

ORDER FOR SUPPLIES OR SERVICES

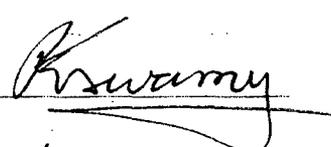
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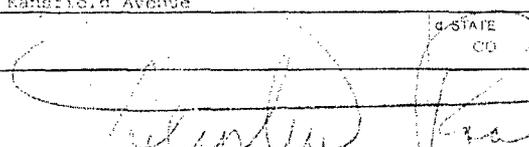
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IMPORTANT: Mark all packages and papers with contract and/or order numbers.

BPA NO

1. DATE OF ORDER 9/21/09		2. CONTRACT NO. (if any) GS10FP0145T		6. SHIP TO:	
3. ORDER NO. NRC-DR-04-09-165		4. REQUISITION/REFERENCE NO. RES-09-165		a. NAME OF CONSIGNEE U.S. Nuclear Regulatory Commission	
5. ISSUING OFFICE (Address correspondence to) U.S. Nuclear Regulatory Commission Div. of Contracts Attn: Neha Dhir Mail Stop: TWB-01-B10M Washington, DC 20555		7. TO		b. STREET ADDRESS	
a. NAME OF CONTRACTOR ENGINEERING MECHANICS CORPORATION OF COLUMBUS EMC2		b. COMPANY NAME		c. CITY Washington	
c. STREET ADDRESS 3518 RIVERSIDE DR STE 202		d. CITY COLUMBUS		d. STATE DC	
e. STATE OH		f. ZIP CODE 43221735		e. ZIP CODE 20555	
9. ACCOUNTING AND APPROPRIATION DATA B&R 960-15-111-123 JCN N6899 BOC 252A APPN 31X200.960 OBLIGATION 540,000 DUNS 014083161		10. REQUISITIONING OFFICE RES		8. TYPE OF ORDER	
11. BUSINESS CLASSIFICATION (Check appropriate box(es))		12. F.O.B. POINT		REFERENCE YOUR	
<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		N/A		Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.	
13. PLACE OF		14. GOVERNMENT B.I. NO.		15. DELIVER TO F.O.B. POINT	
a. INSPECTION		b. ACCEPTANCE		ON OR BEFORE (Date)	
16. DISCOUNT TERMS		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)
	The contractor shall provide the services described in the attached Statement of Work and in accordance with the terms and conditions of GSA schedule contract no. GS-10F-0145T and this delivery order. Title: Piping Integrity Analyses and Support Period of Performance: Three (3) years from date of award Total Obligated Amount: \$40,000 Total Delivery Order Ceiling: \$784,197.30 Accepted:  Date: 9/21/09					

SEE BILLING INSTRUCTIONS ON REVERSE	18. SHIPPING POINT	19. GROSS SHIPPING WEIGHT	20. INVOICE NO.	17(h) TOTAL (Cont. pages)	
	21. MAIL INVOICE TO:				17(i) GRAND TOTAL
	a. NAME Department of Interior / NRC NRCpayments@nrc.gov	b. STREET ADDRESS (or P.O. Box) Attn: Fiscal Services Branch - R2770 7301 W. Mansfield Avenue	c. CITY Denver		
e. ZIP CODE 80235-2230	22. UNITED STATES OF AMERICA BY (Signature) 		23. NAME (Typed) Stephen Pool Contracting Officer	\$40,000.00	
				TITLE: CONTRACTING/ORDERING OFFICER	

AUTHORIZED FOR LOCAL REPRODUCTION PREVIOUS EDITION NOT USABLE

OPTIONAL FORM 347 (REV. 4/2006) PRESCRIBED BY GSA/FAR 48 CFR 53.213(f)

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE

SEP 21 2009

ADM002

ADDITIONAL ORDER TERMS AND CONDITIONS

A.1 PRICE SCHEDULE

Labor Category	Rate/Hour	Hours	Total
President	[REDACTED]	[REDACTED]	\$113,518.30
Vice-President	[REDACTED]	[REDACTED]	\$52,998.00
Senior Research Leader	[REDACTED]	[REDACTED]	\$287,164.00
Research Leader	[REDACTED]	[REDACTED]	\$39,240.00
Principal Engineer	[REDACTED]	[REDACTED]	\$82,517.40
Research Engineer	[REDACTED]	[REDACTED]	\$40,876.50
Engineer	[REDACTED]	[REDACTED]	\$19,116.30
Senior Program Manager	[REDACTED]	[REDACTED]	\$36,850.00
Senior Regulatory Advisor	[REDACTED]	[REDACTED]	\$7,556.40
Electronics Specialist	[REDACTED]	[REDACTED]	\$18,581.40
Master Technician	[REDACTED]	[REDACTED]	\$41,260.00
Administrative Assistant	[REDACTED]	[REDACTED]	\$2,327.00
Total Labor Costs			\$742,005.30
Travel (Travel costs are estimated. The government will pay up to the rates specified in the U.S. Federal Travel Regulation (FTR) for travel destination. No payment will be made without backup documentation/receipts. All travel must be approved in advance by the NRC Project Officer.)			\$42,192.00
TOTAL			\$784,197.30

A.2 CONSIDERATION AND OBLIGATION—LABOR HOURS

(a) The total estimated amount of this contract (ceiling) for the products/services ordered, delivered, and accepted under this contract is \$784,197.30.

(b) The amount presently obligated with respect to this contract is \$40,000.00. This obligated amount may be unilaterally increased 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.3 PERIOD OF PERFORMANCE

This delivery order expires three (3) years from date of award.

A.4 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.

A.5 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.6 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.7 2052.215-71 PROJECT OFFICER AUTHORITY (NOVEMBER 2006)

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

Name: Eric Focht

Address: U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Mail Stop: C-5A24M
Washington, DC 20555

Telephone Number: 301-251-7649

Email: Eric.Focht@nrc.gov

(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 (SOW) or changes to specific travel identified in the SOW), fills in details, or otherwise serves to accomplish the contractual SOW.

(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 Security Branch, Division of Facilities and Security (SB/DFS) (via e-mail) when a contractor employee no longer requires access authorization and return of any NRC issued badge to SB/DFS within three days after their termination.

(6) Ensure that all contractor employees that require access to classified Restricted Data or National Security Information or matter, access to sensitive unclassified information (Safeguards, Official Use Only, and Proprietary information) access to sensitive IT systems or data, unescorted access to NRC controlled buildings/space, or unescorted access to protected and vital areas of nuclear power plants receive approval of SB/DFS prior to access in accordance with Management Directive and Handbook 12.3.

(7) For contracts for the design, development, maintenance or operation of Privacy Act Systems of Records, obtain from the contractor as part of closeout procedures, written certification that the contractor has returned to NRC, transferred to the successor contractor, or destroyed at the end of the contract in accordance with instructions provided by the NRC Systems Manager for Privacy Act Systems of Records, all records (electronic or paper) which were created, compiled, obtained or maintained under the contract.

A.8 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.9 2052.215-78 TRAVEL APPROVALS AND REIMBURSEMENT -ALTERNATE 1 (OCT 1999)

Total expenditure for travel may not exceed \$42,192 without the prior approval of the contracting officer.

- (a) All foreign travel must be approved in advance by the NRC on NRC Form 445, Request for Approval of Official Foreign Travel, and must be in compliance with FAR 52.247-63 Preference for U.S. Flag Air Carriers. The contractor shall submit NRC Form 445 to the NRC no later than 30 days prior to the commencement of travel.
- (b) The contractor will be reimbursed only for those travel costs incurred that are directly related to this contract and which are allowable subject to the limitations prescribed in FAR 31.205-46.
- (c) It is the responsibility of the contractor to notify the contracting officer in accordance with the FAR Limitations of Cost clause of this contract when, at any time, the contractor learns that travel expenses will cause the contractor to exceed the travel ceiling amount identified in paragraph (a) of this clause.
- (d) Reasonable travel costs for research and related activities performed at State and nonprofit institutions, in accordance with Section 12 of Pub. L. 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.

A.10 52.217-8 OPTION TO EXTEND SERVICES (NOV 1999)

The Government may require continued performance of any services within the limits and at the rates specified in the contract. These rates may be adjusted only as a result of revisions to prevailing labor rates provided by the Secretary of Labor. The option provision may be exercised more than once, but the total extension of performance hereunder shall not exceed 6 months. The Contracting Officer may exercise the option by written notice to the Contractor within 30 days of the expiration date of the contract.

A.11 DELIVERY SCHEDULE

All reports shall be submitted electronically as a Microsoft Word, WordPerfect, or PDF file to the Project Officer and Contracting Officer. In addition to the MLSRs, additional deliverables are listed below:

- Task 1 Provide a technical letter report detailing the finite element model results for the butt-weld mockups 18 months after contract award date.
- Task 1b Provide the draft of the material property experimental results in a MS Excel format 18 months after contract award date.
- Task 2a: Provide a technical letter report to the NRC program manager within 18 months of contract award.
- Task 2b: Provide a technical letter report to the NRC program manager within 24 months of contract award.
- Task 3: Provide a technical letter report covering the testing methods, analyses, results and conclusions of the hydrostatic testing performed on the PE pipe samples. Due date is TBD.
- Task 4 The contractor shall provide presentation material and technical support at a future date to-be-determined. A letter report will be delivered for each topic covered at a date to be determined by the program manager.

A.12 PLACE OF DELIVERY--REPORTS (JUN 1988)

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

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

[to be completed at time of award]

Mail Stop: []
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-0001

Phone: (301) 251-[]
Fax: (301) 251-[]
Email: []

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

(b) Contracting Officer (1 copy)

A.13 2052.211-71 TECHNICAL PROGRESS REPORT (JAN 1993)

The contractor shall provide a monthly Technical Progress Report to the following:

Resource Name: RESDEMLSR.Resource@nrc.gov

The report is due within 15 calendar days after the end of the report period and must identify the title of the project, the contract number, appropriate financial tracking code specified by the NRC Project Officer, 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/task order:

- (a) A listing of the efforts completed during the period, and milestones reached or, if missed, an explanation provided;
- (b) Any problems or delays encountered or anticipated and recommendations for resolution. If the recommended resolution involves a contract modification, e.g., change in work requirements, level of effort (cost) or schedule delay, the contractor shall submit a separate letter to the contracting officer identifying the required change and estimated cost impact.
- (c) A summary of progress to date; and
- (d) Plans for the next reporting period.

A.14 2052.209-72 CONTRACTOR ORGANIZATIONAL CONFLICTS OF INTEREST (JAN 1993)

(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 forego 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, that 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 therefore (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.

STATEMENT OF WORK

TITLE: Piping Integrity Analyses and Support

I. BACKGROUND

Integrity analyses are required to conduct safety assessments of nuclear reactor coolant pressure boundary (RCPB) components, including the reactor pressure vessel (RPV), and to develop technical bases for regulatory positions. Nickel-base alloys are used extensively in RCPB components, along with their corresponding weld metals, and have been the focus of leak-before-break analyses due to cracking associated with primary water stress corrosion cracking (PWSCC). The occurrences of cracking have been identified through various means, including the discovery of boric acid deposits resulting from through-wall cracking in the primary system pressure boundary. PWSCC in nickel-based alloy RCPB components is a safety concern due to the potential for reactor pressure boundary leaks and the associated potential of boric acid corrosion of low alloy steels and the development of flaws in piping or welds. Either condition, depending on the size and location of the flaws, could result in a loss of coolant accident.

PWSCC of nickel-base alloys in RCPB components has been documented in both foreign and domestic plants and has been typically identified by the build-up of boric acid deposits in the vicinity of the cracked components. The industry response to addressing PSWCC is coordinated through the Materials Reliability Program (MRP) in a comprehensive, multifaceted effort. Although the industry program is addressing many of the issues raised by these cracking occurrences, the Office of Nuclear Reactor Regulation (NRR) has identified several issues requiring additional consideration regarding the generic implications of these events. In a memorandum dated June 5, 2001, NRR provided a user need request (NRR-2002-018) to the Office of Nuclear Regulatory Research (RES) to evaluate issues involving cracking in Alloy 82/182 welds and Alloy 600 base metal at several domestic and overseas plants. An updated user need request, NRR-2006-006, supersedes NRR-2002-018 and identifies NRR's current needs in the area of PWSCC of nickel-base alloy primary pressure boundary components. A research effort is currently underway in RES to address the specific needs outlined in NRR-2006-006. The results of the research revealed other issues that were outside of the scope of the program, but needed to be addressed. One of the goals of this program is to address emergent issues such as residual stress modeling and complex crack growth prediction as they pertain primarily to piping systems, but may be applicable to other components.

In addition to boundary integrity analyses related to nickel-base alloy components, polyethylene (PE) piping is being considered as a replacement for carbon steel piping in safety-related nuclear applications. Analyses and confirmatory research are required to establish a regulatory position regarding the service life of PE piping, including joints.

In October 2006, Duke Power (Duke) submitted a relief request to use PE piping as a replacement for carbon steel piping for the emergency diesel generator jacket water coolers and other Class 3 safety-related buried piping. Carbon steel piping installed at Catawba experienced aqueous corrosion and microbiologically induced corrosion (MIC) that resulted in operational inefficiencies and replacement expenses. PE piping is immune to both forms of corrosion and has been used by Duke for raw service water applications (non-safety related) for about 10 years with no reported problems associated with corrosion or MIC. Also, in August

2007, Union Electric Company submitted a relief request to use PE as a replacement for carbon steel piping for the essential service water system at its Callaway plant. Both requests were reviewed and the use of PE piping for the third ten-year inspection cycle was approved with specific condition in each case. The basis for a 50-year service life for PE piping still needs to be established. In a memorandum dated March 18, 2006, NRR provided a user need request (NRR-2006-007) to RES to assist NRR in the development of a technical basis to support the staff's review of the proposed use of polyethylene piping for low pressure safety-related piping systems at nuclear power plants and to confirm the intended 50-year service life.

The industry efforts associated with PE piping have been coordinated through the ASME Special Working Group on Polyethylene Piping (SWG-PP) over the past few years. The SWG-PP prepared Code Case N-755 to establish the design requirements for using PE piping in safety-related nuclear applications. Code Case N-755 covers several aspects critical to specifying the design requirements for PE piping, but the first draft put to a vote neglected to adequately address the flaw tolerance of PE and the volumetric inspection of joints. Based on these issues, the NRC voted negative on the first version of N-755. In response, the SWG-PP limited the service conditions to a maximum stress, service temperature and life of PE piping to 430 psi, 140 °F and 10 years, respectively. The original intention was to specify a 50-year service life at 140 °F. Flaws are limited to a depth equivalent to 10% of the wall thickness. The SWG-PP has recently identified circumferential flaws in butt joints to be a critical piping integrity issue since research has shown that butt joints may exhibit lower flaw tolerance than the parent material. However, data is needed on the more modern resins being evaluated to establish the allowable applied stress for a 50-year service life. Slow crack growth (SCG) rate testing on the newest high density PE (HDPE) resins, piping and joints is being conducted to calibrate and confirm SCG models that were developed for earlier HDPE resins. Among other properties, the molecular structure of PE has a significant effect on SCG resistance. It has been shown that the bimodal molecular weight distributions exhibited by more recently developed resins tends to help improve SCG resistance over resins with unimodal molecular weight distributions. The predictive capabilities of SCG models is being re-established for the newer resins so that the proposed service life allowable stresses can be confirmed.

In order to confirm the SCG models, full-scale hydrostatic testing needs to be performed. Full-scale testing consists of pressurizing pipe samples for extended time periods at elevated temperatures until they develop through-wall cracks. Typically, a large number of tests need to be performed to establish the allowable stresses, but this work is aimed at confirming the results previously obtained for HDPE piping and to confirm the models used to predict SCG behavior.

Overall, the deliverables from this project will provide the NRC staff with information needed to enhance the evaluation of industry generic assessments and plant-specific activities and to support long term regulatory actions that provide reasonable assurance of public health and safety in the area of boundary integrity analysis.

II. OBJECTIVE

The objective of this project is to further the development of advanced finite element methods used in probabilistic fracture mechanics codes used to assess the probability of failure and leakage of dissimilar metal welds and other pressure boundary components and to provide

technical analytical support to RES on emergent issues as they arise to develop the technical basis for future regulatory decisions related to enhanced boundary integrity analyses of reactor system components including piping.

III. SCOPE OF WORK

The scope of work under this contract shall cover finite element modeling of residual stress profiles of dissimilar metal welds (nickel-based alloys and stainless steel) based on physical mock-ups of actual reactor system components where the information for the mock-ups will be provided, development of a complex crack growth model that more closely models the growth rate and shape of cracks through complex stress fields such as those resulting from residual stresses in welds and weld repairs, hydrostatic testing of pipe specimens made from high density polyethylene piping materials that meet the requirements of ASME Code Case N-755, and technical assistance on issues related to piping integrity that may include numerical, analytical, experimental, or meeting support as requested by the project manager.

Task 1 - Evaluate Residual Stress Profiles for Mock-up Dissimilar Butt-Weld Configurations

- Task 1a) The contractor shall construct a finite element model to predict the residual stress profile for each of mock-ups produced in a separate residual stress validation program. This program includes 4 plate welds, 6 small diameter pipe welds, two surge nozzle sized pipe girth welds, three relief nozzle sided girth welds and one cold leg sized pipe girth weld. For this modeling effort, the NRC will provide the geometries of the mock-ups needed to construct the finite element models and the detailed fabrication specifications and welding parameters for each butt-weld mockup. The mock-up geometries will be provided by the NRC upon contract award and the fabrication specifications and welding parameters for the representative butt-welds will be provided to the contractor by the NRC within 8 months after the contract award date.
- Task 1b) As part of a cooperative effort with the industry, develop and compile the full set of mechanical properties typically used for weld residual stress modeling and flaw evaluation procedures for Alloy 82, 690, and low carbon steel WNP-3 nozzle. In addition, cyclic stress-strain properties will be developed for the Alloy 82 material to support the combined kinematic and isotropic hardening law embedded in the ABAQUS code. The NRC will provide the sample weld materials in the as-welded condition and the contractor shall provide duplicate full stress-strain curves for the heat treated conditions below per the ASTM E8 standard:
- i.) as-welded condition: room temperature, 300°F, and 600°F
 - ii.) solution-annealed condition: room temperature, 300°F, 600°F, 1000°F, 1400°F, and 1800°F

For cost estimation purposes, assume that the cyclic strain-strain curves for the Alloy 82 material will be produced on material heat treated the same as the

material used for the full stress strain curves. The details of the heat treatments will be determined through discussions between the contractor and the NRC staff.

Task 2 - Complex Crack Growth Model

- Task 2a) Further the development of a fracture mechanics based circumferential crack growth model using the complex crack shape methodology with realistic and bounding assumptions related to RPVH penetration nozzles and dissimilar metal butt welds in PWRs.
- Task 2b) Compare and contrast the complex circumferential crack growth analysis results to MRP work related to this specific research topic including base assumptions, computer codes used, and operational experience supporting results.

Task 3 – Plastic Piping Hydrostatic Testing

Perform hydrostatic testing of high density polyethylene piping to confirm the 50-year service life of PE piping materials. Testing must be performed on bimodal and unimodal grades of PE piping materials that conform to ASME Code Case N-755 (e.g. PE4710). One of each grade will suffice. The testing shall also determine the effect of sharp flaws on the service life. Pipe outside diameters must be a minimum of four inches. The diameter ratio is to-be-determined but will most likely be DR11 or DR9.

Task 4 – Piping Integrity Technical Assistance

If requested by the NRC project manager, the contractor shall provide support for issues relating to piping integrity. These issues may include numerical, analytical, experimental, or meeting support as requested by the project manager.

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 program manager, key personnel, and any other senior technical staff performing work under this contract shall have expertise, experience, and/or education in the following key areas:

- a) Expertise in materials and structural mechanics.
- b) Expertise in finite element analyses.
- c) Expertise in developing probabilistic codes.
- d) Expertise in polymer mechanical behavior and fracture mechanics.
- e) Expertise in polymer piping design.
- f) Expertise in polymeric materials and life prediction using rate process modeling techniques.
- g) Detailed knowledge of ASME Section III and Section XI Codes.
- h) Detailed knowledge of pressurized water reactor piping system design and manufacturing methods including material property information.
- i) Detailed knowledge of techniques used to evaluate residual stresses in pipe welds, e.g. weld sequencing.
- j) Detailed knowledge of DM weld fabrication methods;
- k) Detailed knowledge of industry and NRC staff analyses regarding reported occurrences of DM weld cracking and NRC actions (e.g., notices, bulletins);
- l) Knowledge of NRC regulatory process as it relates to DM weld cracking.
- m) Detailed knowledge of industry and NRC staff analyses regarding reported occurrences of primary water stress corrosion cracking and NRC actions, e.g., notices, bulletins, etc..

VI. PERIOD OF PERFORMANCE

The period of performance for this contract will be 36 months from the date the contract is awarded.

VII. 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.

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.

VIII. MEETINGS AND TRAVEL

Biweekly phone progress reports shall be conducted with the NRC Project Officer for approximately one-hour in duration throughout the period of performance. The frequency and duration of the phone progress reports will be adjusted according to the needs of the program to ensure progress is maintained.

Six three-day trips for up to four people to Rockville, MD or NRC-designated location shall be budgeted to provide expertise related to this program for status meetings or other meeting support.