. NRC-04-97-046

In accordance with Section G.4, Task Order Procedures, of the subject contract, this letter definitizes Task Order No. 9 Mod 4. Accordingly, this task order shall be performed in accordance with the enclosed revised Statement of Work.

The period of performance for Task Order No. 9 is changed to run from August 4, 1999 through November 30, 2001. The total estimated cost for full performance of this task order is increased by $90,000 from $160,604 to $250,604. Funds in the amount of $90,000 are hereby obligated for performance of this task order. The Contractor shall not incur costs for this task order which exceed this total cumulative obligated amount of $250,604.

Accounting data for Task Order No. 9 Mod 4 is as follows:

B&R No.: 16015110135
Job Code: W-6749
BOC Code: 252A
RES ID: RES-C01-363
Appropriation No.: 31X0200.160
Obligated Amount This Action: $90,000

Template . ADM-001

ADM-02

A summary of obligations under this deliver order, from date of award through this modification, is given below:

Total FY 99 obligations	$ 40,000
Total FY 00 obligations	$120,604
Total FY 01 obligations	$ 90,000
Cumulative Total of NRC Obligations	$250,604

This modification obligates $90,000 in FY01 funds.

All other terms and conditions remain unchanged including the ceiling amount of $250,604.

Please indicate your acceptance of this task order modification by having an official, authorized to bind your organization, execute three copies of this document in the space provided and return two copies to the Contract Specialist. You should retain the third copy for your records.

Sincerely,

Donald A. King, Contracting Officer
IT Acquisition Management Branch
Division of Contracts and
Property Management
Office of Administration

Enclosure:
As stated

ACCEPTED: TASK ORDER NO. 9 MOD 4

MAR 9 2001

NAME DATE

Peter E. Dunn
Assistant Vice President for Research

TITLE

Modification (No. 4) to The Statement of Work for Task Order #9, "BWR Model Development and Assessment," under Contract # NRC-04-97-046 and Job Code W6749, Thermal-Hydraulic Research"

I. BACKGROUND

This modification to the Statement of Work (SOW) contains new tasks to repeat some of the TRAC-M calculations that were performed for the "completed" Tasks 1 through 4, but using the latest version of TRAC-M and/or an expanded input model (to be described later). The purpose is to determine if either the latest version of TRAC-M or its combination with the expanded input model would provide better agreement with the test data. Furthermore, a comprehensive literature survey will be conducted to identify and recommend interfacial drag models or correlations for two-phase flow in rod bundles under the conditions applicable to the current and advanced LWRs.

Under the "completed" Tasks 1 through 4 and as summarized below, the University of Maryland has performed TRAC-M and TRAC-B calculations for a number of tests obtained at four test facilities. Code input decks and calculation notebooks were also developed for those facilities.

(1) Task 1 – THTF steady-state boil-off tests for Tests 3.09.10I, 3.09.10J, 3.09.10L, and 3.09.10M

(2) Task 2 – G2-Westinghouse 336-rod bundle transient boil-off tests for Tests 715, 718, 720, 722, and 727

(3) Task 3 – FRIGG subcooled tests for Tests 36 313-016, 36 313-020, 36 313-113, 36 313-114, 36 313-120, 36 313 125, and 36 313-148

(4) Task 4 – GE small and large vessel blowdown and level swell tests for Tests 1004-3, 8-21-1, 5702-16, and 5803-2

II. OBJECTIVES

The objective of this task order is to assess the adequacy of the TRAC-M code in modeling the BWR-relevant phenomena, identify errors in the code, and recommend model improvements if needed.

III. REPORT CONTENT REQUIREMENTS

Letter reports generated for each task listed in the following Scope of Work shall:

1. Describe the test facility, test procedure, and test conditions;

2. Identify the important phenomena of the tests;

3. Describe to the extent possible the impact of each important phenomenon upon the test behavior;

4. Compare TRAC-M calculations against test data;

5. Describe how those phenomena are modeled in the TRAC-M code (e.g., what models or correlations are used and the technical bases for those models and correlations);

6. If the TRAC-M calculations are not in reasonable agreement with test data, perform a literature review to identify candidate models or correlations for improvement. Also perform TRAC-B calculations for the same tests to determine whether the correlations in TRAC-B are better and should therefore be incorporated into TRAC-M.

The quality assurance procedures described in the NRC software quality assurance (SQA) procedures shall be followed to the extent possible for all the TRAC-M input decks and calculations.

IV. SCOPE OF WORK (12/1/00 - 11/30/01)

For this modification (No. 4) to the SOW, continue the existing Task 5, and revise Task 6 (to accommodate error corrections in SNAP), and add new Tasks 7, 8, and 9.

Task 5. Provide Technical Assistance to NRC

This task provides technical assistance to NRC by performing additional calculations, making presentations, reviewing technical reports, providing references, and attending meetings as requested by the NRC Technical Monitor.

Estimate Level of Effort: 0.5 staff-month (for this performance period)
Estimated Completion Date: November 30, 2001 (new completion date)

Task 6. Develop RELAP5 Input Decks Using SNAP and Perform Calculations for THTF and G2/Westinghouse Boil-Off Tests

This task involves the use of the Symbolic Nuclear Analysis Package (SNAP), which is a software tool for assisting a RELAP5 code user to develop input decks. Based on the design information in the TRAC-M (or TRAC-B) input decks for the THTF tests (under Task 1) and the G2/Westinghouse boil-off tests (under Task 2), RELAP5 input decks for those tests will be developed by using SNAP to the extent possible. Since the current version of SNAP is not yet mature, errors are expected. Testing SNAP, reporting errors, and recommending improvements are also part of the task.

Perform RELAP5 calculations for two (out of a total of four) THTF tests analyzed under Task 1and also for two (out of five) G2/Westinghouse tests analyzed under Task 2. Compare the RELAP5 results with the data and TRAC-M (and TRAC-B if applicable) calculations.

Deliverables: (a) a letter report in both text and electronic format that contains the report as pdf files and the RELAP5 input deck (produced with SNAP) in appropriate electronic format for the THTF boil-off tests.
(b) a letter report in both text and electronic format for the G2/Westinghouse boil-off tests.

Estimated Level of Effort: 2 staff-months (for this performance period)
Estimated Completion Date: August 31, 2001 (new completion date)

Task 7. Analyze THTF Steady-State Boil-Off Tests for Model Improvement

This task consists of two elements. The first element is to recalculate the THTF boil-off tests, 3.09.10J and 3.09.10L, in two steps. First, use the same input model as for Task 1 to run the latest version of TRAC-M. Second, use an expanded input model (using the new features of double-sided heat transfer and level tracking for CHAN, PIPE, and VESSEL components) to run the latest version of TRAC-M.

The second element of the task is to conduct a comprehensive literature survey to identify and recommend best-estimate interfacial drag models for rod bundles for a wide range of conditions applicable to the current and advanced LWR designs. In addition, determine and recommend the best approach to model the effect of grid-spacers above the two-phase mixture level. "If" the interfacial drag models recommended are different from those in the latest version of TRAC-M, NRC will provide technical guidance to the University of Maryland to install the new models in a test version of TRAC-M. As part of the second element, this test version of TRAC-M will then be used to calculate the same THTF tests to assess the new models installed.

Deliverables: a letter report to describe the findings of this task in both text and electronic format, input decks in electronic format, and test data in electronic format.

Estimated Level of Effort: 3 staff-months
Estimated Completion Date: June 30, 2001

Task 8. Analyze G2/Westinghouse 336-Rod Bundle Transient Boil-Off Tests

This task consists of four elements. The first element is to perform quality assurance and consistency check on the G2/Westinghouse 336-rod bundle transient boil-off test data, which were copied from the NRC databank. Reconstruct nodal void fractions, heater rod surface temperatures, and heat fluxes from the data. Develop a rationale for the best-estimate values of initial water levels for a total of 22 tests.

The second element of this task is to recalculate five tests (Tests 715, 718, 720, 722, and 727), using the latest version of TRAC-M. Comparisons with the data will be focused on the nodal void fractions, heater rod surface temperatures, two-phase mixture level, and collapsed water level.

The third element of the task is to perform TRAC-M calculations for three additional tests to be selected to cover a broad spectrum of test conditions.

The fourth element of the task is to recalculate at least four of the eight tests above using the test version of TRAC-M with the recommended interfacial drag models, as developed under Task 7. In addition, determine and recommend the best approach to model the effect of grid-spacers above the two-phase mixture level.

Deliverables: a letter report in both text and electronic format, input decks in electronic format, and test data assessed in electronic format

Estimated Level of Effort: 4 staff-months
Estimated Completion Date: August 31, 2001

Task 9. Recalculate TRAC-M Calculations for GE Level Swell Tests

This task consists of two elements. The first element is to use the latest version of TRAC-M to calculate Tests 5702-16 and 5803-2 from the GE large vessel blowdown and level swell test series.

The second element of this task is to use the latest TRAC-M with one-dimensional core models to calculate three additional GE large-vessel blowdown and level swell tests (Tests 5801-13, 5801-19, and 5803-1). In addition, use the latest TRAC-M with one-dimensional core models to calculate a GE small-vessel blowdown and level swell test (to be selected).

These calculations will provide a broad base to assess the interfacial drag and heat transfer models, and flashing and level tracking features in the latest version of TRAC-M.

Deliverables: a letter report in both text and electronic format, input decks in electronic format, and test data assessed in electronic format

Estimated Level of Effort: 3 staff-months
Estimated Completion Date: November 30, 2001

V. MONTHLY PROGRESS REPORT

In addition to the deliverables listed for each task, the contractor shall provide a monthly technical progress report by the 20th of the following month. The report summarizes activities of the month under this task order, which include test data evaluation, TRAC-M assessment against test data, input model development information, preliminary findings, and meetings attended.

VI. MEETINGS AND TRAVEL

For successful completion of the work required in this SOW, it is anticipated that the contractor will travel to the NRC office in Rockville, Maryland, on three occasions for a one-day period. In addition, a student from the University of Maryland could work at the NRC (on a part-time basis) to install new interfacial drag models in a test version of the TRAC-M code, under the supervision of the NRC staff (Dr. Jennifer Uhle).

VII. TECHNICAL DIRECTION

The NRC Project Officer is Dr. James T. Han, U.S. Nuclear Regulatory Commission, 11545 Rockville Pike, Rockville, MD 20852-2738, Mail Stop T-10K08; Telephone: (301) 415-6773.