7 DCD

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

OCT 27 1999

Scientech, Inc
ATTN: Jeffrey Glenn
c/o NES, Inc.
11400 Grooms Road
Blue Ash, OH 45242

Dear Mr. Glenn:

SUBJECT: TASK ORDER NO. 2 UNDER CONTRACT NO. NRC-04-97-039

In accordance with Section G.5, Task Order Procedures, of the subject contract, this letter definitizes Task Order No. 2. This effort shall be performed in accordance with the enclosed Statement of Work.

The period of performance for Task Order No. 2 is October 27, 1999 through November 30, 2000. The total estimated cost for full performance of this task order is $891,921 of which $833,572 represents the reimbursable cost and $58,350 represents the fixed fee. Funds in the amount of $575,000 are hereby obligated for performance of this task order. Of this allotted amount, 537,384 represents funds for the estimated cost and $37,616 represents funds for the fixed fee. It is estimated that these allotted funds will be sufficient for performance through June 30, 2000.

In addition, it is agreed that the CPFF amount for performance of the optional tasks 2.1.1(d), 2.1.3(b), 2.2.2(d) and 2.2.3(e) will be $199,784 (est cost $186,714 and fixed fee $13,070) if these optional tasks are exercised unilaterally by the NRC Contracting Officer within the next 120 days via modification to this task order.

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

B&R No.: 06015110125
Job Code: W6706
BOC Code: 252A
RES ID: RES-C00-323
Appropriation No.: 31X0200
Obligated Amount This Action: $575,000

The following individuals are considered by the Government to be essential to the successful performance of the work hereunder:

Glen Mortensen, Ben Gitnick, Terry Gitnick, Nick Newman, Dan Prelewicz, Weidong Wang

The contractor agrees that such personnel shall not be removed from the effort under this task order without compliance with Contract Clause H.4-Key Personnel

99 NOV 15 AM 9:31

PDR CONTR

DF02

The issuance of this task order does not amend any terms or conditions of the subject contract.

Your contacts during the course of this task order are:

Technical Matters: Tim Lee, Project Officer
(301) 415-6479
Contractual Matters: Stephen Pool, Contract Specialist
(301) 415-8168

Please indicate your acceptance of this task order 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,

Stephen M. Pool, Contracting Officer
Division of Contracts and Property Management

Enclosure:
As stated

ACCEPTED: TASK ORDER NO. 2

Jeffrey H. Glenn 11/1/99
NAME Jeffrey H. Glenn DATE

Sr. Contracts Administrator
TITLE

Task Order #2 (Under Task Area 2 NRC-04-97-039)

2.1 RELAP5 Thermal-Hydraulic Code Modifications

2.1.1 Code Robustness/Numerical Issues

a. Noncondensable Derivatives

In a paper presented at the 1997 Annapolis RELAP5 Users Meeting ("Potential for RELAP5 Numerics Improvements", by Prof. Mahhaffy of Penn State University), it was stated that the partial derivatives returned from the steam tables for noncondensables may be in error. This task will examine this area, after the new steam tables have been added to the code, to determine if the derivatives are indeed in error. One option that will be considered will be to compute the noncondensable derivatives for all the volumes all of the time, instead of using the current method of backing the code up one time step when noncondensables first appear in a volume. If the errors do not exist, the task shall be stopped, and the effort redirected per NRC Project Officer's instruction.

The deliverables will be manual updates and a version of RELAP5 with subroutines that return improved noncondensable properties and derivatives.

Estimated Level of Effort: 6 staff-months
Estimated Completion Date: 6/30/00

b. Interfacial Temperature Model Improvements

An improved interfacial temperature model has been developed by Prof. Ransom of Purdue University this past year. The model which was tested out using a pilot code uses exponential under-relaxation of the interfacial temperature to its steady-state value as determined by the saturation pressure. This task shall install this model into the RELAP5 code in an attempt to improve the robustness of the code when large pressure changes occur.

The deliverables will be manual updates and a version of RELAP5 code with the improved interfacial temperature model.

Estimated Level of Effort: 2 staff-months
Estimated Completion Date: 4/30/00

c. Interfacial Temperature Model for Noncondensable-Steam Mixtures

An interfacial temperature model for noncondensable-steam mixtures has been installed in the code and is partially operational under card 1 option #74. It takes into account the fact that the noncondensable mass fraction near the interface is different from the bulk noncondensable mass fraction as a result of steam depletion when it condenses to liquid. This model is only operational for condensation in the annular mist flow regime. This task would expand the model

to other flow regimes and to evaporation. This task should be coordinated with Task 2.1.1 (b) - Interfacial Temperature Model Improvements and might also make use of the same under-relaxation technique.

The deliverables will be manual updates and a version of RELAP5 code with the improved interfacial temperature model for noncondensable-steam mixtures.

Estimated Level of Effort: 4 staff-months
Estimated Completion Date: 6/30/00

2.1.2 Code Model Improvement

(a) Courant Limit Based on Momentum Flux

The current Courant limit in RELAP5 is based on not over-extracting all the liquid or vapor mass from a volume. Theoretically, the Courant limit should be based on not over-extracting all the liquid or vapor momentum from a volume. This task will involve writing a new subroutine to calculate this limit so that the time step can be limited to be less than this value. It is anticipated that this new formulation could improve robustness of the code.

The deliverables will be manual updates and a version of the RELAP5 code with the subroutine installed.

Estimated Level of Effort: 1.5 staff-months
Estimated Completion Date: 1/31/00

(b) Level Model Cleanup

The level model was installed to replace the vertical stratification model. The level model has never been completely reliable, so it is still not used as much as it could be. This task will re-engineer the LEVEL.F subroutine so that it will be easier to understand and maintain. The rewrite will be along the same lines as was done for the ILEVEL.F subroutine soon after the code was delivered to SCIENTECH.

The deliverables will be manual updates and a version of the RELAP5 code with the re-engineered subroutine installed.

Estimated Level of Effort: 2 staff-months
Estimated Completion Date: 4/30/00

2.1.3 User Convenience

(a) Installer for RELAP5 on PCs

RELAP5 has been ported to PCs but the porting process is programmer intensive. This task will develop installer software for RELAP5. The users will be

able to double click on the installation icon, e.g., relap5setup.exe, and the code will be built on their computer.

The deliverables will be manual updates and a version of the RELAP5 installer that easily installs the code on PCs.

Estimated Level of Effort: 2 Staff-months
Estimated completion Date: 5/30/00

2.1.4 Code Assessment

(a) Upgrading of Developmental Assessment Matrix

This task will continue the work that was started last year on upgrading the developmental assessment matrix for RELAP5. The work for the last fiscal year addressed level 1 and level 2 DA cases. This task will extend the work to include a sampling of longer running level 3 plant models and integral effects tests. The level 3 cases are generally run only for release versions. This task includes identifying level 3 cases to be added to the matrix and obtaining input decks and experimental data. On-going and recently completed NRC sponsored tests shall be included in identification of those Level 3 cases. The auto-DA script shall be modified to include these new cases as appropriate.

The deliverable will be a letter report on justification of the developmental assessment matrix and the auto-DA script for the complete level 3 DA matrix.

Estimated Level of Effort: 3.5 staff-months
Estimated completion Date: 5/30/00

(b) Code Manual, Volume III - Developmental Assessment

This task will involve running the developmental assessment problems with the next release version of RELAP5 (most likely MOD3.3) and adding the results to Volume III of the RELAP5 set of manuals. This manual only exists in paper form, so there will be some work involved in converting it into electronic form prior to publication. As a part of this task, the input decks will be annotated with headings for each word on each card in the deck using the capabilities built into SNAP.

The deliverable will be the RELAP5 Manual, Volume III - Developmental Assessment.

Estimated Level of Effort: 9 staff-month
Estimated Completion Date: 11/30/00

The following tasks, 2.1.1(d) and 2.1.3(b), are **optional** that may be considered if additional funds are available.

2.1.1 Code Robustness/Numerical Issues

(d) Nearly-Implicit Time Advancement Improvements

The nearly-implicit time advancement scheme has been in the RELAP5 code for a long time. It is used periodically, but has been shown to not work correctly for a significant set of problems. This task will improve the nearly-implicit time-advancement scheme in RELAP5 which is expected to make the code running faster and more robust.

The deliverables will be manual updates and a version of the RELAP5 code with the improved nearly-implicit time advancements.

Estimated Level of Effort: 6 staff-months
Estimated Completion Date: TBD

2.1.3 User Convenience

(b) Restart/Plot File Restructuring

The current restart/plot file is a sequential file. When a restart is done after a long run, it is necessary to copy this restart/plot file to another file name and add the new information onto the end of the copied file. This can consume a lot of computer time and requires a large amount of disk space. This task would restructure the restart/plot file into two direct-access files. One file would be for restarts and the other file would be for plots. By using a FORTRAN direct-access file, a restart run would not have to copy any files; it could directly write new restart records to the restart file. As another part of this task, a black box option will be available for the restart file. This option will only keep the last N restarts, where N is a number specified on an input card. When it comes time to write restart number N+1, restart 1 will be overwritten. This reuse of the N restarts continues until the run is completed.

The plot file would be another direct-access file. In addition, three options (small, medium, and large) will be added to the code to control the amount of output that is generated for the plot file. These options will be modifiable at a restart. Using the small plot option, the plot file size can be minimized. When detailed information is needed, the problem can be restarted with the large plot option and detailed plotting information can be obtained. The restart and plot files will be small for a normal run, yet the user has the flexibility to go back in time up to N restarts, and get detailed information about the run, if necessary.

The deliverables will be manual updates and a version of the RELAP5 code with the direct-access version of the restart and plot files. In addition, a conversion program would be written and included in the package to convert back and forth from the two versions of the restart/plot file formats.

Estimated Level of Effort: 3 staff-months

Estimated Completion Date: TBD

2.2 SNAP

To ensure the SNAP code to convert RELAP5 input decks to those for TRAC-M, the following tasks need to be completed. A copy of the latest revision of LANL's "Graphical Description of the Evolution of TRAC Input" is attached (Attachment 1A) for information. Scientech shall ensure that their program is consistent with the plan.

2.2.1 TRAC-M Related Tasks

(a) TRAC-M Heat Structures

SCIENTECH shall incorporate in SNAP capabilities to import/export two-dimensional TRAC-M heat structures and related information such as material properties. Where necessary, the dialogs to create or modify one-dimensional RELAP5 heat structures will be expanded and made consistent with TRAC-M heat structures. The contractor shall also create new dialogs as necessary to gather the needed information into SNAP.

Deliverables: Updated SNAP design documentation and a CDROM with the updated source code and executables at the completion of the task.

Estimated Level of Effort: 2.0 staff-months
Estimated Completion date: 7/31/00

(b) TRAC-M Trips and Controls

SCIENTECH shall incorporate in SNAP capabilities to import/export TRAC-M trips and controls. Where necessary, the existing RELAP5 trips and controls dialogs will be expanded and modified to be consistent with the requirements of TRAC-M. The contractor shall also create new dialogs as necessary to gather the needed information into SNAP.

Deliverables: Updated SNAP design documentation and a CDROM with the updated source code and executables at the completion of the task.

Estimated Level of Effort: 1.0 staff-month
Estimated Completion date: 3/31/00

(c) Update SNAP's TPR and Local Save Format

This task shall update the local save format that is being developed by SCIENTECH to support TRAC-M specific requirements as specified by LANL and implement new versions of LANL's TPR format as the TRAC-M development effort progresses.

Deliverables: Updated SNAP design documentation and a separate letter report documenting the final local save file design. A CDROM with the updated source code and executable at the completion of the task.

Estimated Level of Effort: 1.0 staff-months
Estimated Completion Date: 11/30/00

(d) Modify SNAP to Read and Write Additional TRAC-M PWR 1-D Components

This task completes two subtasks (d and e) which were deferred from the SOW for the previous year. These subtasks were deferred to allow TPR design information to be coordinated with LANL.

SNAP shall be modified to read local save files and export TPR files for all TRAC-M PWR 1-D Hydro Components. SCIENTECH shall report areas where the TPR file format and function library requires modification to NRC/RES and LANL as they are identified.

Deliverables: Updated SNAP design documentation and a CDROM with the revised SNAP source code and executables at the completion of the task.

Estimated Level of Effort: 3.5 staff-months
Estimated Completion Date: 7/31/00

(e) Modify SNAP for BWR 1-D Components

Provide classes in SNAP for both RELAP5 and TRAC-M which implement import/export of BWR 1-D components. For TRAC-M, this will involve adding the capability to read database or local save files and write TPR files.

Deliverables: Updated SNAP design documentation and a CDROM with the revised SNAP source code and executables at the completion of the task.

Estimated Level of Effort: 2.0 staff-months
Estimated Completion Date: 9/30/00

(f) Modify SNAP to Read and Write TRAC-M 3-D Vessel Components

SNAP shall be modified to add the capability to graphically display and modify TRAC-M 3-D Vessel Components as well as read database or local save files and export results to TRAC-M TPR files.

Deliverables: Updated SNAP design documents and a CDROM with the revised SNAP source code and executables at the completion of the task.

Estimated Level of Effort: 2.5 staff-months
Estimated Completion Date: 11/30/00

2.2.2 Model Upgrading

(a) Add Restart Capability to SNAP Model Editor

This task shall modify the SNAP Model Editor to add the capability to modify and restart long calculations and what-if variation cases.

Deliverables: Updated SNAP design documentation and a CDROM with the updated source code and executables at the completion of the task.

Estimated Level of Effort: 1.5 staff-months
Estimated Completion Date: 11/30/00

(b) Point Kinetics

The contractor shall add the necessary dialogs, graphical displays and export/import procedures to SNAP to provide a point kinetics capability for both RELAP5 and TRAC-M.

Deliverables: Updated SNAP design documentation and a CDROM with the revised SNAP source code and executables at the completion of the task.

Estimated Level of Effort: 1.0 staff-months
Estimated completion Date: 7/31/2000

(c) Model Editor Interface to Runtime and Visualizer

Provide interface functionality and coordinate development of the SNAP Model Editor with the Runtime and Visualizer post-processor. Perform Alpha testing of the combined SNAP code system and error corrections.

Deliverables: None. Deliverables will be included with Runtime and Visualizer.

Estimated Level of Effort: 1.0 staff-month
Estimated Completion Date: 11/30/00

2.2.3 User Convenience Features

(g) Initial Condition Wizard

A simple wizard will be included into the framework of SNAP which allows users to specify the initial conditions for multiple nodes based on the conditions specified at a single node. This wizard reads the given initial conditions and applies the Bernoulli equation to correct for elevation, friction and local pressure changes to determine the conditions in adjacent nodes in the same flow network. Whenever multiple junctions are encountered which splits the flow path, simple rules of thumb will be used to estimate the flow through each path.

Estimated Level of Effort: 1.5 staff-months

Estimated completion Date: 11/30/00

2.2.4 Quality Assurance

(a) Testing/Debugging

Perform alpha testing of SNAP as new features are added to the code. Debug the code and correct errors as they are identified. Distribute the code per NRC/RES instruction. Support Beta testing of SNAP and user error reporting. Provide error corrections to Beta testers.

Deliverables: None. A list of SNAP errors and bugs corrected will be maintained at SCIENTECH for NRC inspection.

Estimated Level of Effort: 3.0 staff-months
Estimated Completion Date: 11/30/00

(b) Documentation

The SNAP design documentation, users manual and programmers manual will be kept up to date as the SNAP code is modified and expanded.

Deliverables: Updated SNAP design documentation.

Estimated Level of Effort: 1.0 staff-month
Estimated Completion Date: 11/30/00

(c) Automated Testing (GUI and Portability Checking)

Automated testing capability will be developed to assess fidelity of GUI and import/export processes of SNAP whenever significant modifications and/or upgrading are implemented to SNAP. Portability of SNAP will be ensured for major UNIX platforms, that will be determined with the NRC Project Officer, and WINDOWS-NT.

Deliverables: Automated SNAP testing software. A list of SNAP errors and bugs corrected will be maintained at SCIENTECH for NRC inspection.
Estimated Level of Effort: 1.5 staff-months
Estimated Completion Date: 11/30/00

The following tasks, 2.2.2(d) & (e) and 2.2.3(c), are **optional** that may be considered if additional funds are available.

2.2.2 Model Upgrading

(d) New Water Properties

This task will revise the water properties in SNAP to match the new International Association for Properties of Water and Steam (IAPWS) 1995 formulation being installed in RELAP5.

Estimated Level of Effort: 1.0 staff-months
Estimated Completion Date: TBD

(e) QA "Pedigree" File

A feature will be added to SNAP to document the model preparation and verification effort in an engineering calculation file format for documentation and quality assurance purposes. SNAP will produce tables of all listing of the physical data entered for all components, and the properties of nodes and junctions SNAP computed for the RELAP5 or TRAC input model. User overrides of SNAP default values will be identified and listed to facilitate the QA verification process.

Estimated Level of Effort: 1.5 staff-months
Estimated Completion Date: TBD

2.2.3 User Convenience Features

(c) Component Navigator

The component navigator will provide a convenient method to input data to multiple components and make global changes using a spreadsheet-like table dialog. This will alleviate the need to open each component in a repetitive fashion to change a single input value in each component.

Estimated Level of Effort: 1.5 staff-months
Estimated Completion Date: TBD