ORDER FOR SUPPLIES OR SERVICES

PAGE OF PAGES

IMPORTANT: Mark all packages and papers with contract and/or order numbers. BPA NO. NRC-DR-04-08-147

1. DATE OF ORDER: JAN 13 2009	2. CONTRACT NO. (If any)
3. ORDER NO.: NRC-T001	MODIFICATION NO.
4. REQUISITION/REFERENCE NO.: 04-08-147T001	

5. ISSUING OFFICE (Address correspondence to)
U.S. Nuclear Regulatory Commission
Div. of Contracts
Attn: Adelis M Rodriguez, 301-492-3623
Mail Stop: TWB-01-B10M
Washington, DC 20555

6. TO:
a. NAME OF CONTRACTOR: ENGINEERING MECHANICS CORPORATION OF COLUMBUS ENCI
b. COMPANY NAME:
c. STREET ADDRESS: 3518 RIVERSIDE DR STE 202
d. CITY: COLUMBUS | e. STATE: OH | f. ZIP CODE: 432211735

7. SHIP TO
a. NAME OF CONSIGNEE: U.S. Nuclear Regulatory Commission
b. STREET ADDRESS: Mail Stop: O-OWFN
ATTN: Eric Weeks
c. CITY: Washington | d. STATE: DC | e. ZIP CODE:
f. SHIP VIA:

8. TYPE OF ORDER
___ a. PURCHASE — REFERENCE YOUR: Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet, if any, including delivery as indicated.
X b. DELIVERY — 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.

9. ACCOUNTING AND APPROPRIATION DATA
Obligate $50,000.00 B&R:960-15-111-123 JOB:N6637 BOC: 252A 31X0200.960 FFS: RES-08-147 DUNS: 014083161

10. REQUISITIONING OFFICE: RES

11. BUSINESS CLASSIFICATION (Check appropriate box(es))
X a. SMALL ___ b. OTHER THAN SMALL ___ c. DISADVANTAGED ___ g. SERVICE-DISABLED VETERAN-OWNED
___ d. WOMEN-OWNED ___ e. HUBZone ___ f. EMERGING SMALLBUSINESS

12. F.O.B. POINT: Destination

13. PLACE OF	14. GOVERNMENT B/L NO.	15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)	16. DISCOUNT TERMS
a. INSPECTION: destination	b. ACCEPTANCE: destination		

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 perform the services as described in the attached statement of work in accordance with the price schedule in section A.1 and the terms and conditions of BPA NRC-DR-04-08-147. Order Type: Labor Hour Period of Performance: Award date- 8/19/2011 Total Order Ceiling: $325,230.60 Total Obligated Amount: $50,000.00 Accepted: [signature] 1/13/09 Date					

18. SHIPPING POINT | 19. GROSS SHIPPING WEIGHT | 20. INVOICE NO

SEE BILLING INSTRUCTIONS ON REVERSE

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

17(h) TOTAL (Cont. pages)

17(i) GRAND TOTAL

22. UNITED STATES OF AMERICA
BY (Signature) [signature]

23. NAME (Typed)
Stephen Pool
Contracting Officer
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 JAN 23 2009

ADM002

TASK ORDER TERMS AND CONDITIONS

A.1 PRICE SCHEDULE

Labor Category	Labor Rate	Est. Hours	Total
President	[redacted]		$ 74,135.04
Vice-President			$ 70,665.00
Senior Program Manager			$ 4,231.44
Senior Regulatory Advisor			$ 29,016.00
Senior Research Leader			$ 74,152.00
Research Leader			$ 9,369.60
Principal Engineer			$ 41,913.60
Research Engineer			$ -
Engineer			$ -
Master Technician			$ -
Electronics Specialist			$ -
Administrative assist.			$ 1,063.92
ODC – Cost reimbursement. No G&A or Materials and handling charges are applicable.			$ 0.00
Travel - Cost reimbursement. No G&A or Materials and handling charges are applicable.			$ 20,684.00
Total			**$325,230.60**

A.2 CONSIDERATION AND OBLIGATION - LABOR HOUR ORDER

(a) The total not to exceed cost to the Government for full performance of this contract is $325,230.60.

(b) The amount currently obligated by the Government with respect to this contract is $50,000. The contractor shall not exceed this obligated amount at any time.

NRC-DR-04-08-147
Task order No. 001

STATEMENT OF WORK
FOR CONTRACTOR TO PROVIDE
TECHNICAL ASSISTANCE IN BOUNDARY INTEGRITY ANALYSES AND SUPPORT

I. BACKGROUND

Boundary 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 RCS 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 RCS 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. The user need request supersedes NRR-2002-018 and identifies NRR's current needs in the area of PWSCC of nickel-base alloy primary pressure boundary components. An effort is currently underway in RES to address the specific needs outlined in NRR-2002-018. During that effort, several ASME Code-related issues arose that were outside of the scope of the contract and need to be addressed under a separate contract.

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 are under review by the NRC.

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 10% of the wall thickness deep. 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 long-life service allowable stresses. Specifically, slow crack growth (SCG) rate testing on the newest high density PE (HDPE) resins, piping and joints is required 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 needs to be re-establish for the newer resins.

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.

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 task is to provide technical and analytical support to NRC staff on an as needed basis to develop the technical basis for future regulatory decisions related to enhanced boundary integrity analysis of reactor systems and components.

III. SCOPE OF WORK

The contractor shall provide technical and analytical support to NRC staff on an as needed basis to develop the technical basis for future regulatory decisions related to enhanced boundary integrity analysis of reactor systems and components.

IV. REQUIREMENTS

The work to be performed under this task order consists of the following:

Task 1 **Support ASME Code Case Development, Review and Confirmation**

Task 1a Support ASME Code Case development, review and confirmation for subject areas related to nickel based alloy fabrication and inspection, polyethylene piping structural integrity, flaw tolerance, joining and inspection and other ASME Code-related activities determined to be necessary to support NRC regulatory considerations,

Task 1b Fracture mechanics-based flaw tolerance evaluations of RCPB components including nickel base alloy weldments and polyethylene piping base materials and joints to support component integrity analyses,

Task 1c Provide technical assistance to NRC staff on subject matter related to, but not confined to nickel based alloy fabrication and inspection, polyethylene piping structural integrity, flaw tolerance, joining and inspection. This may include participation in meetings and on conference calls. Five trips to NRC headquarters are anticipated during the period of performance.

Deliverable Schedule

Task 1a Attend ASME Code meetings and provide technical reviews of issues related to Code Cases and other Code activities, including confirmatory analyses. Technical reviews, including confirmatory analyses, shall consist of well written (*i.e. grammatically correct*) *and thorough descriptions of: the issues and the* implications on possible regulatory actions, the approaches used, analyses of the issues supported by documented literature and/or engineering analyses and computations, the findings and conclusions of the analyses. Analyses completed during the reporting period shall be included in the MLSR for the month in which the analyses were completed. There are typically four ASME Code meetings per calendar year. Twelve trips to ASME Code meetings are anticipated during the performance period.

Task 1b Periodic analysis summaries of fracture mechanics-based flaw tolerance evaluations. Summaries of analyses completed during the reporting period shall be included in the MLSR for the month in which the analyses were completed.

Task 1c Provide technical assistance as needed.

V. PERIOD OF PERFORMANCE

The period of performance for this contract will be from the award date to August 19, 2011.

VI. MEETING AND TRAVEL REQUIREMENTS

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.

Four five-day trips to ASME meetings per year for up to three people during the period of performance and up to five three-day trips for up to three people to Rockville, MD or NRC-designated location shall be budgeted to provide expertise related to this program.

VII. 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.

VIII. TECHNICAL AND OTHER SPECIAL QUALIFICATIONS NEEDED

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 finite element analyses;
b) Expertise in mechanical properties testing and measurement techniques
c) Expertise in developing fracture mechanics codes;
d) Expertise in leakage detection technologies and leak-rate predictive codes;
e) Expertise in polymeric materials and life prediction using rate process modeling techniques.
f) Detailed knowledge of DM weld fabrication methods;
g) Detailed knowledge of industry and NRC staff analyses regarding reported occurrences of DM weld cracking and NRC actions (e.g., notices, bulletins);
h) Knowledge of NRC regulatory process as it relates to DM weld cracking.

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. NRC-FURNISHED MATERIAL

None.