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

JUN 21 2001

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

Dear Mr. Wright:

SUBJECT: MODIFICATION NO. 10 TO TASK ORDER NO. 2
UNDER CONTRACT NO. NRC-04-97-046

This letter definitizes Modification No. 10 to Task Order No. 2. Accordingly, this task order modification shall be performed in accordance with the enclosed revised task 16. Please note the start date for this effort was originally estimated to be 06/01/01. The new start date is July 1, 2001. The estimated completion date remains the same.

The total estimated cost for Task Order No. 2 is increased by $8,273 from $2,087,216 to $2,095,489. Funds in the amount of $8,273 are hereby obligated for performance of this modification, i.e., the obligated amount of Task Order No. 10 is increased by $8,273 from $1,795,943.60 to $1,804,216.60. The Contractor shall not incur costs for this task order which exceed the cumulative obligated amount of $1,804,216.60.

Accounting data for Task Order No. 2, Modification No. 10 is as follows:

| | |
|---|---|
| B&R No.: | 16060401710 |
| Job Code: | F6277 |
| BOC Code: | 252A |
| RES ID: | RES-C01-430 |
| Appropriation No.: | 31X0200.160 |
| Amount Obligated This Action: | $8,273 |

TEMPLATE-ADM001

ADM02

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

| | |
|---|---|
| Total FY97 Obligation: | $ 162,000 |
| Total FY98 Obligation: | $ 300,012 |
| Total FY99 Obligation: | $ 478,549.60 |
| Total FY00 Obligation: | $ 457,382 |
| Total FY01 Obligation: | $ 406,273 |
| Cumulative Total of NRC Obligations: | $1,804,216.60 |

This modification obligates FY01 funds in the amount of $8,273.

**All other terms and conditions remain unchanged.**

Please indicate your acceptance of this task order modification by having an official, authorized to bind your organization, execute three (3) copies of this document in the space provided and return two (2) copies to the Contract Specialist, Ms. Amy Siller, at the address listed below. You should retain the third copy for your records.

U.S. Nuclear Regulatory Commission
ADM/DCPM/CMB1, Mail Stop T-7-I-2
Washington, DC 20555

If you have any questions concerning this action, please contact Ms. Siller at (301) 415-6747.

Sincerely,

for Mary H. Mace, Contracting Officer
Contract Management Branch 1
Division of Contracts and Property Mgmt.

Enclosure: As stated

ACCEPTED: TASK ORDER NO. 2, MODIFICATION NO. 10

NAME
Douglas W. Sabel, Director
University Contracting Group

TITLE

JUL 3 2001

DATE

Modification (No.10) to the Statement of Work of Task Order #2, "Modularization of TRAC-P," under Contract # NRC-04-97-046 and Job Code W6749, "Thermal-Hydraulic Research"

**Work Requirements** (Through 11/30/01)

Replace the existing Task 16, "Higher Order Numerical Methods," with the following new Task 16. Note that the only difference between the new Task 16 and the existing one is in the last paragraph, where additional work is shown in **bold letters** and funded for 2 staff-months.

Task 16. Higher Order Numerical Methods

Incorporation of the External Component has facilitated coupling the consolidated code to other tools, such as CFD codes. CFD codes utilize higher-order differencing schemes, whereas the consolidated code is limited to a first-order technique. Unfortunately, when coupling two different order numerical schemes, numerically-induced bifurcations may be generated at the location of the coupling if strong gradients are present. Therefore, it may be necessary to incorporate higher-order numerics into the consolidated code.

First-order differencing limits the ability of the code to preserve gradients in physical properties, such as boron concentration and thermal and density fronts. A second-order method would ameliorate this limitation and improve the code's prediction of boron concentration and physical properties (such as density and temperature) that influence the core power predicted by a coupled kinetics code. These gradients also influence instability predictions, and a less numerically diffusive scheme would improve the code's ability to model these transients. Instability calculations are now performed only with the semi-implicit method, due to the high diffusion of the SETS scheme. However, SETS allows the code to run at larger time steps. It may be possible to run stability cases with SETS if a higher order scheme were used. This would result in a faster running code and would allow the semi-implicit option to be removed from the code, which would reduce the maintenance effort. (Note that RELAP5 currently has a method to sharpen the thermal gradient. This would not be needed if a higher order differencing scheme were implemented, thereby facilitating the RELAP5 consolidation.)

In order to efficiently couple the TRAC code to a CFD code and to minimize numerical diffusion to better represent gradients in physical properties, higher-order numerics should be incorporated into TRAC. This work has been facilitated by the modularization of the hydraulic component to hydraulic component communication in the code as well as the modularization of the solution procedure. Before the optimal means of providing this capability is determined, a pilot study of various approaches should be done so that final incorporation into TRAC is done efficiently and the run-time is not dramatically hindered.

TRAC code will be stripped down to minimize its complexity, leaving just the minimal coding required to run SETS and SEMI-IMPLICIT schemes. **A FULLY-IMPLICIT numerical scheme will also be implemented to study the feasibility of using this advanced scheme to decrease runtime.** All schemes will be functional for a network consisting of both one-dimensional and three-dimensional components. The numerics will also be modified to provide a second-order differencing technique for all schemes, while leaving the first-order technique in place. This approach will provide the ability to judge the benefit and detriment of the higher-order technique. Factors shall include numerical diffusion, run-time, and numerical stability. Test cases shall be devised to test these factors and shall be run with both schemes to

determine the most advantageous differencing method. Implementation is also a concern and the code architecture shall also be studied and assessed to ensure that when incorporated into TRAC, the coding is readable and extendable. A letter report shall be provided to the NRC to summarize the results of this study and a **recommendation shall be made as to which numerical scheme would best meet the NRC goals.** All coding shall be done in F90 and shall be portable across all NRC platforms (SUN, SGI, HP, DEC Alpha, Windows NT, and IBM AIX).

Deliverables: a letter report in both text and electronic format, and the pilot code developed during this study in electronic format.

Estimated Level of Effort: 2 staff-months (for additional work defined in this task)
Estimated Completion Date: November 30, 2001