

**ORDER FOR SUPPLIES OR SERVICES**

PAGE OF PAGES

1 : 10

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

BPA NO

1. DATE OF ORDER <b>APR 19 2010</b>		2. CONTRACT NO. (# and) GS23F0110M		6. SHIP TO:	
3. ORDER NO.: NRC-DR-04-10-136		MODIFICATION NO.		4. REQUISITION/REFERENCE NO. RES-10-136	
5. ISSUING OFFICE (Address correspondence to) U.S. Nuclear Regulatory Commission Div. of Contracts Attn: Mr. Michael Mills, Mail Stop: TWB-01-B10M Washington, DC 20555				a. NAME OF CONSIGNEE U.S. Nuclear Regulatory Commission	
				b. STREET ADDRESS U.S. Nuclear Regulatory Commission Attn: Mr. Nathanael Hudson Mail Stop CSB-3A07M	
				c. CITY Washington	
				d. STATE DC	
				e. ZIP CODE 20555	
7. TO:				f. SHIP VIA	
a. NAME OF CONTRACTOR ENERGY RESEARCH, INC.					
b. COMPANY NAME					
c. STREET ADDRESS 6189 EXECUTIVE BLVD					
d. CITY ROCKVILLE		e. STATE MD		f. ZIP CODE 208523901	
9. ACCOUNTING AND APPROPRIATION DATA B&R No. 060-15-111-205, Job Code: N6913, BOC: 252A APP No. 31X0200.060 RES-C10-652 (\$30,000.00) RES-C10-622 (\$90,000.00)				10. REQUISITIONING OFFICE RES \$120,000.00	
11. BUSINESS CLASSIFICATION (Check appropriate box(es)) <input checked="" type="checkbox"/> a. SMALL <input type="checkbox"/> b. OTHER THAN SMALL <input type="checkbox"/> c. DISADVANTAGED <input type="checkbox"/> d. WOMEN-OWNED <input type="checkbox"/> e. HUBZone <input type="checkbox"/> f. EMERGING SMALL BUSINESS				12. F.O.B. POINT N/A	
13. PLACE OF i. INSPECTION b. ACCEPTANCE		14. GOVERNMENT B/L NO.		15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date) April 14, 2010	
16. DISCOUNT TERMS Net 30					

17. SCHEDULE (See reverse for Rejections)

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	<p>This delivery order for technical assistance is subject to the terms and conditions set forth under GSA Federal Supply Schedule no. GS-23F-0110M, in accordance with the attached Statement of Work (Attachment B)</p> <p>Period of performance: April 14, 2010 through April 13, 2011</p> <p>Energy Research, Inc.'s price schedule (Attachment A) is hereby incorporated as part of this delivery order. All travel costs shall be in accordance with Federal Government travel regulations.</p> <p>Time and Material Delivery Order Fixed Ceiling Price: \$191,262.30 Obligated Amount: \$120,000.00</p> <p>DDNS No. 621211259</p>					

*Moh K... April 19, 2010*  
Accepted Date

18. SHIPPING POINT		19. GROSS SHIPPING WEIGHT		20. INVOICE NO.	
21. MAIL INVOICE TO:					
a. NAME Department of Interior / NBC NRCPayments@nbc.gov					
b. STREET ADDRESS (or P.O. Box) Attn: Fiscal Services Branch - D2770 7301 W. Mansfield Avenue					
c. CITY Denver		d. STATE CO		e. ZIP CODE 80235-2230	
UNITED STATES OF AMERICA BY (Signature) <i>Sheila Bumpass</i>				23. NAME (Typed) Sheila Bumpass TITLE: CONTRACTING/ORDERING OFFICER	
SEE BILLING INSTRUCTIONS ON REVERSE				17(h) TOTAL (Cont. pages) 17(i) GRAND TOTAL Not-to-Exceed \$191,262.30	

FOR LOCAL REPRODUCTION  
THIS EDITION NOT USABLE

OPTIONAL FORM 347 (REV. 4/2008)  
PRESCRIBED BY GSA/FAR 48 CFR 53.213(m)

TEMPLATE - ADMIN001

SUNSI REVIEW COMPLETE

APR 22 2010

ADMIN002

## TASK ORDER TERMS AND CONDITIONS

NOT SPECIFIED IN THE CONTRACT

### A.1 2052.209-73 CONTRACTOR ORGANIZATIONAL CONFLICTS OF INTEREST

(a) Purpose. The primary purpose of this clause is to aid in ensuring that the contractor:

(1) Is not placed in a conflicting role because of current or planned interests (financial, contractual, organizational, or otherwise) which relate to the work under this contract; and

(2) Does not obtain an unfair competitive advantage over other parties by virtue of its performance of this contract.

(b) Scope. The restrictions described apply to performance or participation by the contractor, as defined in 48 CFR 2009.570- 2 in the activities covered by this clause.

(c) Work for others.

(1) Notwithstanding any other provision of this contract, during the term of this contract the contractor agrees to forgo entering into consulting or other contractual arrangements with any firm or organization, the result of which may give rise to a conflict of interest with respect to the work being performed under this contract. The contractor shall ensure that all employees under this contract abide by the provision of this clause. If the contractor has reason to believe with respect to itself or any employee that any proposed consultant or other contractual arrangement with any firm or organization may involve a potential conflict of interest, the contractor shall obtain the written approval of the contracting officer before the execution of such contractual arrangement.

(2) The contractor may not represent, assist, or otherwise support an NRC licensee or applicant undergoing an NRC audit, inspection, or review where the activities that are the subject of the audit, inspection or review are the same as or substantially similar to the services within the scope of this contract (or task order as appropriate), except where the NRC licensee or applicant requires the contractor's support to explain or defend the contractor's prior work for the utility or other entity which NRC questions.

(3) When the contractor performs work for the NRC under this contract at any NRC licensee or applicant site, the contractor shall neither solicit nor perform work in the same or similar technical area for that licensee or applicant organization for a period commencing with the award of the task order or beginning of work on the site (if not a task order contract) and ending one year after completion of all work under the associated task order, or last time at the site (if not a task order contract).

(4) When the contractor performs work for the NRC under this contract at any NRC licensee or applicant site,

(i) The contractor may not solicit work at that site for that licensee or applicant during the period of performance of the task order or the contract, as appropriate.

(ii) The contractor may not perform work at that site for that licensee or applicant during the period of performance of the task order or the contract, as appropriate, and for one year thereafter.

(iii) Notwithstanding the foregoing, the contracting officer may authorize the contractor to solicit or perform this type of work (except work in the same or similar technical area) if the contracting officer determines that the situation will not pose a potential for technical bias or unfair competitive advantage.

(d) Disclosure after award.

(1) The contractor warrants that to the best of its knowledge and belief, and except as otherwise set forth in this contract, it does not have any organizational conflicts of interest as defined in 48 CFR 2009.570-2.

(2) The contractor agrees that, if after award, it discovers organizational conflicts of interest with respect to this contract, it shall make an immediate and full disclosure in writing to the contracting officer. This statement must include a description of the action which the contractor has taken or proposes to take to avoid or mitigate such conflicts. The NRC may, however, terminate the contract if termination is in the best interest of the government.

(3) It is recognized that the scope of work of a task-order-type contract necessarily encompasses a broad spectrum of activities. Consequently, if this is a task-order-type contract, the contractor agrees that it will disclose all proposed new work involving NRC licensees or applicants which comes within the scope of work of the underlying contract. Further, if this contract involves work at a licensee or applicant site, the contractor agrees to exercise diligence to discover and disclose any new work at that licensee or applicant site. This disclosure must be made before the submission of a bid or proposal to the utility or other regulated entity and must be received by the NRC at least 15 days before the proposed award date in any event, unless a written justification demonstrating urgency and due diligence to discover and disclose is provided by the contractor and approved by the contracting officer. The disclosure must include the statement of work, the dollar value of the proposed contract, and any other documents that are needed to fully describe the proposed work for the regulated utility or other regulated entity. NRC may deny approval of the disclosed work only when the NRC has issued a task order which includes the technical area and, if site-specific, the site, or has plans to issue a task order which includes the technical area and, if site-specific, the site, or when the work violates paragraphs (c)(2), (c)(3) or (c)(4) of this section.

(e) Access to and use of information.

(1) If in the performance of this contract, the contractor obtains access to information, such as NRC plans, policies, reports, studies, financial plans, internal data protected by the Privacy Act of 1974 (5 U.S.C. Section 552a (1988)), or the Freedom of Information Act (5 U.S.C. Section 552 (1986)), the contractor agrees not to:

(i) Use this information for any private purpose until the information has been released to the public;

(ii) Compete for work for the Commission based on the information for a period of six months after either the completion of this contract or the release of the information to the public, whichever is first;

(iii) Submit an unsolicited proposal to the Government based on the information until one year after the release of the information to the public; or

(iv) Release the information without prior written approval by the contracting officer unless the information has previously been released to the public by the NRC.

(2) In addition, the contractor agrees that, to the extent it receives or is given access to proprietary data, data protected by the Privacy Act of 1974 (5 U.S.C. section 552a (1988)), or the Freedom of Information Act (5 U.S.C. section 552 (1986)), or other confidential or privileged technical, business, or financial information under this contract, the contractor shall treat the information in accordance with restrictions placed on use of the information.

(3) Subject to patent and security provisions of this contract, the contractor shall have the right to use technical data it produces under this contract for private purposes provided that all requirements of this contract have been met.

(f) Subcontracts. Except as provided in 48 CFR 2009.570-2, the contractor shall include this clause, including this paragraph, in subcontracts of any tier. The terms contract, contractor, and contracting officer, must be appropriately modified to preserve the Government's rights.

(g) Remedies. For breach of any of the above restrictions, or for intentional nondisclosure or misrepresentation of any relevant interest required to be disclosed concerning this contract or for such erroneous representations that necessarily imply bad faith, the Government may terminate the contract for default, disqualify the contractor from subsequent contractual efforts, and pursue other remedies permitted by law or this contract.

(h) Waiver. A request for waiver under this clause must be directed in writing to the contracting officer in accordance with the procedures outlined in 48 CFR 2009.570-9.

(i) Follow-on effort. The contractor shall be ineligible to participate in NRC contracts, subcontracts, or proposals therefor (solicited or unsolicited), which stem directly from the contractor's performance of work under this contract. Furthermore, unless so directed in writing by the contracting officer, the contractor may not perform any technical consulting or management support services work or evaluation activities under this contract on any of its products or services or the products or services of another firm if the contractor has been substantially involved in the development or marketing of the products or services.

(1) If the contractor, under this contract, prepares a complete or essentially complete statement of work or specifications, the contractor is not eligible to perform or participate in the initial contractual effort which is based on the statement of work or specifications. The contractor may not incorporate its products or services in the statement of work or specifications unless so directed in writing by the contracting officer, in which case the restrictions in this paragraph do not apply.

(2) Nothing in this paragraph precludes the contractor from offering or selling its standard commercial items to the Government.

## **A.2 NRCAR 2052.212-72 FINANCIAL STATUS REPORT (DEC 1995)**

The contractor shall provide a monthly Financial Status Report to the project officer and the contracting officer. Also, whenever the report references the acquisition of, or changes in status of, property valued at the time of purchase at \$50,000 or more, send a copy of the report to the Chief, Property Management Branch, Division of Facilities and Property Management, Office of Administration. The report is due within 15 calendar days after the end of the report period and shall identify the title of the project, the contract number, job code, project manager and/or principal investigator, the contract period of performance, and the period covered by the report. Each report must include the following for each discrete task:

- (a) Total estimated contract amount.
- (b) Total funds obligated to date.
- (c) Total costs incurred this reporting period.
- (d) Total costs incurred to date.
- (e) Detail of all direct and indirect costs incurred during the reporting period for the entire contract or each task, if it is a task ordering contract.
- (f) Balance of obligations remaining.
- (g) Balance of funds required to complete contract/task order.

(h) Contractor Spending Plan (CSP) status:

(1) Projected percentage of completion cumulative through the report period for the project/task order as reflected in the current CSP.

(2) Indicate if there has been a significant change in the original CSP projection in either dollars or percentage of completion. Identify the change, the reasons for the change, whether there is any projected overrun, and when additional funds would be required. If there have been no changes to the original NRC- approved CSP projections, a written statement to that effect is sufficient in lieu of submitting a detailed response to item h.

(3) A revised CSP is required with the Financial Status Report whenever the contractor or the contracting officer has reason to believe that the total cost for performance of this contract will be either greater or substantially less than what had been previously estimated.

(i) Property status:

(1) List property acquired for the project during the month with an acquisition cost of \$500 or more and less than \$50,000. Give the item number for the specific piece of equipment.

(2) List property acquired for the project during the month with an acquisition cost of \$50,000 or more. Provide the following information for each line item of property: item description or nomenclature, manufacturer, model number, serial number, acquisition cost, and receipt date. If no property was acquired during the month, include a statement to that effect. Note: The same peripheral equipment which is part of a "system or system unit."

(3) For multi-year projects, in the September monthly financial status report provide a cumulative listing of property with an acquisition cost of \$50,000 or more (\$5,000 or more if purchased prior to October 1, 1995) showing the above information.

(4) In the final monthly status report provide a close-out property report containing the same elements described above for the monthly financial status reports, for all property purchased with NRC funds regardless of value unless title has been vested in the contractor. If no property was acquired under the contract, provide a statement to that effect. The report should note any property requiring special handling for security, health, safety, or other reasons as a part of the report.

(j) Travel status:

List the starting and end dates for each trip, the starting point and destination, and the traveler(s) for each trip.

If the data in this report indicates a need for additional funding beyond that already obligated, this information may only be used as support to the official request for funding required in accordance with the Limitation of Cost (LOC) Clause (FAR 52.232-20) or the Limitation of Funds (LOF) Clause FAR 52.232-22.

**A.3 2052.215-70 KEY PERSONNEL (JAN 1993)**

(a) The following individuals are considered to be essential to the successful performance of the work hereunder:



The contractor agrees that personnel may not be removed from the contract work or replaced without compliance with paragraphs (b) and (c) of this section.

(b) If one or more of the key personnel, for whatever reason, becomes, or is expected to become, unavailable for work under this contract for a continuous period exceeding 30 work days, or is expected to devote substantially less effort to the work than indicated in the proposal or initially anticipated, the contractor shall immediately notify the contracting officer and shall, subject to the concurrence of the contracting officer, promptly replace the personnel with personnel of at least substantially equal ability and qualifications.

(c) Each request for approval of substitutions must be in writing and contain a detailed explanation of the circumstances necessitating the proposed substitutions. The request must also contain a complete resume for the proposed substitute and other information requested or needed by the contracting officer to evaluate the proposed substitution. The contracting officer and the project officer shall evaluate the contractor's request and the contracting officer shall promptly notify the contractor of his or her decision in writing.

(d) If the contracting officer determines that suitable and timely replacement of key personnel who have been reassigned, terminated, or have otherwise become unavailable for the contract work is not reasonably forthcoming, or that the resultant reduction of productive effort would be so substantial as to impair the successful completion of the contract or the service order, the contract may be terminated by the contracting officer for default or for the convenience of the Government, as appropriate. If the contracting officer finds the contractor at fault for the condition, the contract price or fixed fee may be equitably adjusted downward to compensate the Government for any resultant delay, loss, or damage.

#### A.4 2052.215-71 PROJECT OFFICER AUTHORITY

(a) The contracting officer's authorized representative hereinafter referred to as the project officer for this contract is:

Name: Mr. Nathanael Hudson  
Address: U.S. Nuclear Regulatory Commission  
Mail Stop -CSB-3A07M  
21 Church Street  
Rockville, MD 20852  
Telephone Number: 301-251-7534

(b) Performance of the work under this contract is subject to the technical direction of the NRC project officer. The term "technical direction" is defined to include the following:

(1) Technical direction to the contractor which shifts work emphasis between areas of work or tasks, authorizes travel which was unanticipated in the Schedule (i.e., travel not contemplated in the Statement of Work or changes to

specific travel identified in the Statement of Work), fills in details, or otherwise serves to accomplish the contractual statement of work.

(2) Provide advice and guidance to the contractor in the preparation of drawings, specifications, or technical portions of the work description.

(3) Review and, where required by the contract, approval of technical reports, drawings, specifications, and technical information to be delivered by the contractor to the Government under the contract.

(c) Technical direction must be within the general statement of work stated in the contract. The project officer does not have the authority to and may not issue any technical direction which:

(1) Constitutes an assignment of work outside the general scope of the contract.

(2) Constitutes a change as defined in the "Changes" clause of this contract.

(3) In any way causes an increase or decrease in the total estimated contract cost, the fixed fee, if any, or the time required for contract performance.

(4) Changes any of the expressed terms, conditions, or specifications of the contract.

(5) Terminates the contract, settles any claim or dispute arising under the contract, or issues any unilateral directive whatever.

(d) All technical directions must be issued in writing by the project officer or must be confirmed by the project officer in writing within ten (10) working days after verbal issuance. A copy of the written direction must be furnished to the contracting officer. A copy of NRC Form 445, Request for Approval of Official Foreign Travel, which has received final approval from the NRC must be furnished to the contracting officer.

(e) The contractor shall proceed promptly with the performance of technical directions duly issued by the project officer in the manner prescribed by this clause and within the project officer's authority under the provisions of this clause.

(f) If, in the opinion of the contractor, any instruction or direction issued by the project officer is within one of the categories as defined in paragraph (c) of this section, the contractor may not proceed but shall notify the contracting officer in writing within five (5) working days after the receipt of any instruction or direction and shall request the contracting officer to modify the contract accordingly. Upon receiving the notification from the contractor, the contracting officer shall issue an appropriate contract modification or advise the contractor in writing that, in the contracting officer's opinion, the technical direction is within the scope of this article and does not constitute a change under the "Changes" clause.

(g) Any unauthorized commitment or direction issued by the project officer may result in an unnecessary delay in the contractor's performance and may even result in the contractor expending funds for unallowable costs under the contract.

(h) A failure of the parties to agree upon the nature of the instruction or direction or upon the contract action to be taken with respect thereto is subject to 52.233-1 - Disputes.

(i) In addition to providing technical direction as defined in paragraph (b) of the section, the project officer shall:

(1) Monitor the contractor's technical progress, including surveillance and assessment of performance, and recommend to the contracting officer changes in requirements.

(2) Assist the contractor in the resolution of technical problems encountered during performance.

(3) Review all costs requested for reimbursement by the contractor and submit to the contracting officer recommendations for approval, disapproval, or suspension of payment for supplies and services required under this contract.

(4) Assist the contractor in obtaining the badges for the contractor personnel.

(5) Immediately notify the Personnel Security Branch, Division of Facilities and Security (PERSEC/DFS) (via e-mail) when a contractor employee no longer requires access authorization and return the individual's badge to PERSEC/DFS within three days after their termination.

#### **A.5 CONSIDERATION AND OBLIGATION--LABOR HOURS TYPE TASK ORDER**

(a) The total estimated amount of this contract (ceiling) for the services ordered, delivered, and accepted under this contract is \$191,262.30.

(b) The amount presently obligated with respect to this contract is \$120,000.00. This obligated amount may be unilaterally increased from from time to time by the Contracting Officer by written modification to this contract. The obligated amount shall, at no time, exceed the contract ceiling as specified in paragraph a above. When and if the amount(s) paid and payable to the Contractor hereunder shall equal the obligated amount, the Contractor shall not be obligated to continue performance of the work unless and until the Contracting Officer shall increase the amount obligated with respect to this contract. Any work undertaken by the Contractor in excess of the obligated amount specified above is done so at the Contractor's sole risk.

#### **A.6 52.232-19 AVAILABILITY OF FUNDS FOR THE NEXT FISCAL YEAR (APR 1984)**

Funds are not presently available for performance under this contract beyond \$120,000.00. The Government's obligation for performance of this contract beyond that date is contingent upon the availability of appropriated funds from which payment for contract purposes can be made. No legal liability on the part of the Government for any payment may arise for performance under this contract beyond \$120,000.00, until funds are made available to the Contracting Officer for performance and until the Contractor receives notice of availability, to be confirmed in writing by the Contracting Officer.

#### **A.7 2052.215-81 TRAVEL REIMBURSEMENT**

(a) Total expenditure for domestic travel may not exceed \$2,600.00 without the prior approval of the contracting officer.

(b) The contractor is encouraged to use Government contract airlines, AMTRAK rail services, and discount hotel/motel properties in order to reduce the cost of travel under this contract. The contracting officer shall, upon request, provide each traveler with a letter of identification which is required in order to participate in this program. The Federal Travel Directory (FTD) identifies carriers, contract fares, schedules, payment conditions, and hotel/motel properties which offer their services and rates to Government contractor personnel traveling on official business under this contract. The FTD, which is issued monthly, may be purchased from the U.S. Government Printing Office, Washington, DC 20402.

(c) The contractor will be reimbursed for reasonable travel costs incurred directly and specifically in the performance of this contract. The cost limitations for travel costs are determined in accordance with the specific travel regulations

cited in FAR 31.205-46, as are in effect on the date of the trip. Travel costs for research and related activities performed at State and nonprofit institutions, in accordance with section 12 of Public Law 100-679, shall be charged in accordance with the contractor's institutional policy to the degree that the limitations of Office of Management and Budget (OMB) guidance are not exceeded. Applicable guidance documents include OMB Circular A-87, Cost Principles for State and Local Governments; OMB Circular A-122, Cost principles for Nonprofit Organizations; and OMB Circular A-21, Cost Principles for Educational Institutions.

(d) When the Government changes the Federal Travel Regulations, or other applicable regulations, it is the responsibility of the contractor to notify the contracting officer in accordance with the Limitations of Cost clause of this contract if the contractor will be unable to make all of the approved trips and remain within the cost and fee limitations of this contract due to the changes.

#### **A.8 NRC Acquisition Clauses - (NRCAR) 48 CFR Ch. 20**

#### **A.9 Other Applicable Clauses**

See Addendum for the following in full text (if checked)

52.216-18, Ordering

52.216-19, Order Limitations

52.216-22, Indefinite Quantity

52.217-6, Option for Increased Quantity

52.217-7, Option for Increased Quantity Separately Priced Line Item

52.217-8, Option to Extend Services

52.217-9, Option to Extend the Term of the Contract

#### **A.10 SEAT BELTS**

Contractors, subcontractors, and grantees, are encouraged to adopt and enforce on-the-job seat belt policies and programs for their employees when operating company-owned, rented, or personally owned vehicles.

#### **A.11 WHISTLEBLOWER PROTECTION FOR NRC CONTRACTOR AND SUBCONTRACTOR EMPLOYEES (JULY 2006)**

(a) The U.S. Nuclear Regulatory Commission (NRC) contractor and its subcontractor are subject to the Whistleblower Employee Protection public law provisions as codified at 42 U.S.C. 5851. NRC contractor(s) and subcontractor(s) shall comply with the requirements of this Whistleblower Employee Protection law, and the implementing regulations of the NRC and the Department of Labor (DOL). See, for example, DOL Procedures on Handling Complaints at 29 C.F.R. Part 24 concerning the employer obligations, prohibited acts, DOL procedures and the requirement for prominent posting of notice of Employee Rights at Appendix A to Part 24.

(b) Under this Whistleblower Employee Protection law, as implemented by regulations, NRC contractor and subcontractor employees are protected from discharge, reprisal, threats, intimidation, coercion, blacklisting or other employment discrimination practices with respect to compensation, terms, conditions or privileges of their employment because the contractor or subcontractor employee(s) has provided notice to the employer, refused to engage in unlawful practices, assisted in proceedings or testified on activities concerning alleged violations of the Atomic Energy Act of 1954 (as amended) and the Energy Reorganization Act of 1974 (as amended).

(c) The contractor shall insert this or the substance of this clause in any subcontracts involving work performed under this contract.

#### **A.12 AUTHORITY TO USE GOVERNMENT PROVIDED SPACE AT NRC HEADQUARTERS (JUNE 2006)**

Prior to occupying any government provided space at the NRC Headquarters in Rockville, Maryland, the Contractor shall obtain written authorization to occupy specifically designated government space via the NRC Project Officer from the Chief, Space Planning and Property Management Branch, Division of Facilities and Security. Failure to obtain this prior authorization may result in one or a combination of the following remedies as deemed appropriate by the Contracting Officer.

1. Rental charge for the space occupied to be deducted from invoice amount due the Contractor
2. Removal from the space occupied
3. Contract Termination

#### **A.13 OPTION PERIODS - TASK ORDER/DELIVERY ORDER UNDER A GSA FEDERAL SUPPLY SCHEDULE CONTRACT (MARCH 2007)**

The Period of Performance (PoP) for this requirement may extend beyond the Offeror's current PoP on their GSA Schedule. Offerors may submit proposals for the entire PoP as long as their current GSA Schedule covers the requested PoP, or their GSA Schedule contains GSA's "Evergreen Clause" (Option to Extend the Term of the Contract), which covers the requested PoP if/when the option(s) are exercised. Offerors are encouraged to submit accurate/realistic pricing for the requirement's entire PoP, even if the proposed GSA Schedule does not include pricing for the applicable option years, etc.

For proposal evaluation purposes, the NRC assumes that applicable Evergreen Clause Option(s) will be exercised and the NRC will apply price analysis, as applicable. It is in the best interest of the Offeror to explain major deviations in escalation, proposed in any Evergreen Clause option years. Resulting GSA task/delivery order option years subject to the Evergreen Clause will be initially priced utilizing the same rates proposed under the last GSA-priced year of the subject GSA Schedule. Upon GSA's exercise of the GSA Schedule option year(s) applicable to the Evergreen Clause, the NRC will modify the awarded task/delivery order to incorporate either the proposed pricing for the option years or the GSA-approved pricing (whichever is lower).

It is incumbent upon the Offeror to provide sufficient documentation (GSA-signed schedule, schedule modifications, etc.) that shows both the effective dates, pricing and terms/conditions of the current GSA Schedule, as well as Evergreen Clause terms/conditions (as applicable). Failure to provide this documentation may result in the Offeror's proposal being found unacceptable.

ATTACHMENT B

STATEMENT OF WORK

TITLE: TRACE Applicability to Anticipated Operational Occurrences in BWR's

I. BACKGROUND

Two of the major components of the staff's reactor systems analysis suite are the TRAC/RELAP Advanced Computational Engine (TRACE<sup>1</sup>) system thermal hydraulics code and the PARCS<sup>2</sup> reactor physics nodal code. TRACE is a best estimate reactor system thermal hydraulics code that is used for the analysis of transient and steady-state behavior in light water reactors. PARCS is used to simulate three-dimensional (3-D) steady-state core neutronics and fuel depletion. The TRACE/PARCS combination is used for the analyses of normal operations and transients, the analyses to support resolution of generic issues, evaluation of emergency procedures and accident management strategies, confirmation of licensee's analyses, testing the fidelity of NRC simulators, training exercises for NRC staff, and supporting analyses for the certification review of advanced reactor designs.

TRACE V5.0 has been largely assessed for Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) loss-of-coolant accidents. However, to support application of TRACE to the Anticipated Operational Occurrences (AOO's) that may occur during BWR operation, TRACE assessment needs to be performed against additional separate effects tests and integral effects tests.

II. OBJECTIVE

The objective of this work is to assess the performance of TRACE against data applicable to BWR AOO's. New assessment problems for TRACE will be developed against experimental facilities, using the following guidelines.

General Requirements for Development Assessment

Developmental assessment (also known as validation testing) is a part of code quality assurance procedures outlined in "Software Quality Assurance Procedures for NRC Thermal Hydraulic Codes," NUREG-1737. In the developmental assessment process, code-calculated results are compared either to analytical results, or experimental results, or other acceptable code calculation. Developmental assessment shall contain the following activities:

1. Identification of the phenomena occurring in the test facility. This requires careful study of the test facility, experimental procedure, and experimental data. The report shall include a

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<sup>1</sup>TRACE is an acronym for "TRAC (*Transient Reactor Analysis Code*) RELAP (*Reactor Excursion and Leak Analysis Program*) Advanced Computational Engine."

<sup>2</sup>PARCS is an acronym for "Purdue Advanced Reactor Core Simulator."

description of the facility, experimental procedure, and discussion of the measurement uncertainty, interpretation of the data, and the effect of the uncertainty on the data and their interpretation.

2. Development of the input deck. This requires familiarity with the TRACE User Guide and an understanding of the phenomena in order to capture important phenomena governing the process. The report shall include nodalization diagrams, as needed, a listing of the input deck, and discussion and justification of options used to construct the input deck.
3. Development of the acceptance criteria. Acceptance criteria permit acceptance of results calculated by the code when compared to experimental data. It requires careful study of the experimental data to distinguish measurement uncertainty from random behavior of the data, especially during two-phase flow. As explained in NUREG-1737, the acceptance criteria can be qualitative or quantitative. Appendix C of NUREG-1737 presents sample acceptance criteria. The report shall include a discussion of the development of the acceptance criteria used for this project.
4. Comparison of Code Calculations with the Test Data. This requires running the code with a selected version of the code and comparing the results with test data. If comparisons indicate that the acceptance criteria are met, then the code results are acceptable. If they do not meet the acceptance criteria, sensitivity calculations may be required. Sensitivity calculations may be needed in order to capture phenomena more accurately. These calculations are performed using different nodalization schemes or choosing more appropriate options. Changes to the input deck to perform sensitivity calculations should be discussed and justified. If sensitivity calculations indicate a better agreement with the test data and that acceptance criteria are met, new user guidelines better capturing the phenomena should be prepared. The report shall include discussions of comparisons of code calculations with the test data, including whether or not acceptance criteria are met. If the criteria are not met, the report shall also include discussion of the need for sensitivity calculations, and if sensitivity calculations are performed, the report shall also include a description of the calculated results and new user guidelines, if applicable.

### III. SCOPE OF WORK

#### New TRACE Assessments.

To expand the validation base for BWR AOO's, new assessment problems for TRACE shall be developed for the FRIGG and FIST tests, the BFBT transient, and the Christensen tests.

In the case of the FRIGG and FIST series of tests, several developmental assessment problems have already been performed, and this effort will extend the existing assessment for an additional series of tests. With guidance and interaction with the Project Manager (PM), several parameterized TRACE models will be selected and developed from each of several classes of runs that were meant to capture certain phenomena.

In the case of FRIGG experiments (Reference 1), several TRACE models will be developed from the Natural Circulation Tests, the Stability Tests, and the Void Fraction Tests that have not been completed so far. Such a test matrix may include, but be not limited to the following series of runs.

Table 1: FRIGG Tests

Test	Series
FRIGG-Natural Circulation Tests	601147-157; 601158-167; 601168-174
FRIGG-Stability Tests	601205-210
FRIGG-Void Fraction Tests	613127, 613130, 613005, 613006

In the case of FIST series of experiments (References 2 and 3), more TRACE models and comparisons will be made for the transient and ATWS (Anticipated Transient Without SCRAM) cases that have not been completed. Such a test matrix may include the following runs.

Table 2: FIST Tests

Test	Series
FIST	6SB2
	6SB2B
	4PMC1
	6PMC1
	6PMC2
	6PMC2A
	6PMC3-A2
	6PMC3-B
6PMC3-B2	

For the Christensen--Subcooled Boiling test (Test #15) (Reference 4), a new assessment problem (TRACE input deck and comparison report) will be developed from the experimental data and reports.

For the case of the BWR Full-Size Fine-Mesh Bundle Tests (BFBT) the transient problems of both Phase I and II will be performed, with the TRACE input decks being developed from the problem benchmark specifications (References 5). Comparisons will be made to the measured critical power and void distributions.

Table 3: BFBT Tests

Test	Series
BFBT-Phase I	Exercise 3
BFBT-Phase II	Exercise 2

The following steps shall be taken in developing these assessments:

- A) Develop a TRACE input deck.

B) Simulate the tests case and compare the code predicted results to the applicable experimental data. Develop AVScript inputs for each test run so that the same test condition can be simulated easily with newer versions of the TRACE code.

C) Using the general guidelines above, produce a technical report 1) containing short descriptions of the relevant parameters of the test facility and 2) describing the phenomena occurring in the run, 3) discussing why the input deck with selected nodalization and options should capture the phenomena, 4) discussing comparisons of the TRACE calculations with the test data, 5) providing details of the TRACE calculations and discussing the acceptability of these calculations. If the code does not run or some errors are discovered, these problems will be communicated to the NRC. The NRC staff will resolve these problems within a period of time which will be negotiated. If the correction of these errors cause some delays in delivery of final products, the NRC PM will initiate appropriate modifications as necessary. These reports will be prepared first in a draft form for review by NRC. It will be issued in a final form after the contractor resolves the comments.

For the above problems, if digitized experimental results are not available from the NRC Reactor Safety Data Bank (or equivalent source), then it may be necessary to scan the historical reports of the experiments and digitize the data with specialized software. In the case of the FIST and FRIGG series experiments, existing TRACE input decks and assessment reports are already available for parts of the series.

If, through these exercises, it is determined that the selected test series aren't available (or else, for whatever reason, don't capture the phenomena desired for a BWR AOO), a comparable test case shall be substituted with the permission of the PM.

Estimated Level of Effort: 10 S-M

Estimated Completion Date: 12 months after contract initiation.

Expected milestone deliverables and due dates:

- Draft assessment matrix.
  - Due: 2 months after contract initiation
- Draft input decks, assessment results, draft report, and AVScripts.
  - Due: 10 months after contract initiation
- Final input decks, assessment results, report, and AVScripts.
  - Due: 12 months after contract initiation

## REFERENCES

1. O. Nylund, K. M. Becker, R. Eklund, O. Gelius, A. Jensen, D. Malnes, A. Olsen, Z. Rouhani, F. Akerhielm, "FRIGG Loop Project: Hydrodynamic and Heat Transfer Measurements on a Full-scale Simulated 36-rod BWR Fuel Element with Non-uniform Axial and Radial Heat Flux Distribution." FRIGG-4, R4-502/RL-1253, Sweden, 1970.
2. W. S. Hwang, Md. Alamgir, and W. A. Sutherland, "BWR Full Integral Simulation Test (FIST) Phase 1 Test Results," NUREG/CR-3711, EPRI NP-3602, GEAP-30496, September 1984.

3. A. G. Stephens, "BWR Full Integral Simulation Test (FIST) Program Facility Description Report," NUREG/CR-2576, EPRI NP-2314, GEAP-22054, September 1984.
4. K.E. Carlson, R.A. Riemke, S.Z. Rouhani, R.W. Shumway and W.L. Weaver, RELAP5/MOD3 Code Manual Volume III: Developmental Assessment Problems (DRAFT), EG&G Idaho, Inc., NUREG/CR-5535, EGG-2596, Volume III, June 1990.
5. B Neykov, F. Aydogan, L. Hochreiter, K. Ivanov, H. Utsuno, K. Fumio, E. Sartori, OECD/NRC Benchmark Based on NUPEC BWR Full-Size Fine-Mesh Bundle Test (BFBT) Benchmark: Volume I: Specifications. NEA Nuclear Science Committee/NEA Committee on Safety of Nuclear Installations. May 2005. NEA/NSC/DOC(2005)5 Version 02.

#### IV. RESEARCH QUALITY

The quality of NRC research programs are assessed each year by the Advisory Committee on Reactor Safeguards. Within the context of their reviews of RES programs, the definition of quality research is based upon several major characteristics:

- Results meet the objectives (75% of overall score)
  - Justification of major assumptions (12%)
  - Soundness of technical approach and results (52%)
  - Uncertainties and sensitivities addressed (11%)

- Documentation of research results and methods is adequate (25% of overall score)
  - Clarity of presentation (16%)
  - Identification of major assumptions (9%)

It is the responsibility of the contractor to ensure that these quality criteria are adequately addressed throughout the course of the research that is performed. The NRC project manager and technical monitor will review all research products with these criteria in mind.

#### V. TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

The contractor shall provide personnel that are experienced in thermal-hydraulic analysis as it applies to the nuclear industry, recent familiarity with TRACE plant model development, and some historical knowledge of other systems thermal hydraulic codes such as TRAC-BF1 or RELAP. The thermal-hydraulic analyst must also have a working knowledge of AVScript.

It is the responsibility of the contractor to assign technical staff, employees, subcontractors, or specialists who have the required educational background, experience, or combination thereof to meet both the technical objectives of the work specified in this SOW. In addition, the contractor and personnel assigned to this work must be approved for handling and working with proprietary information.

The use of key personnel and any proposed change to key personnel on this contract is subject to the NRC Contracting Officer's written approval. This includes proposed use of principal persons (i.e., key contributors) during the life of the contract.

For any work to be subcontracted or performed by consultants to the contractor, the contractor shall obtain the NRC Contracting Officer'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.

Site access will not be required for this effort.

VI. DELIVERY SCHEDULE

Deliverables and their due dates are summarized below.

<b>Deliverable</b>	<b>Schedule</b>
1. Draft Assessment Matrix	Within 2 months of contract award
2. Draft Input Decks, Assessment Results, Draft Report and AVScripts	Within 10 months of contract award
3. Final Input Decks, Assessment Results, Report and AVScripts	Within 12 months of contract award
4. Monthly Status Letter Report	Monthly by the 20 <sup>th</sup> of the month following the reporting period

VII. PLACE OF DELIVERY--REPORTS

The items to be furnished hereunder shall be delivered, with all charges paid by the Contractor, to:

(a) Project Officer (1 hard & electronic copy)

Mr. Nathanael Hudson  
Mail Stop: CSB-3A07M  
U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555-0001

Phone: (301) 251-7534  
Email: Nathanael.Hudson@nrc.gov

Hand-Carried mail should be sent to:  
U. S. Nuclear Regulatory Commission  
Mail Stop: CSB-3A07M  
11545 Rockville Pike  
Rockville, MD 20852-2738

(b) NRC Contract Specialist (1 electronic copy)

Mr. Michael Mills (Michael.Mills@nrc.gov)

#### VIII. PERIOD OF PERFORMANCE

The period of performance for this contract is April 14, 2010 through April 13, 2011.

#### IX. PUBLICATIONS NOTE

RES encourages the publication of the scientific results from RES sponsored programs in refereed scientific and engineering journals as appropriate. If the laboratory proposes to publish in the open literature or present the information at meeting in addition to submitting the required technical reports, approval of the proposed article or presentation should be obtained from the NRC Project Manager. The RES Project Manager shall either approve the material as submitted, approve it subject to NRC suggested revisions, or disapprove it. In any event, the RES Project Manager may disapprove or delay presentation or publication of papers on information that is subject to Commission approval that has not been ruled upon or which has been disapproved. Additional information regarding the publication of NRC sponsored research is contained in NRC Management Directives 3.7, "NUREG Series Publications," and 3.9, "NRC Staff and Contractor Speeches, Papers, and Journal Articles on Regulatory and Technical Subjects."

If the presentation or paper is in addition to the required technical reports and the RES Project Manager determines that it will benefit the RES project, the Project Manager may authorize payment of travel and publishing costs, if any, from the project funds. If the Project Manager determines that the article or presentation would not benefit the RES project, the costs associated with the preparation, presentation, or publication will be borne by the contractor. For any publication or presentations falling into this category, the NRC reserves the right to require that such presentation or publication will not identify the NRC's sponsorship of the work.

#### X. NEW STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS

The U.S. Nuclear Regulatory Commission (NRC) began to capture most of its official records electronically on January 1, 2000. The NRC will capture each final NUREG-series publication in its native application. Therefore, please submit your final manuscript that has been approved by your NRC Project Manager in both electronic and camera-ready copy.

All format guidance, as specified in NUREG-0650, Revision 2, will remain the same with one exception. You will no longer be required to include the NUREG-series designator on the bottom of each page of the manuscript. The NRC will assign this designator when we send the camera-ready copy to the printer and will place the designator on the cover, title page, and spine. The designator for each report will no longer be assigned when the decision to prepare a publication is made. The NRC's Publishing Services Branch will inform the NRC Project Manager for the publication of the assigned designator when the final manuscript is sent to the printer.

For the electronic manuscript, the Contractor shall prepare the text in Microsoft Word, and use any of the following file types for charts, spreadsheets, and the like.

File Types to be Used for NUREG-Series Publications	
File Type	File Extension
Microsoft®Word®	.doc
Microsoft® PowerPoint®	.ppt
Microsoft®Excel	.xls
Microsoft®Access	.mdb
Portable Document Format	.pdf

This list is subject to change if new software packages come into common use at NRC or by our licensees or other stakeholders that participate in the electronic submission process. If a portion of your manuscript is from another source and you cannot obtain an acceptable electronic file type for this portion (e.g., an appendix from an old publication), the NRC can, if necessary, create a tagged image file format (file extension.tif) for that portion of your report. Note that you should continue to submit original photographs, which will be scanned, since digitized photographs do not print well.

If you choose to publish a compact disk (CD) of your publication, place on the CD copies of the manuscript in both (1) a portable document format (PDF); (2) a Microsoft Word file format, and (3) an Adobe Acrobat Reader, or, alternatively, print instructions for obtaining a free copy of Adobe Acrobat Reader on the back cover insert of the jewel box.

#### XI. Monthly Letter Status Report

A Monthly Letter Status Report (MLSR) is to be submitted to the NRC Project Manager by the 20<sup>th</sup> of the month following the month to be reported with copies provided to the Contracting Officer and to the following:

Resource Name: 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 shall be immediately brought to the attention of the NRC project manager.

The MLSR must be organized in the following manner:

1. Objective - Provide a brief statement of understanding of the objectives of the project

2. Spending Plan - Provide a list of expenditures on each task for the period and compare results with the funding allocated and remaining for the task
3. Progress During Reporting Period - Discuss the work performed during the reporting period. Discussion must include sufficient detail to support the costs reported for the period.
4. Financial Schedule Status – Refer to page 2 of the contract (Task Order Terms and Conditions) A.1 NRCAR 2052.212-72 Financial Status Report (Dec 1995).
5. Travel - Travel taken during the reporting period must be described and must include, as a minimum, the purpose of the travel, whether prior NRC authorization was required and obtained, the identity of the traveler, beginning and end days of the travel, and the origin and destination points. The cost of travel shall be reported in "Financial Schedule Status" as per the attached format.
6. Anticipated and Encountered Problem Areas - Problems both encountered during the performance period and anticipated for the next performance period must be identified and discussed. Discussion of problems must include the actual or proposed solutions if a solution has not been implemented during the performance period.

Variance - Any variance in either schedule or spending rate must be identified and discussed in detail. Discussions must include the cause for the variance, together with any proposed solution to the dates and cost within planned dates and amounts

## XII. DISSEMINATION OF INFORMATION

There shall be no dissemination or publication, except within and between the Contractor and any subcontractors, of information developed under this contract or contained in the reports to be furnished pursuant to this contract without prior written approval from the Contracting Officer.

## XIII. RELEASE OF REPORTS

The Contractor is prohibited from releasing to any source, other than the sponsoring activity, any interim, draft and final reports or information pertaining to services performed under this contract until report approval or official review has been obtained. Furthermore, the contractor shall insure that the cover of all interim, draft and final reports contain the following statement: "The view, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Government position, policy or decision, unless so designated by other documentation."

## XIV. RELEASE OF NEWS INFORMATION

No news release (including photographs and films, public announcements, denial or confirmation of same) on any part of the subject matter of this contract or any phase of any program hereunder shall be made without the prior written approval of the Contracting Officer.

XV. MEETINGS AND TRAVEL

There will be an initial program kick-off meeting upon contract award. There will also be a program review meeting mid-way through the POP. Both meetings will be held at the NRC headquarters in the Rockville, MD area. In these meetings, travel will be allowed by two contractor staff members (the PI and one additional contractor staff).

## Appendix A

### Special Requirements:

All code development activities must follow principles described in NUREG-1737 and adhere to the Programming Guidelines and Design Philosophies as outlined on the TRACE Development website <https://trace.nrc.gov>. The contractor shall prepare a Software Requirements Document (SRD) (using an established NRC Framemaker template), Test Plan, and Software Design and Implementation Document (SDID) before implementing new models or features and submit them to NRC for their approval. Upon approval of the SRD and SDID, the contractor shall implement the changes. The results of the programming effort shall be documented in a Completion Report. The contractor does have the freedom to combine these documents, where appropriate and with NRC approval. It is important is that the relevant topics belonging to each document be addressed and formally communicated.

All code transmittal packages shall be generated using the buildTransmittal.pl perl script and shall include the following:

- SQA documentation
- Patch files to the TRACE source in diff format
- Modified source files
- HTML summary file explaining the nature of the changes and testing
- Modified test input files (if any)
- Newly added test input decks (if any)
- HTML results of the testSummary.pl script (generated for the regression test set)
- AVScript input files (if applicable)
- Scripts or programming tools that might have been used/generated in the course of completing the update

If changes to the code manuals are required in conjunction with a particular update, the contractor may be asked by NRC to make those modifications in addition to the SQA documentation outlined above. Regarding this issue, it is NRC's expectation that the contractor shall become familiar with the content of each chapter in each manual so that manual changes are applied comprehensively and at a level of detail similar to the content that surrounds the modified or added text. The contractor shall ensure that inconsistencies between various sections of content (either in thought or in nomenclature) are not introduced.

Changes to manuals shall generally be made to the on-line, official electronic files directly. In cases where this practice is either not prudent or not possible, the contractor shall use Framemaker's built-in change bar feature to call out modifications to make it easier for NRC staff to integrate those changes into the official electronic files at the appropriate time.

The NRC will not consider it acceptable to submit graduate theses as the final product of research. All final assessment reports shall use NRC-supplied Framemaker templates and in accordance with the specifications provided in the Statement of Work.

The development of all assessment input problems shall be accompanied by the development of a calculation notebook that justifies the use of every value provided in the model. For every value, the calculation notebook shall answer the questions such as

- What is it?
- Why was it chosen?
- What did you have to assume?
- How was it calculated? and/or
- Where did it come from?

The calculation notebook shall be prepared in an electronic format using a template to be provided by the NRC.

## Appendix B

### TRACE Standard F90 Programming Practices and General Design Philosophies

Last updated: 12/07/2005

Developers shall adhere to these practices for all new coding. Please send feedback to [Christopher.Murray@nrc.gov](mailto:Christopher.Murray@nrc.gov). Improper style in old coding will be corrected as resources permit.

\* Write GOOD requirements - see

<http://www.incose.org/workgrps/rwg/writing.html> for some online guidelines

\* All code SQA reports and code documentation shall be prepared and submitted to NRC in Framemaker format. Equations shall be generated using Framemaker's built-in equation tools. Line and vector-based diagrams shall be generated using Framemaker's built-in drawing tools. In cases where this is not possible, the original picture files shall accompany the document and be in a format editable by common drawing tools (eps, svg, mif, pdf, cdr). Use encapsulated postscript (eps) only as a very last resort - we expect developers to employ modern drawing tools that will not lead to this limitation. For engineering plots, ACGrace is the preferred program for generating such plots. Save them to mif format for importing into a Framemaker document. Plots shall NOT be imported as bitmap images (use vector formats instead. For raster/bitmap pictures, the image may be inserted directly into the document, but the transmittal shall include the image in its own file in a standard format (gif, png, or jpg).

\* All new variables will be explicitly typed, and all new routines shall include IMPLICIT NONE statements.

\* Implement a standard KIND representation for Integers and Reals

+ Always insert the line "USE IntrType" after the MODULE statement, or for any subprograms that are not module procedures, after the SUBROUTINE or FUNCTION statement. If IntrType is declared at the module level, there is no need to include it within the CONTAINED subroutines.

+ Begin all definitions of real variables with "REAL(sdk)"

+ Begin all definitions of integer variables with "INTEGER(sik)"

\* All use of real and integer constants should be implemented with the \_sdk and \_sik kind type parameters

+ For example, use 2\_sik instead of just 2, or 1.0e+10\_sdk instead of 1.0d+10, etc

\* Do not use continuation lines inside of variable declaration statements

\* When declaring a variable of TYPE POINTER, ALWAYS initialize it with the => NULL() syntax.

\* Get in the habit of using default initialization whenever variables are declared, but keep in mind that use of this syntax implies the SAVE attribute for any variable for which this is done.

Developers should get in the habit of using the ONLY syntax in their USE statements. This prevents unintended variables from coming into scope and preventing the compiler from detecting instances where a local variable is undeclared or an unintended global variable is used mistakenly (as can happen with variables like cco when cutting and pasting code).

\* Developers should always strive for object-oriented designs. What does this imply? It means that coding should be data-centric. In other words, design the data structure first. Make it flexible enough to handle all possible situations for which you could ever envision needing it. Once an effective data structure is fleshed out, on paper, begin to think about methods that operate on that data structure. As a minimum, there ought to be constructor/initialization and destructor methods for the data structure as a whole and any substructure pointer or allocatable arrays that might exist. Make the data structure PRIVATE to the module of interest. Access to the data structure shall only be through subroutines or functions. Factor these ideas into your proposals and predictions about time and cost. NRC will expect it. The penalty with these sorts of designs is in run-time speed, so there may be situations where such designs don't make sense but a developer's priorities should be object-oriented first, run-time second. Speed can always be recaptured in the next generation of processors or by optimizing other aspects of the code. If resource permit, some prototyping of various methodologies to understand the exact costs/benefits would be appropriate.

\* All dummy arguments and important local variables should be declared within their own TYPE declaration statements.

\* The INTENT of all dummy arguments should be declared in all new coding

\* Do not use bare END statements

\* All Fortran statements, attributes, intrinsic subprograms, and logical operators in new coding shall be in all upper case.

```
REAL(sdk), POINTER, DIMENSION(:,:) :: a, aa
```

```
IF ( i.GT.j ) THEN
```

\* Leading and trailing underscores shall not be used in any names (due to the potential for name mangling issues during linking), but underscores in the middle of names are allowed.

\* Variable, file, and procedure names will be long enough to be self-documenting, within reason, with a suggested limit of 15-20 characters

\* All new variable names shall have the first letter of each sub-element capitalized except the first, as in pipeData.

\* All derived type names shall end in "T", as in pipeDataT.

\* Module and subprogram names will begin with a capitalized letter, but don't change old subprogram names.

\* All new coding shall be structured, with an indentation level of three spaces.

```
DO i = 1,n
  DO j = 1,n
    IF (i.gt.j) THEN
      a(i,j) = - aa(j,i)
    ELSE
      a(i,j) = aa(i,j)
    ENDIF
  ENDDO
ENDDO
```

\* Use IF-THEN-ENDIF instead of IF (condition) statement

\* "GOTO" statements shall be used sparingly, if at all. Instead, programmers should use IF-THEN-ELSE, SELECT CASE, CYCLE, EXIT, and internal subprograms as appropriate

\* Use standard F90 free format code style with the following exceptions:

+ a limit of 110 columns per line

+ Source code should generally start in column 7. Columns 1-6 are to be reserved for statement labels. This does not apply to comments and MODULE statements.

\* Comments lines are indicated with a "!" in column 1.

\* Comments that serve to delineate, summarize, and/or clarify larger multi-step algorithms shall be indented one or two spaces.

\* Comments that serve to clarify the intent of and/or summarize small blocks of code shall be given the same indentation level as that code.

\* Comments shall be offset by at least one blank line from the previous F90 statement.

\* Never place a comment at the end of a continued line (illegal Fortran).

Try not to ever use multi-line statements. It makes writing scripts to parse FORTRAN more difficult and invalidates line coverage profiling studies.

\* End-of-line comments should not be used except in context of data type declaration statements or where a brief comment on the same line as the statement clearly accentuates and improves the readability and intent of the IF statement or block that follows, ala

```
INTEGER(sik) :: height = 0.0_sdk ! height of the cell
```

or

```
IF (fillTab(cco)%flowin .GE. 0.0d0) THEN !Determine donor cell mixture.
```

\* Comment blocks should generally not be longer than a dozen lines (additional information can go in the programmer's manual, and/or the SDID subroutine report).

\* Authorship information shall be included for each new subroutine that a developer creates or rewrites from scratch. When significant, well defined blocks of changes (on the order of 100 lines or more) are made to an existing subroutine, a note should be placed directly beneath the existing authorship info (or below the subroutine purpose if it doesn't) denoting the name, organization, date and quick description of the modifications. Authorship info should not be provided when the changes are spread out (i.e. not in well defined blocks) - even if they significantly modify some behavior of the algorithm contained therein - although the subroutine description should be checked for accuracy and modified when appropriate.

\* The following standard template should be used for each new subroutine that is developed (a plug-in to Visual Fortran has been created which can create this automatically):

```
SUBROUTINE SampleSub()  
!  
USE IntrType  
IMPLICIT NONE  
!  
! The purpose of this routine is to <<Insert Description here>>  
!  
! Programmed by Name, Organization, Date (Month/Year)  
!  
! Subroutine Argument Descriptions:  
!  
! Variable Declarations:  
!  
RETURN  
!  
END SUBROUTINE SampleSub  
!
```

When making a change, in general do not comment out the old coding but instead delete it.

\* Do not surround your coding with your initials - it just uglifies the code.

- \* Never use COMMON. Use a MODULE and corresponding USE instead.
- \* Never use EQUIVALENCE. Use POINTERS if you must, but better practice is to redesign so pointers are not necessary.
- \* All code shall be standard F90 - no use of non-standard compiler extensions or preprocessor definitions are allowed.
- \* If available in the compiler, all code should be developed with strict F90 standards checking and array bounds checking turned on. Also, compiler flags should be engaged which check for any unused variables and uninitialized variables. If any unused variables are located in a routine that a developer touches, then he or she shall remove them.
- \* If a new subroutine is added to the code outside the scope of a MODULE statement, then an explicit interface to that routine should be created. This allows the compiler to handle checking of the argument lists at compile time.
- \* Developers shall remove any unused subroutines which are created as a result of their efforts.
- \* When incorporating legacy code from other computer codes into TRACE, every effort should be made to clean that code up and make sure it conforms to the stylistic rules and design philosophies outlined in this document.

When preparing an SRD for a particular development project, the requirements should take into account the planned update's effect on or interaction with such areas as:

- + restart processing
- + CSS controllers
- + control system
- + exterior component and other parallel programming interfaces
- + timestep backup flow logic
- + SNAP and/or VEDA
- + English units

\* Any modification or enhancement of intercomponent transfer of information should never involve direct modification of bd array elements. All transfer should be arranged during the initialization phase of the calculation (module SysService) through the system service transfer tables.

**Attachment C**  
**BILLING INSTRUCTIONS FOR**  
**LABOR HOUR/TIME AND MATERIALS TYPE CONTRACTS (JUNE 2008)**

**General:** During performance and through final payment of this contract, the contractor is responsible for the accuracy and completeness of data within the Central Contractor Registration (CCR) database and for any liability resulting from the Government's reliance on inaccurate or incomplete CCR data.

The contractor shall prepare vouchers/invoices as prescribed herein. FAILURE TO SUBMIT VOUCHERS/INVOICES IN ACCORDANCE WITH THESE INSTRUCTIONS WILL RESULT IN REJECTION OF THE VOUCHER/INVOICE AS IMPROPER.

**Form:** Claims shall be submitted on the payee's letterhead, voucher/invoice, or on the Government's Standard Form 1034, "Public Voucher for Purchases and Services Other than Personal," and Standard Form 1035, "Public Voucher for Purchases Other than Personal--Continuation Sheet."

**Number of Copies:** A signed original shall be submitted. If the voucher/invoice includes the purchase of any property with an initial acquisition cost of \$50,000 or more, a copy of the signed original is also required.

**Designated Agency Billing Office:** The preferred method of submitting vouchers/invoices is electronically to the Department of the Interior at [NRCPayments@nbc.gov](mailto:NRCPayments@nbc.gov)

If the voucher/invoice includes the purchase of any property with an initial acquisition cost of \$50,000 or more, a copy of the signed original shall be electronically sent to: [Property@nrc.gov](mailto:Property@nrc.gov)

However, if you submit a hard-copy of the voucher/invoice, it shall be submitted to the following address:

Department of the Interior  
National Business Center  
Attn: Fiscal Services Branch - D2770  
7301 West Mansfield Avenue  
Denver, CO 80235-2230

If you submit a hard-copy of the voucher/invoice and it includes the purchase of any property with an initial acquisition cost of \$50,000 or more, a copy of the signed original shall be mailed to the following address:

U.S. Nuclear Regulatory Commission  
NRC Property Management Officer  
Mail Stop: O-4D15  
Washington, DC 20555-0001

HAND-CARRIED SUBMISSIONS WILL NOT BE ACCEPTED

**Agency Payment Office:** Payment will continue to be made by the office designated in the contract in Block 12 of Standard Form 26, Block 25 of Standard Form 33, or Block 18a. of Standard Form 1449, whichever is applicable.

**Attachment C**  
**BILLING INSTRUCTIONS FOR**  
**LABOR HOUR/TIME AND MATERIALS TYPE CONTRACTS (JUNE 2008)**

**Frequency:** The contractor shall submit claims for reimbursement once each month, unless otherwise authorized by the Contracting Officer.

**Format:** Claims shall be submitted in the format depicted on the attached sample form entitled "Voucher/Invoice for Purchases and Services Other than Personal" (see Attachment 1). The sample format is provided for guidance only. The format is not required for submission of a voucher/invoice. Alternate formats are permissible provided all requirements of the billing instructions are addressed.

**Billing of Cost after Expiration of Contract:** If costs are incurred during the contract period and claimed after the contract has expired, you must cite the period during which these costs were incurred. To be considered a proper expiration voucher/invoice, the contractor shall clearly mark it "EXPIRATION VOUCHER" or "EXPIRATION INVOICE".

Final vouchers/invoices shall be marked "FINAL VOUCHER" or "FINAL INVOICE".

**Currency:** Billings may be expressed in the currency normally used by the contractor in maintaining his accounting records and payments will be made in that currency. However, the U.S. dollar equivalent for all vouchers/invoices paid under the contract may not exceed the total U.S. dollars authorized in the contract.

**Supersession:** These instructions supersede any previous billing instructions.

**Attachment C**  
**BILLING INSTRUCTIONS FOR**  
**LABOR HOUR/TIME AND MATERIALS TYPE CONTRACTS (JUNE 2008)**

**INVOICE/VOUCHER FOR PURCHASES AND SERVICES OTHER THAN PERSONAL**  
**(SAMPLE FORMAT - COVER SHEET)**

**1. Official Agency Billing Office**

Department of the Interior  
National Business Center  
Attn: Fiscal Services Branch - D2770  
7301 West Mansfield Avenue  
Denver, CO 80235-2230

**2. Voucher Information**

a. Payee's DUNS Number or DUNS+4. The Payee shall include the Payee's Data Universal Number (DUNS) or DUNS+4 number that identifies the Payee's name and address. The DUNS+4 number is the DUNS number plus a 4-character suffix that may be assigned at the discretion of the Payee to identify alternative Electronic Funds Transfer (EFT) accounts for the same parent concern.

b. Payee's Name and Address. Show the name of the Payee as it appears in the contract and its correct address. If the Payee assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Payee shall require as a condition of any such assignment, that the assignee shall register separately in the Central Contractor Registration (CCR) database at <http://www.ccr.gov> and shall be paid by EFT in accordance with the terms of this contract. See Federal Acquisition Regulation 52.232-33(g) Payment by Electronic Funds Transfer - Central Contractor Registration (October 2003).

c. Contract Number. Insert the NRC contract number.

d. Voucher/Invoice. The appropriate sequential number of the voucher/invoice, beginning with 001 should be designated. Contractors may also include an individual internal accounting number, if desired, in addition to the 3-digit sequential number.

e. Date of Voucher/Invoice. Insert the date the voucher/invoice is prepared.

f. Billing period. Insert the beginning and ending dates (day, month, and year) of the period during which costs were incurred and for which reimbursement is claimed.

**g. Required Attachments (Supporting Documentation).** Direct Costs. The contractor shall submit as an attachment to its invoice/voucher cover sheet a listing of labor categories, hours billed, fixed hourly rates, total dollars, and cumulative hours billed to date under each labor category authorized under the contract/purchase order for each of the activities to be performed under the contract/purchase order. The contractor shall include incurred costs for: (1) travel, (2) materials, including non-capitalized equipment and supplies, (3) capitalized nonexpendable equipment, (4) materials handling fee, (5) consultants (supporting information must include the name, hourly or daily rate of the consultant, and reference the NRC approval), and (6) subcontracts (include separate detailed breakdown of all costs paid to approved subcontractors during the billing period) with the required supporting documentation, as well as the cumulative total of each cost, billed to date by activity.

**Attachment C**  
**BILLING INSTRUCTIONS FOR**  
**LABOR HOUR/TIME AND MATERIALS TYPE CONTRACTS (JUNE 2008)**

**3. Definitions**

- a. Non-capitalized Equipment, Materials, and Supplies. These are equipment other than that described in number (4) below, plus consumable materials, supplies. List by category. List items valued at \$1,000 or more separately. Provide the item number for each piece of equipment valued at \$1,000 or more.
- b. Capitalized Non Expendable Equipment. List each item costing \$50,000 or more and having a life expectancy of more than one year. List only those items of equipment for which reimbursement is requested. For each such item, list the following (as applicable): (a) the item number for the specific piece of equipment listed in the property schedule of the contract; or (b) the Contracting Officer's approval letter if the equipment is not covered by the property schedule.
- c. Material handling costs. When included as part of material costs, material handling costs shall include only costs clearly excluded from the labor-hour rate. Material handling costs may include all appropriate indirect costs allocated to direct materials in accordance with the contractor's usual accounting procedures.

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**Sample Voucher Information (Supporting Documentation must be attached)**

This voucher/invoice represents reimbursable costs for the billing period from \_\_\_\_\_ through \_\_\_\_\_.

		<u>Amount Billed</u>	
		<u>Current Period</u>	<u>Cumulative</u>
(f)	<u>Direct Costs:</u>		
	(1) Direct Labor	\$ _____	\$ _____
	(2) Travel	\$ _____	\$ _____
	(3) Materials	\$ _____	\$ _____
	(4) Equipment	\$ _____	\$ _____
	(5) Materials Handling Fee	\$ _____	\$ _____
	(6) Consultants	\$ _____	\$ _____
	(7) Subcontracts	\$ _____	\$ _____
	Total Direct Costs:	\$ _____	\$ _____