

2. AMENDMENT/MODIFICATION NO. M011	3. EFFECTIVE DATE See Block 15c.	4. REQUISITION/PURCHASE REQ. NO. RES-C06-673 RES-03-046	5. PROJECT NO. (If applicable)
6. ISSUED BY U.S. Nuclear Regulatory Commission Div. of Contracts Attn: Jeffrey R. Mitchell, 301-415-6465 Mail Stop T-7-I-2 Washington, DC 20555	CODE 3100	7. ADMINISTERED BY (If other than Item 6) U.S. Nuclear Regulatory Commission Div. of Contracts Mail Stop T-7-I-2 Washington, DC 20555	CODE 3100

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) ENGINEERING MECHANICS CORPORATION OF COLUMBUS 3518 RIVERSIDE DR STE 202 COLUMBUS OH 432211735	(X)	9A. AMENDMENT OF SOLICITATION NO.
CODE 014083161 FACILITY CODE		9B. DATED (SEE ITEM 11)
		10A. MODIFICATION OF CONTRACT/ORDER NO. NRC-04-03-046
	X	10B. DATED (SEE ITEM 13) 07-16-2003

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers is extended, is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required) 66015111193 Y6649 252A 31x0200.660
Obligate \$68,000.00

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(X)	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
X	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: Bilateral Mutual Agreement of the Parties
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor is not, is required to sign this document and return 2 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

.....REFER TO THE ATTACHED PAGE TWO FOR A DESCRIPTION OF MODIFICATION NO. 11.....

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print) Gery M. Wilkowiak President	16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) Donald A. King Contracting Officer
15B. CONTRACTOR/OFFEROR <i>Gery M. Wilkowiak</i> (Signature of person authorized to sign)	15C. DATE SIGNED 10/05/06
16B. UNITED STATES OF AMERICA BY <i>Donald A. King</i> (Signature of Contracting Officer)	16C. DATE SIGNED 9/29/06

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE

STANDARD FORM 30 (REV. 10-83)

ADM002

The purpose of this modification is to (1) Revised the Statement of Work to add Task 12, Task 13 and Task 14 and incorporate additional effort under Task 8; (2) Add the clause "Copyright of Crack Mesh Generator – Special Nuclear Purpose License" to Section H of the Contract; (3) increase the contract ceiling by \$108,357.13 from \$712,661.68 to \$821,018.81; (4) incrementally fund this contact in the amount of \$68,000.00, thereby increasing the NRC obligations from \$650,000.00 to \$718,000.00; (5) extend the period of performance to expire on March 31, 2007. Accordingly the contract is modified as follows:

- (1) The Statement of Work is revised to incorporate the changes in the attached Statement of Work Modification No. 11. (Attachment No. 1)
- (2) The following clause is added to section H:

H.8 COPYRIGHT OF CRACK MESH GENERATOR - SPECIAL NUCLEAR PURPOSE LICENSE

(A) The NRC may, pursuant to Section (c) of FAR Clause 52-227-14, direct the contractor to claim a copyright in computer software and associated data first produced in the performance of this contract. In addition to the general government license rights identified in Section (c) of FAR Clause 52-227-14, such copyright shall be subject to the following Special Nuclear Purpose License rights:

In addition to the license rights granted the government under paragraph (c) of Section I of the contract, 52.227-14 RIGHTS IN DATA-GENERAL (JUN 1987), the contractor grants the NRC and others acting on its behalf an exclusive, paid up, worldwide, irrevocable license to distribute the crack mesh generator for nuclear health and safety purposes, which may include analyses of operational, decommissioned, or designs of nuclear reactor systems and other such facilities involving nuclear technology performed by parties which may include but are not limited to licensees, vendors, contractors, educational institutions, public interest groups, participants in NRC international agreement programs and other government agencies. Further, consistent with NRCAR 2052.209-73 CONTRACTOR ORGANIZATIONAL CONFLICTS OF INTEREST, the contractor agrees that it will not sell or distribute the crack mesh generator to or for the use of such parties or participants and that it will not provide technical services relating to the crack mesh generator to such parties or participants, unless authorized by NRC. In addition, NRC retains the right to improvements made to the crack mesh generator resulting from the contractor's commercial activity that the NRC contracting officer determines are of use for nuclear health and safety purposes. Further, the contractor agrees to include in any licensing agreement that it may enter into with a third party such limitations as are necessary to preserve the rights of the government, and limit the sale and distribution of the software as described above and as limited by the U.S. Departments of Commerce and State concerning foreign sales.

(B) The NRC reserves the right to direct the contractor to transfer the copyright crack mesh generator and associated data developed under this contract to successor contractors subject to the above general government and special license rights. Should NRC determine that it is in the government's interest to have NRC staff perform the software development and maintenance work required under this contract, the contractor agrees to maintain the copyright subject to the above general government and special license rights.

(3) Under Section B.3, Consideration and Obligation – Cost Plus Fixed Fee, paragraphs a., c., and d. are revised as follows:

- a. The total estimated cost to the Government for full performance of this contract is \$821,018.81, of which the sum of \$767,307.29 represents the estimated reimbursable costs, and \$53,711.52 represents the fixed fee.
- c. The amount currently obligated by the Government with respect to this contract is \$718,000.00, of which the sum of \$671,028.00 represents the estimated reimbursable costs, and \$46,972.00 represents the fixed fee.
- d. It is estimated that the amount currently obligated will cover performance through March 31, 2007.”

(4) Section F.6 “Duration of Contract” is hereby deleted and replaced with the following:

“The Contract shall commence on July 16, 2003 and will expire on March 31, 2007”

A summary of obligations from the date of award through the date of this modification is provided below:

FY03 Obligations	\$150,000.00
FY04 Obligations	\$250,000.00
FY05 Obligations	\$250,000.00
FY06 Obligations	<u>\$ 68,000.00</u>
Cumulative Total of NRC Obligations	\$718,000.00

This modification obligates FY06 funds in the amount of \$68,000.00.

All other terms and conditions remain the same.

OFFICE OF NUCLEAR REGULATORY RESEARCH
DIVISION OF FUEL, ENGINEERING AND RADIOLOGICAL RESEARCH

MODIFICATION NO. 11 TO STATEMENT OF WORK
FOR CONTRACT NO: NRC-04-03-046

PROJECT TITLE: ALLOY 600 CRACKING - PHASE II

NRC PROJECT MANAGER:

NAME: Aladar A. Csontos

PHONE: (301) 415-6352

B&R NUMBER: 6015111193

JOB CODE: Y6649

I BACKGROUND (Information Added)

Cracking in the Control Rod Drive Mechanism (CRDM) nozzles and seal welds at Oconee Nuclear Station was first noted on Unit 1 when small amounts of boron residue was found on the top of the reactor pressure vessel (RPV) head in November 2000. Similar problems were found on Unit 3 in February 2001 and on Unit 2 in May 2001. Subsequent examinations of the CRDM nozzles with boron residue found through-wall axial cracking in all of these nozzles and through-wall circumferential cracking in three of the nozzles. Since April 2001, the NRC staff has frequently held public meetings with the industry at NRC Headquarters to discuss cracking of CRDM nozzles.

On August 3, 2001, the NRC issued Bulletin 2001 -01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles." The bulletin requested information from the licensees of 69 pressurized water reactors (PWRs) regarding the structural integrity of their nuclear reactor RPV head penetrations. Because of the potentially serious consequences of the cracking and questions relative to the continued safe operation of these nuclear power plants, an urgent sole source purchase order was placed on June 22, 2001, with a contractor to perform an independent evaluation of industry submittals relative to circumferential cracking of reactor pressure vessel head penetration nozzles (Purchase Order no. OR-01-0106, "Control Rod Drive Mechanism Cracking"). This contractor had previously performed work for the NRC relative to cracking in stainless steel piping. Because of the similarities in materials and cracking mechanism (primary water stress corrosion cracking [PWSCC]), the contractor was requested to review industry submittals relative to CRDM cracking and assess whether nuclear power plant detection systems are adequate for detecting the type and size cracks that were reported in CRDM nozzles. In addition, as required, the contractor would provide expertise and assessments relative to: additional industry submittals, NRC staff analyses, and meetings with the NRC Advisory Committee on Reactor Safeguards (ACRS).

As plants began their scheduled inservice inspections in the fall of 2001 and examined CRDM nozzles in response to the bulletin, a number of reports of additional nozzle cracking were received by the NRC staff. Fifteen PWRs reported 69 cracked CRDM nozzles. On January 2, 2002, a contract was awarded to develop an improved probabilistic model for performing time to failure from leakage relative to circumferential crack evaluations in CRDMs (NRC-04-02-062).

The efforts of the contractor provided some of the analyses required by the NRC staff to adequately disposition industry responses to the bulletin and to predict the service life of CRDMs for operating reactors.

On February 16, 2002, the Davis-Besse Nuclear Power Station in Oak Harbor, Ohio, began a refueling outage that included inspecting the CRDM nozzles (consistent with the licensee's commitments in response to NRC Bulletin 2001-01). In conducting its inspections, the licensee found that three CRDM nozzles had indications of axial cracking, which had resulted in leakage of the reactor's pressure boundary. On March 6, 2002, during the repair process, the licensee discovered significant material wastage of the head of the RPV. Boric acid had consumed the RPV head down to the stainless steel cladding on the inside surface of the RPV head. On March 7, 2002, the Office of Nuclear Reactor Regulation (NRR) requested additional support from the Office of Nuclear Regulatory Research (RES) to assess the causes and consequences of the RPV head wastage. Due to the serious nature of the occurrence, the assessment had to be initiated very quickly. On March 7, 2002, RES requested that the contractor assist in the Davis-Besse assessment (the head wastage issue is directly related to the tasks in the original statement of work (CRDM cracking). The contract was modified to address this occurrence. On August 23, 2002, the contract was modified to make enhancements to the CRDM probabilistic fracture mechanics code and provide further expert panel technical assistance in assessing industry submittals.

Phase II of this program addresses the enhancement of some previous and/or on-going efforts plus additional long term needs relative to the assessment of CRDM cracking. Cracking has occurred in CRDM nozzles not predicted to experience cracking for at least 15 more years. This has raised questions relative to the issues of residual stresses, crack driving forces, and crack growth. In addition, the head wastage at Davis-Besse has generic implications relative to using leakage detection as a viable tool for detecting CRDM cracking.

Currently, NRR has requested assistance from RES with a user need request (UNR) dated April 21, 2006 on Primary Water Stress Corrosion Cracking of Nickel-Base Alloy Primary Pressure Boundary Components. NRR identified this UNR as a high priority item since PWSCC in nickel-base alloy primary pressure boundary components may lead to the potential for reactor pressure boundary leaks and boric acid corrosion of low alloy steels. As such, phase II of this Alloy 600 project was modified to evaluate specific issues related to this UNR in a timely manner.

II. OBJECTIVES

Additions and Revision to Objectives:

Revised: Incorporate a deterministic intermediate nozzle (approximately midway down side of head) into probabilistic model.

New: Aid NRR in identifying the regulatory requirements to address PWSCC of all susceptible nickel-base alloy primary pressure boundary components.

III. SCOPE OF WORK

Add the following new tasks to the current SOW:

Task 12: Determination of the Distance below the Control Rod Drive Mechanism (CRDM) J-Groove Weld where Hoop Stresses Drop to 20 ksi

Stress analysis work for Reactor Pressure Vessel Head (RPVH) nozzles previously performed by the Contractor and by the Electric Power Research Institute Materials Reliability Program will be reviewed. The distance above the root, and the distance below the toe, of the J-groove weld where hoop stresses drop to 20 ksi will be determined for various nozzle angles. The results will be documented in a letter report.

Delivery Date: Technical letter report due 4 months after project initiation date.

Task 13: Literature Survey of Alloy 182/82 Stress-Strain Values for Applicability of to Alloy 152/52

The Contractor will perform a literature survey of stress-strain curves for Alloy 182/82, and will review this data to see if the stress-strain curves for Alloy 182/82 are sufficiently similar to those for Alloy 152/52 to permit the use of the Alloy 182/82 data as also representing the behavior of Alloy 152/52. The results will be documented in a letter report.

Delivery Date: Technical letter report due 4 months after project initiation date.

Task 14: Develop Complex Crack Mesh Generator

The Contractor will develop a complex crack mesh generator to be used for further development of an existing "complex model" of circumferential crack growth in RPVH CRDM nozzle J-welds and dissimilar metal piping butt welds. A letter report describing the features of the mesh generator will be provided.

Delivery Date: Technical letter report due 4 months after project initiation.

V. DELIVERABLES

- a. A letter report documenting the distance above the root, and the distance below the toe, of the J-groove weld where hoop stresses drop to 20 ksi for various nozzle angles will be provided.
- b. A letter report documenting the literature survey of stress-strain curves for Alloy 182/82 and the acceptability of using these curves for Alloy 152/52 will be provided.
- c. A letter report describing the features of the complex crack mesh generator will be provided.
- d. Monthly progress reports (including financial updates).

VI. MEETINGS AND TRAVEL REQUIREMENTS

Three trips, one individual, to NRC Headquarters in Rockville, Maryland for two days each shall be required at dates to be determined. One trip, two individuals, location to be determined within continental U.S. to Westinghouse/CE facility to acquire information relative to reactor pressure vessel head and CRDM manufacturing.