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): GS10F0145T
3. ORDER NO.: NRC-7003	MODIFICATION NO.: 4. REQUISITION/REFERENCE NO.: 04-08-147

5. ISSUING OFFICE (Address correspondence to):
U.S. Nuclear Regulatory Commission
Div. of Contracts
Attn: Amelia M Rodriguez, 301-492-3633
Mail Stop: TWB-01-B10M
Washington, DC 20555

6. SHIP TO:
a. NAME OF CONSIGNEE: U.S. Nuclear Regulatory Commission
b. STREET ADDRESS: Mail Stop: O-07D9
ATTN: Eric Poole
c. CITY: Washington d. STATE: DC e. ZIP CODE:

7. TO:
a. NAME OF CONTRACTOR: ENGINEERING MECHANICS CORPORATION OF COLUMBUS EMCC
b. COMPANY NAME:
c. STREET ADDRESS: 3518 RIVERSIDE DR STE 202
d. CITY: COLUMBUS e. STATE: OH f. ZIP CODE: 432212735

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
c. 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: $129,945.75 Total Obligated Amount: $50,000.00 Accepted: 1/13/09 Date					

SEE BILLING INSTRUCTIONS ON REVERSE

18. SHIPPING POINT:
19. GROSS SHIPPING WEIGHT:
20. INVOICE NO.:
17(h) TOTAL (Cont. pages)

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(i) GRAND TOTAL

22. UNITED STATES OF AMERICA
BY (Signature)

23. NAME (Typed): Stephen Pool
TITLE: CONTRACTING/ORDERING OFFICER: Contracting 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]	0	$ 0.00
Vice-President	[redacted]		$ 40,380.00
Senior Program Manager	[redacted]		$ 1,410.48
Senior Regulatory Advisor	[redacted]		$ 2,901.60
Senior Research Leader	[redacted]		$ 32,240.00
Research Leader	[redacted]		$ 1,249.28
Principal Engineer	[redacted]		$ 26,196.00
Research Engineer	[redacted]		$ 1,805.44
Engineer	[redacted]		$ 1,450.88
Master Technician	[redacted]		$ 18,861.60
Electronics Specialist	[redacted]		$ 1,595.84
Administrative assist.	[redacted]		$ 354.64
ODC – Cost reimbursement. No G&A or Materials and handling charges are applicable.			$1,500
Travel - Cost reimbursement. No G&A or Materials and handling charges are applicable.			$0
Total			**$129,945.76**

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 $129,945.76.

(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. 2

STATEMENT OF WORK
FOR CONTRACTOR TO PERFORM
BOUNDARY INTEGRITY ANALYSES AND SUPPORT
PE PIPING SERVICE LIFE CONFIRMATION

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. 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 allowables. 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-established 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.

II. OBJECTIVE

The objective of this task is to conduct testing and analysis to confirm the service life of high density polyethylene piping including joints. Testing and analyses will include, but may not be limited to, tensile testing, dynamic mechanical analysis, slow crack growth testing, service life modeling, and modeling of joint fusion processes.

III. SCOPE OF WORK

The contractor shall 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.

IV. REQUIREMENTS

The scope of work to be performed under this task order will be conducted under NRC-DR-04-08-147 and consists of the following:

Task 2 **Mechanical testing, DMA and slow crack growth testing**

Task 2a *Mechanical Testing of HDPE Piping and Joints* – Tensile testing and dynamic mechanical analysis will be performed on PE piping samples selected for use in slow crack growth testing. A minimum of three resins proposed by the ASME SWG-PP shall be evaluated. More resins may be added to the testing plan upon agreement between the Project officer and the contractor.

Task 2b *Slow Crack Growth Testing of PE Piping Materials* – Slow crack growth testing of PE piping materials being considered for use in safety-related nuclear power plant applications will be performed to calibrate life-prediction models, such as the bi-directional shift model. A minimum of three resins proposed by the ASME SWG-PP shall be evaluated. More resins may be added to the testing plan upon agreement between the Project officer and the contractor.

Task 2c *Service Life Prediction* - SGC data will be used to calibrate models, such as the bi-directional shift model, to estimate the service life for each resin evaluated.

Deliverable Schedule

Task 2a Letter report on testing and results. The report shall include at a minimum: an introduction and background that describes the purpose and goals of the work and how the work relates to possible regulatory actions, the approach including relevant standards used for the testing, the results of the tests including graphs

of the test data (i.e. load v. displacement, stress v. strain, etc.) and tables of the results, and the conclusions reached based on the data. The report shall be well written and grammatically correct. Due by 31 July 2009.

Task 2b Letter report on slow crack growth testing, results and analysis. The letter report shall include at a minimum: an introduction and background that describes the purpose and goals of the work and how the work relates to possible regulatory actions, the approach including relevant standards used for the testing, the results of the tests including graphs of the test data (i.e. load v. displacement, stress v. strain, etc.) and tables of the results, and the conclusions reached based on the data. The report shall be well written and grammatically correct. Due date TBD since it depends on the number of resins to be examined.

Task 2c Letter report on the application of models to predict the service life of PE resins based on the SCG data developed for the resins tested in Task 1a & 1b. The letter report shall include at a minimum: an introduction and background that describes the purpose and goals of the work and how the work relates to possible regulatory actions, the approach including the data and models used for the analyses , the results of the analyses, and the conclusions reached based on the analyses. The report shall be well written and grammatically correct. Due date TBD since it depends on the number of resins to be examined.

V. PERIOD OF PERFORMANCE

The period of performance for this contract will be through August 19, 2011 from the date the contract is awarded.

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.

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 slow crack growth testing and analysis of polymeric materials;
e) Expertise in polymeric materials and life prediction using rate process modeling techniques.

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.

XIII. NRC-FURNISHED MATERIAL

None.