

| | | | | | | | |
|--|--|---|--|--|--|--------------------------------|--|
| AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT | | | | 1. CONTRACT ID CODE | | PAGE OF PAGES | |
| | | | | | | 1 11 | |
| 2. AMENDMENT/MODIFICATION NO. | | 3. EFFECTIVE DATE | | 4. REQUISITION/PURCHASE REQ. NO. | | 5. PROJECT NO. (If applicable) | |
| M0007 | | See Block 16C | | RES-19-0326 | | | |
| 6. ISSUED BY | | CODE | | 7. ADMINISTERED BY (If other than Item 6) | | CODE | |
| US NRC - HQ | | NRCHQ | | | | | |
| ACQUISITION MANAGEMENT DIVISION | | | | | | | |
| MAIL STOP TWFN-07B20M | | | | | | | |
| WASHINGTON DC 20555-0001 | | | | | | | |
| 8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) | | | | (x) 9A. AMENDMENT OF SOLICITATION NO. | | | |
| INFORMATION SYSTEMS LABORATORIES INC | | | | | | | |
| 8130 BOONE BLVD STE 500 | | | | 9B. DATED (SEE ITEM 11) | | | |
| VIENNA VA 221827745 | | | | | | | |
| | | | | x 10A. MODIFICATION OF CONTRACT/ORDER NO. | | | |
| | | | | NRC-HQ-60-14-E-0002 | | | |
| | | | | NRC-HQ-60-17-T-0001 | | | |
| | | | | 10B. DATED (SEE ITEM 13) | | | |
| CODE 960756138 | | | | FACILITY CODE | | | |
| | | | | 09/14/2017 | | | |
| 11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS | | | | | | | |
| <input type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers <input type="checkbox"/> is extended, <input type="checkbox"/> is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified. | | | | | | | |
| 12. ACCOUNTING AND APPROPRIATION DATA (If required) Net Increase: \$59,705.08 2019-X0200-FEEBASED-60-60D003-60B301-1147-11-6-174-252A-11-6-174-1147 | | | | | | | |
| 13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14. | | | | | | | |
| CHECK ONE | | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. | | | | | |
| | | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). | | | | | |
| x | | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: Mutual Agreement of the Parties; FAR 43.103(a) Bilateral Modification | | | | | |
| | | D. OTHER (Specify type of modification and authority) | | | | | |
| E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input checked="" type="checkbox"/> is required to sign this document and return <u>1</u> copies to the issuing office. | | | | | | | |
| 14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) The purpose of this task order modification is to: 1)increase the task order ceiling by \$59,705.08 from \$348,543.00 to \$408,248.08; 2) provide funding in the amount of \$59,705.08 increasing the total task order obligated amount to \$408,248.08; 3)revise the cost schedule; and 4)revise the Statement of Work to include additional level of effort for Task 3 requirements. A detailed description is provided on page three. Total Task Order Ceiling: \$408,248.08 (changed) Total Task Order Exercised Ceiling: [REDACTED] (changed) Total Task Order Obligated Amount: \$408,248.08 (changed) Continued ... Except as provided herein, all terms and conditions of the document referenced in Item 9 A or 10A, as heretofore changed, remains unchanged and in full force and effect. | | | | | | | |
| 15A. NAME AND TITLE OF SIGNER (Type or print) | | | | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) | | | |
| | | | | JENNIFER A. DUDEK | | | |
| 15B. CONTRACTOR/OFFEROR | | 15C. DATE SIGNED | | 16B. UNITED STATES OF AMERICA | | 16C. DATE SIGNED | |
| [REDACTED] | | | | [REDACTED] | | 09/25/2019 | |
| (Signature of person authorized to sign) | | | | (Signature of Contracting Officer) | | | |

| | | |
|---|------|----|
| REFERENCE NO. OF DOCUMENT BEING CONTINUED | PAGE | OF |
| NRC-HQ-60-14-E-0002/NRC-HQ-60-17-T-0001/M0007 | 2 | 11 |

INFORMATION SYSTEMS LABORATORIES INC

NSN 7540-01-152-8067

The purpose of this task order modification is to: 1) increase the task order ceiling by \$59,705.08 from \$348,543.00 to \$408,248.08; 2) provide funding in the amount of \$59,705.08 to increase the total task order obligated amount to \$408,248.08; 3) revise the cost schedule; and 4) revise the Statement of Work to include additional level of effort for Task 3 requirements. Accordingly, the task order is hereby modified as follows:

1) Section **B.2 CONSIDERATION AND OBLIGATION—COST-PLUS-FIXED-FEE**

ALTERNATE I is deleted in its entirety and replaced with the following:

“(a) The total estimated cost to the Government for full performance of this contract is \$408,248.08 of which the sum of [REDACTED] represents the estimated reimbursable costs, and of which [REDACTED] represents the fixed-fee.

(b) There shall be no adjustment in the amount of the Contractor's fixed fee.

(c) The amount currently obligated by the Government with respect to this contract is \$408,248.08, of which the sum of [REDACTED] represents the estimated reimbursable costs, and of which [REDACTED] represents the fixed-fee.

(d) It is estimated that the amount currently obligated will cover performance through February 19, 2020.

(e) This is an incrementally-funded contract and FAR 52.232-22 - “Limitation of Funds” applies.

(f) In accordance with FAR 52.216-8 - Fixed Fee, it is the policy of the NRC to withhold payment of fee after payment of 85 percent of the fee has been paid in order to protect the Government's interest. The amount of fixed-fee withheld from the contractor will not exceed 15 percent of the total fee or \$100,000, whichever is less. Accordingly, the maximum amount of fixed-fee that may be held in reserve is [REDACTED].

(End Clause)”

2) Section **B.3 COST SCHEDULE** is deleted in its entirety and replaced with the following:

Period of Performance: Date of Award – February 19, 2020

| CLIN | DESCRIPTION | ESTIMATED COST |
|---------------------------|--|---------------------|
| 0001 | Labor (Prime) | [REDACTED] |
| 0002 | Labor (Consultant/Subcontractor) | [REDACTED] |
| 0003 | Travel | [REDACTED] |
| 0004 | ODC | [REDACTED] |
| SUBTOTAL (rounded) | | [REDACTED] |
| 0005 | Indirect Cost Pool (includes G&A, Fringe, Overhead and Subcontractor Handling) | [REDACTED] |
| SUBTOTAL (rounded) | | [REDACTED] |
| 0006 | Fixed-Fee | [REDACTED] |
| TOTAL | | \$408,248.08 |

3) **SECTION C – Descriptions/Specifications** is deleted in its entirety and replaced with Attachment 1.

All other terms and conditions of this task order remain unchanged.

TASK ORDER STATEMENT OF WORK
TASK ORDER NO. NRC-HQ-60-17-T-0001 under Contract No. NRC-HQ-60-14-E-0001

C.1 PROJECT TITLE

Assess Methods for Large System Code Performance Evaluation and Uncertainty Quantification using the TRACE Code.

C.1.2 BACKGROUND

The rapid increase in computing power over the last two decades has led to very complex computer codes for safety analyses of reactor systems. When Title 10, of the Code of Federal Regulations (CFR) 50.46 was revised in 1988, the regulation permitting “best estimate” Loss-Of-Coolant Accident (LOCA) analysis specified that the regulatory criteria are to be met with “a high probability” and that an appropriate statistical method be used to determine the uncertainty in the analysis. At U.S. Nuclear Regulatory Commission (NRC), the TRAC/RELAP Advanced Computational Engine (TRACE) code is being developed for best-estimate analysis of reactor systems. The Symbolic Nuclear Analysis Package (SNAP) was developed to provide user interface between TRACE code and SNAP, with an enhancement by the Design Analysis Kit for Optimization and Terascale Applications (DAKOTA) to add features for statistical analysis capabilities. Since enactment of the rule change, an increasing number of analyses utilize “best estimate” analysis rather than continuing to use Appendix K. Several methods of determining code uncertainty have been submitted to the staff for review. The reviews of these methods have been long, complex, difficult, and controversial. The agency’s review process would be greatly improved and shortened if the staff could perform independent and consistent assessments of large system code performance and uncertainty quantification for particular applications. This task order is to develop a computational framework for staff that allows for global variance-based methods for identifying and quantifying code uncertainties, and development of benchmark problems for purpose of reducing review time and effort and allowing for better review process standardization.

C.1.3 SCOPE

The focus of this task is to demonstrate a statistical methodology, based on principal components analysis, with a proof-of-principle through an application of the sequence TRACE/SNAP/DAKOTA codes, and to demonstrate an assessment of techniques for the identification of the main sources of uncertainty and their quantification.

C.1.4 APPLICABLE DOCUMENTS AND STANDARDS

- Background information on licensing of a domestic nuclear reactor can be found in NRC Regulations, Title 10, Code of Federal Regulations Title 50 Sec. 46, which provides information about maximum clad temperature and other parameters relevant to the safety of the reactor coolant system
- DAKOTA Uncertainty Analysis is provided as a SNAP plug-in. This plug-in, when used together with TRACE/SNAP, perform uncertainty analysis. DAKOTA is an

open-source toolkit developed at Sandia National Laboratories. Resources for DAKOTA are available at <http://dakota.sandia.gov>.

If necessary, any references that are not available at this website will be provided to the contractor by the Contracting Officer's Representative (COR).

C.1.5 SPECIFIC TASKS

The following three tasks are expected as part of the initial proof-of-principle project phase. The scope of work outline is provided for each of the identified tasks.

Task 1: Generate TRACE Predictions for a Selected Experiment and Production of an Integral-Data Matrix for TRACE Code Performance Statistical Evaluation

Subtask 1A: Generate a Proof-of-Principle TRACE Application Case

The contractor shall select one integral-effects test (IET) from the documented TRACE assessment cases for the initial proof-of-principle project phase. This selection shall be based on expert insights in performing best-estimate methodologies review and licensing reactor thermal hydraulic (TH) safety analyses, TH computer model development and assessment, TH experimental data production and phenomenological data evaluation, and knowledge of the existing reactor TH databases. For the selected IET facility, the contractor shall simulate one experiment (test run) from the available data base to generate the TRACE prediction data for the proof-of-principle TRACE application case. The contractor shall develop an input model for the proof-of-principle TRACE application case by implementing the proper boundary and initial conditions corresponding to the application experiment; examining key model inputs including modeling options and nodalization features on system- and component-wide bases and implementing necessary model changes; and troubleshooting TRACE execution. The contractor shall generate a series of calculation runs for sets of randomized model parameters, applying an appropriately selected version of the TRACE code. These TRACE code predictions will be examined visually with regard to their plausibility in comparison to test data, adequacy of the applied convergence and time-step control criteria and expected sensitivities to variations in selected key modeling inputs relative to both nodalization and code modeling features/options to confirm the soundness of the applied proof-of-principle TRACE test case model.

Subtask 1B: Generate a Data Matrix for Statistical Evaluation

The contractor shall define a set of figures of merit (FOMs) for the analyzed TH IET test case chosen from the measured TH parameters that are key to TH phenomena and test data; spatial location, distribution, and type of instrumentation sensors. Proposed FOMs will be based on direct measurements to reflect the phenomenological content of the analyzed test case. For each defined FOM, a comparative set of both test data and TRACE predicted data histories will be generated on a consistent basis with regard to both time and space by producing each set of measured and computed FOM values as related to appropriately determined common points in time on a consistent time scale; and, by applying a test facility nodalization scheme that appropriately accounts for the spatial location of instrumentation sensors. The produced sets of FOMs will be used to generate a data matrix suitable for the purpose of the statistical evaluation of the proof-of-principle TRACE application case. The contractor shall devise a process of matrix generation based on the following principles: it will generate results using direct access to test data; it will generate results on a consistent time scale; it will allow for data matrix expansion; and it will produce output results in formats suitable for interfacing to different statistical engines. The proof-of-principle TRACE application case shall demonstrate the process of the data matrix construction using TRACE-generated data and will serve as an example case outlining the prospect for a platform-based automated matrix-generation approach using SNAP.

Task 2: Use the Example of TRACE Application Case to perform a Proof-of-Principle Statistical Evaluation of the TRACE Performance

The following analysis capabilities shall be demonstrated in the context of the TRACE analysis of the IET/SET experiment and the concomitant FOM-based integral-data matrix developed in Task 1.

- 1) Two techniques for random sampling of the model parameters shall be applied and evaluated: Latin hypercube sampling (LHS) and quasi-random Sobol's sequences.
- 2) The transient data generated in Task 1 for selected FOMs shall be plotted and visually assessed with regard to consistency of measured vs. computed behavior.
- 3) Statistical properties of the computed data matrices for FOMs that have been deemed not consistent with the measured values shall be statistically analyzed by assessing the transient properties of Spearman's correlation coefficient and the correlation ratio.
- 4) An assessment of the order of influence of the model parameters on the computed FOMs shall be made through two global variance-based sensitivity analyses: principal components analysis and Sobol' sensitivity indices variance decomposition.
- 5) Based on the results of model parameter ordering, an assessment of order reduction of the code parameters shall be made.

An approach shall be devised and tested that allows for the exclusion and/or identification of possible impact on the results from the analyses, performed in Task 2 under the above identified steps, stemming from inadequacy and/or limitations of the spatial/time discretization of the numerical solution including implemented nodalization features.

Task 3: Large System Code Performance Evaluation and Uncertainty Quantification Process Outline and Documentation of the Proof-of-Principle TRACE Application Case

The rationale and concept for the proposed process of large system code performance evaluation and uncertainty quantification (UQ) shall be documented in a technical report. The application feasibility and practical potential of the described process for enhancing the NRC regulatory and licensing practice related to safety evaluation of complex codes shall be demonstrated on the basis of the performed proof-of-principle TRACE application case. The capabilities, versatility, suitability, and adaptiveness of the implemented code performance evaluation method will be revealed by exemplifying its practical application and outcome, to a degree possible on a case-specific basis, by performing the key elements of the outlined process. The results from the proof-of-principle TRACE performance evaluation on the basis of the performed code application case will be used to identify and justify further development of a standardized uncertainty quantification methodology.

- 1) Data matrix construction with TRACE-generated data: As part of this element, key requirements for its platform-based automated implementation in SNAP will be outlined and application of scripts used will be documented.
- 2) Identify the possibility of dimensionality reduction based on the sensitivity analysis developed in task 2.
- 3) Code calibration and benchmarking: Use the sensitivity results from previous step, which is effectively a “qPIRT”, compare it against a SBLOCA PIRT that have been conducted in the past.
- 4) Provide suggestions for applying the knowledge gained for future regulatory licensing review process.

C.1.6. REPORTING REQUIREMENTS

Monthly Letter Status Report (MLSR)

A Monthly Letter Status Report (MLSR) describing the work performed under this contract modification will be submitted to the NRC Project Manager by the 20th of the month following the month to be reported with copies provided to the following:

RESDSAMLSR.Resource@nrc.gov

The MLSR will identify the title of the project, the job code, the Principal Investigator, the period of performance, the reporting period, summarize each month's technical progress, list monthly spending, total spending to date, and the remaining funds and will contain information as directed in NRC Management Directive 11.1. Any administrative or technical difficulties which

may affect the schedule or costs of the project will be immediately brought to the attention of the NRC Project Manager

C.1.7 DELIVERABLES AND DELIVERY SCHEDULE

The period of performance (POP) for this Task Order will be 29 months starting from the date on which the Task Order is awarded by NRC. The specific deliverables, estimated level of effort (LOE) and the associated delivery deadlines are outlined below individually for each task and subtask in the Task Order.

In addition to the MLSR, the following deliverables will be prepared and delivered to NRC according to the identified milestone for each individual task:

Deliverable for Subtask 1A:

A technical letter report in the form of a memo describing the analysis of the chosen proof-of-principle IET TH experiment. This report describes the list of key TH phenomena addressed, parametric studies providing the rationale for their choice and their governing modeling parameters.

Deliverable for Subtask 1B:

A computer file of the data matrix, for key figures-of-merit for statistical analysis, based on the analyses in Subtask 1A.

Deliverable for Subtask 2A:

A technical letter report in the form of a memo describing the statistical analyses through graphic display and statistical hypothesis tests of the results of the proof-of-principle case of the IET experiment developed in Task1. The NRC will review the technical letter report provided as a deliverable under this Subtask. The NRC anticipates a 2-week review period prior to submitting comments to the contractor to be incorporated into the final letter report.

Delivery Schedule: 1) Draft due 17 months after Task Order Award.
 2) Final due 2 weeks after receipt of NRC comments.

Deliverable for Subtask 2B:

A technical letter report in the form of a memo describing the tests of the efficiency of introducing code corrections based on the identified inadequacies and/or limitations elicited via the global variance-based statistical analyses of Task 2A. The NRC will review the technical letter report provided as a deliverable under this Subtask. The NRC anticipates a 2-week review period prior to

submitting comments to the contractor to be incorporated into the final letter report.

Delivery Schedule: 1) Draft due 20 months after Task Order Award.
2) Final due 2 weeks after receipt of NRC comments.

Deliverable for Task 3:

Final documentation in a Technical Report format describing the essential theoretical foundations and approaches applied in Tasks 1 and 2. Also include are the scripts used in this development work and the quantitative results of the proof-of-principle case analyses, and comparison of this qPIRT result with a traditional SBLOCA PIRTs developed by NRC staff in the past. The report will also address the knowledge gained and suggestions to be considered for future developments for consistent evaluation of UQ analyses via large reactor system computer codes within a regulatory context. The draft shall be submitted 2 month before the end of performance period to allow staff review and comments. After receipt of comments, the contractor shall incorporate all changes into the final report.

Delivery Schedule: 1) Draft due 27 Months after task order award.
2) Final due 3 weeks after receipt of NRC comments.

Estimated level of effort: 270 staff hours

C.1.8 REQUIRED LABOR CATEGORIES (Except for Information Technology Services)

The contractor shall provide personnel that are experienced in thermal-hydraulic analysis. Familiarity of TRACE/SNAP plant model development and statistical methods of analysis are required. In addition, the project requires computer capabilities to perform model development and code validation.

The contractor is responsible for assigning technical staff, employees, subcontractors, or specialists who have the above-mentioned qualification experience, or combination thereof to meet the technical objectives of the work specified in this statement of work. NRC will rely on the contractor to verify the qualifications of the personnel assigned to this contract including assurance that all information contained in the technical and cost proposals (including resumes) is accurate and truthful.

The use of key personnel and any proposed change to key personnel on this contract is subject to the NRC Contracting Officer's Representative's (COR) approval.

For any work to be subcontracted or performed by consultants, the contractor shall obtain the NRC COR's written approval of the subcontractor or consultant prior to initiation of the subcontract effort. Conflict-of-interest considerations shall apply to any subcontracted effort.

C.1.9 GOVERNMENT-FURNISHED PROPERTY

NRC will provide the appropriate version of TRACE/SNAP and User Manuals and the selected IET test data upon request from the contractor.

C.1.10 LICENSE FEE RECOVERABLE

PLEASE INDICATE IF ANY OF THE WORK WILL BE LICENSE FEE RECOVERABLE. IF NOT THEN INDICATE, "All work under this task order is not license fee recoverable."

C.1.11 PLACE OF PERFORMANCE

All work shall be performed at the contractor's site.

C.1.12 PERIOD OF PERFORMANCE

Period of Performance will be 29 months after the Task Order is awarded.

C.1.13 SECURITY

This work is UNCLASSIFIED but may utilize pre-determination information and proprietary test data. The required security form (NRC Form 187 – Contract Security and/or Classification Requirements) must be provided with the requisition.