

2. AMENDMENT/MODIFICATION NO. M0006	3. EFFECTIVE DATE See Block 16C	4. REQUISITION/PURCHASE REQ. NO. NRO-18-0048	5. PROJECT NO. (If applicable) EWC
6. ISSUED BY      CODE US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-07B20M WASHINGTON DC 20555-0001		7. ADMINISTERED BY (If other than Item 6)      CODE	

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) ENERGY RESEARCH INC ATTN TRACEY MULLINIX 6189 EXECUTIVE BLVD ROCKVILLE MD 208523901	(x)	9A. AMENDMENT OF SOLICITATION NO.
		9B. DATED (SEE ITEM 11)
	x	10A. MODIFICATION OF CONTRACT/ORDER NO. NRC-HQ-25-14-E-0002 NRC-HQ-25-14-T-0002
CODE    621211259      FACILITY CODE		10B. DATED (SEE ITEM 13) 09/30/2014

**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 ACKNOWLEDGEMENT 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)      Net Increase:      \$20,000.00  
See Schedule

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

CHECK ONE	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).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER (Specify type of modification and authority) 52.243-2 Changes - Cost Reimbursement (AUG 1987)

**E. IMPORTANT** Contractor  is not,  is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)  
NRC-HQ-25-14-E-0002/NRC-HQ-25-14-T-0002  
The purpose of this modification is to A) increase the total task order ceiling in the amount of \$29,834.00 (from \$330,756.41 to \$360,590.41); B) provide incremental funding in the amount of \$20,000.00 (from \$330,756.41 to \$350,756.41); and C) modify the statement of work and deliverable schedule to incorporate additional tasks within the scope of the original statement of work.

Total Task Order Ceiling: \$360,590.41 (Changed)  
Total Obligated Amount: \$350,756.41 (Changed)  
Period of Performance: 09/30/2014 through 12/31/2018 (Unchanged)

Continued ...

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

15A. NAME AND TITLE OF SIGNER (Type or print)	16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) RICHARD W. ROBINSON		
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ (Signature of person authorized to sign)		[REDACTED] (Signature of Contracting Officer)	03/30/2018

**CONTINUATION SHEET**

REFERENCE NO. OF DOCUMENT BEING CONTINUED  
NRC-HQ-25-14-E-0002/NRC-HQ-25-14-T-0002/M0006

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NAME OF OFFEROR OR CONTRACTOR  
ENERGY RESEARCH INC

ITEM NO. (A)	SUPPL ES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	<p>See attached pages for specific changes regarding this modification.</p> <p>NEW ACCOUNTING CODE ADDED: Account code: 2018-X0200-FEEBASED-25-25D006-3002-17-4-118-251A-17-4-118-3002</p> <p>All other terms and conditions remain unchanged. Period of Performance: 09/30/2014 to 12/31/2018</p>				

**SPECIFIC CHANGES ARE MADE AS FOLLOWS:**

1. Delete Section B.1 "PRICE/COST SCHEDULE" in its entirety and replace with the following:

**"B.1 PRICE/COST SCHEDULE**

CLIN	DESCRIPTION OF SUPPLIES/SERVICES	ESTIMATED COST	FIXED FEE	TOTAL COST PLUS FIXED FEE
█	█	█	█	█
	█	█	█	<b>\$360,590.41"</b>

2. Delete Section NRCB044 in its entirety and replace with the following:

**"NRCB040A CONSIDERATION AND OBLIGATION—COST-PLUS-FIXED-FEE ALTERNATE I**

(a) The total estimated cost to the Government for full performance of this contract is \$360,590.41 of which the sum of █ represents the estimated reimbursable costs, and of which █ represents the fixed-fee.

(b) There shall be no adjustment in the amount of the Contractor's fixed fee.

(c) The amount currently obligated by the Government with respect to this contract is \$350,756.41, of which the sum of █ represents the estimated reimbursable costs, and of which █ represents the fixed-fee.

(d) It is estimated that the amount currently obligated will cover performance through July 31, 2018.

(e) This is an incrementally-funded contract and FAR 52.232-22 - "Limitation of Funds" applies.

(f) In accordance with FAR 52.216-8 - Fixed Fee, it is the policy of the NRC to withhold payment of fee after payment of 85 percent of the fee has been paid in order to protect the Government's interest. The amount of fixed-fee withheld from the contractor will not exceed 15 percent of the total fee or \$100,000, whichever is less. Accordingly, the maximum amount of fixed-fee that may be held in reserve is █."

3. Delete Section C" DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK FOR TASK ORDER 2" in its entirety and replace with the following:

"

**Statement of Work for  
Technical Review of KHNP APR1400 Large Break LOCA Methodology Topical Report**

This Statement of Work for this Task Order falls within the Small Business Set-Aside part of NRC IDIQ Contract entitled Technical Assistance in Support of Agency Environmental and Reactor Programs, paragraph 3.7, APR-1400 DESIGN CENTER.

**1. PROJECT TITLE**

Technical Review of KHNP APR1400 Large Break LOCA Realistic Evaluation Methodology Topical Report

**2. BACKGROUND**

In January 2013, the Applicant, Korea Hydro and Nuclear Power Co., Ltd. (KHNP) submitted topical report APR1400-F-A-TR-12004-P, Revision 0, "Realistic Evaluation Methodology for Large Break LOCA of the APR1400," [LBLOCA REM] for review by the Nuclear Regulatory Commission, Office of New Reactors (NRO). The topical report is part of the pre-application package for the APR1400 Design Certification application. Although the Design Certification application package has not been accepted for review by the NRC, the topical report was accepted for review in March 2013. Resubmittal of the Design Certification application is expected in late 2014.

The APR1400 LBLOCA REM follows the concept of "Code Scalability, Applicability, and Uncertainty (CSAU)" described in NUREG/CR-5249, "Quantifying Reactor Safety Margins," and the guidelines of Regulatory Guide (RG) 1.157, "Best-Estimate Calculations of Emergency Core Cooling System Performance." The APR1400 LBLOCA REM uses the RELAP5/MOD3.3/K and CONTEMPT4/MOD5 codes for the calculation of the reactor coolant system thermal-hydraulics and containment backpressure, respectively, for the large-break LOCA transient scenarios. Statistical techniques used to quantify the overall uncertainty of the calculation are different from those of the CSAU methodology in order to accommodate the increased number of uncertainty parameters, but still conform to the requirement of RG 1.157.

The LBLOCA REM topical report provides the detailed methodology to be used in the Design Certification Document (DCD), Chapter 15, Section 15.6.5, "Loss-of-Coolant Accidents Resulting From Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary". Detailed review guidance is provided in Section 15.6.5 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition - Transient and Accident Analysis" (SRP 15.6.5). The principal purpose of the SRP is to assure the quality and uniformity of staff safety reviews. Guidance for the LOCA Evaluation Model and analysis methods is provided in SRP 15.0.2, "Review of Transient and Accident Analysis Methods" and in Regulatory Guide 1.203, "Transient and Accident Analysis Methods."

Independent of the full scope APR1400 DCD review, the staff of NRO's Reactor Systems, Nuclear Performance & Code Review Branch (SRSB) will conduct a review of the LBLOCA REM topical report to determine its acceptability to be used for the APR1400 large-break LOCA analysis. Documentation of this review will be provided in a Final Safety Evaluation Report (FSER).

The FSER must provide sufficient information to adequately explain the NRC staff's rationale for determining that there is reasonable assurance that public health and safety is protected. The FSER should be written in a manner whereby a person with a technical (non-nuclear) background and unfamiliar with the applicant's request could understand the basis for the staff's conclusions. The FSER format is described in Attachment 1 to this task order statement of work (SOW).

The objective of this task order is to obtain technical expertise from the contractor to assist the staff in determining the adequacy of the KHNP APR1400 Large Break LOCA Realistic Evaluation Model topical report APR1400-F-A-TR-12004-P, Revision 0, for use in the APR1400 Design Certification application. The review will also include Technical Report APR1400-F-C-NR-12001-P, "Thermal Design Methodology", which was submitted in support of the topical report.

### **3. SCOPE OF WORK**

The Contractor must provide all resources necessary to accomplish the tasks and deliverables described in this statement of work (SOW).

The Contractor must provide individuals who have the required educational background and work experience to meet the objectives of the work specified in this task order. Specific qualifications for this effort include: a) expertise and experience in analysis of nuclear reactor thermal-hydraulics; b) expertise in use of the RELAP5 computer code; c) expertise and familiarity with NRC regulations pertaining to analysis of nuclear reactor thermal-hydraulics, specifically LOCA analyses under the standard review plan (SRP) Sections 4.4 and Sections 15.0.2 and 15.6.5; d) familiarity with requests for additional information (RAI) development; and e) experience and familiarity with development of technical evaluation report (TER) supporting positions developed during the review.

NOTE: Work on this task order will involve the handling of proprietary information.

The contractor shall provide a contract project manager (PM) to oversee the effort and ensure the timely submittal of quality deliverables so that all information is accurate and complete as defined in the base contract.

The NRC will rely on representations made by the contractor concerning the qualifications of the personnel assigned to this task order, including assurance that all information contained in the technical and cost proposals, including resumes, is accurate and truthful. The resume for each professional proposed to work under this task order (contractor, subcontractor, or consultant) shall describe the individual's experience in applying his or her area of engineering specialization to work in the proposed area. The use of particular personnel on this contract is subject to the NRC technical monitor's (TM's) approval. This includes any proposed changes to key personnel during the life of the task order.

The contractor shall provide at a minimum, monthly letter status reports (MLSRs) to the NRC Technical Monitor and the Contracting Officer. Copies must also be sent to the Division of Contracts at [ContractsPOT.Resource@nrc.gov](mailto:ContractsPOT.Resource@nrc.gov).

#### 4. SPECIFIC TASKS

Specific tasks are summarized in the table below, along with the expected deliverables and approximate timetable:

Task #	Task Description	Milestone/Deliverable	Due Date
1a	Become familiar with KHNP's LBLOCA REM topical report APR1400-F-A-TR-12004-P and DCD Section 15.6.5 LBLOCA analysis.	An e-mail to the COR detailing the review plan and the completion of the familiarization with the material	One week after Task Order award.  <b>COMPLETE.</b>
1b	Become familiar with KHNP's Technical Report APR1400-F-C-NR-12001-P, Revision 0, "Thermal Design Methodology".	An e-mail to the COR detailing the review plan and the completion of the familiarization with the material	2 days after completion of Task 1a <b>COMPLETE.</b>
2	Participate in an orientation/kick-off meeting with the NRC staff personnel to discuss potential issues identified during familiarization tasks 1a and 1b and information needed from NRC staff or the Applicant.	N/A	TBD. Meeting will be held by teleconference at a date/time scheduled by the COR, as soon as possible after completion of Tasks 1a and 1b. <b>COMPLETE.</b>
3a	Review LBLOCA REM Topical Report APR1400-F-A-TR-12004-P. Determine if the methods and approach proposed by the Applicant meet the applicable regulations and review guidance. Evaluate the applicant's realistic evaluation methodology for the LBLOCA analysis using the APR1400 RELAP5 model (to be provided upon authorization to proceed with the contract Task Order). This task requires thorough review of the KHNP	Draft RAIs by e-mail to NRC COR Provide bi-weekly status reports to the NRC COR (by e-mail or phone call)	Initial RAIs provided 8 weeks after authorization to proceed <b>COMPLETE.</b>  Bi-weekly status update

	<p>RELAP5/MOD3.3/K code, assessment of the code against separate and integral effects tests, coupling of the RELAP5/MOD3.3/K and CONTEMPT4/MOD5, implementation of the CSAU steps, and statistical method of uncertainty calculation.</p> <p>Identify any technical issues and the need for any additional or clarifying information (requests for additional information, RAIs).</p>		
3b	<p>Review KHNP Thermal Design Methodology Technical Report APR1400-F-C-NR-12001-P. This report describes the overall process to be used to perform core thermal analysis, the critical heat flux correlation that will be used for APR1400 core design and safety analyses, and the computer codes to be used.</p> <p>NOTE: This task <u>does not require</u> acceptance/approval of the CHF correlation or of the computer codes. These reviews are being performed by the NRC staff.</p> <p>Identify any technical issues related to the core thermal design process and the need for any additional or clarifying information (requests for additional information, RAIs).</p>	Draft RAIs by e-mail to NRC COR	<p>Initial RAIs provided 10 weeks after authorization to proceed</p> <p><b>COMPLETE.</b></p>
4	<p>Participate in an audit of the Applicant's calculations used in preparation of RELAP5 model inputs at the Applicant's Vienna, Virginia office. Provide a summary</p>	<p>Audit summary report provided to the NRC Technical Monitor which includes a list of documents reviewed and identifies open</p>	<p>Audit tentatively planned for October of 2014. A maximum of 3 days is expected. Some documents may</p>

	report which identifies documents audited and describes any open issues which will require the Applicant to submit additional information.	issues.	be made available in an electronic reading room. <b>COMPLETED (Jan, 12 thru Jan. 15, 2016)</b> Summary report should be completed one week after audit closure. <b>COMPLETED.</b>
5	Upon receipt of the Applicant's responses to RAIs developed under Tasks 3a, 3b, and 4, determine if the responses are complete and sufficient for the NRC to make a safety determination, or if further information is needed (supplemental RAIs).	If the Contractor or the COR determines that the Applicant's responses are insufficient and that supplemental information is needed, provide draft supplemental RAIs by e-mail to the NRC COR.	Two weeks after receipt of responses (if needed) <b>COMPLETED March 17, 2016.</b>
6	Based on the review of the topical report and technical report and the supplemental information provided in the responses to RAIs, prepare a draft Technical Evaluation Report (TER) using the format provided in the enclosed TER template.	Draft TER by e-mail to the NRC COR	4 weeks after completion of Task 5 Rev. 3 of TER completed 3/4/2016 TER update is needed to reflect final audit issue response review and resulting audit RAIs for all issues not satisfactorily resolved by KHNP. These RAIs can be considered Open Items in the TER. This TER update should document all issues identified during the Topical Report Revision 0 review and their resolution, except those identified as Open Items. <b>COMPLETED.</b>



7	Review responses to RAIs issued in Task 6; determine if responses are satisfactory or if supplemental information is needed.	Draft supplemental RAIs (if needed) by e-mail to NRC COR	2 weeks after responses received from KHNP and provided by the COR.  <b>COMPLETED.</b>
8	Review LBLOCA REM Topical Report APR1400-F-A-TR-12004-P, Revision 1. Determine if all changes KHNP committed to in resolution of audit issues or RAIs have been properly incorporated in the revision. Confirm that the changes made do not introduce new issues.	E-mail to COR summarizing the Revision 1 review. If new issues are identified or audit issues are not satisfactorily resolved, provide new draft RAIs	3 weeks after receipt of Revision 1 of the topical report  <b>COMPLETED.</b>
9	Update TER revision prepared under Task 6 to incorporate discussion on review of Revision 1 of the Topical Report and supplemental RAI responses.	Draft TER revision by e-mail to the NRC COR	2 weeks after RAI responses received  <b>COMPLETED.</b>
10	Upon receipt of NRC staff comments on the draft TER, develop and issue a final TER which incorporates the staff comments. If supplemental RAIs are generated in Task 5, incorporate resolution/closure discussion based on the Applicant's responses.	Final TER and Cover Transmittal Letter provided to the NRC. Electronic files shall be submitted in both Microsoft WORD and ADOBE Acrobat format.	Two weeks after receipt of NRC comments on the draft TER prepared under Task 9 <del>or 10 (if a Revision 2 of the topical report is needed).</del>
10a	Provide in the NRC Final Safety Evaluation (FSER) format the technical evaluation provided in the TER in Task 9	FSER Draft	March 22, 2018  Complete
10b	Provide technical and editorial assistance during OGC comment resolution	Participation by telephone during comment resolution meetings	March 26, 2018 Complete

11a	Develop draft Advisory Committee on Reactor Safeguards (ACRS) presentation slides which summarize the TER review.	Slides provided to the NRC COR in Microsoft PowerPoint format.	2 weeks prior to ACRS meeting (currently scheduled for April 17, 2018)
11b	Upon receipt of NRC staff comments, prepare final ACRS presentation slides.	Slides provided to the NRC COR in Microsoft PowerPoint format.	2 days after receipt of NRC comments
12	Provide technical support to the staff during related ACRS meeting.  This may include addressing ACRS member questions during the meeting and any follow-up letter (if needed).	(If needed) an e-mail to the NRC COR providing information required to address ACRS Member question(s).	April 17, 2018 ACRS Subcommittee Meeting and May 3, 2018 ACRS Full Committee Meeting

## 5. APPLICABLE DOCUMENTS AND STANDARDS

Key regulatory requirements are specified in Title 10 of the Code of Federal Regulations, Part 50 – “Domestic Licensing of Production and Utilization Facilities”. Detailed review guidance for the review is provided in Section 15.6.5 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition - Transient and Accident Analysis” (SRP 15.6.5). The principal purpose of the SRP is to assure the quality and uniformity of staff safety reviews. Guidance for the LOCA Evaluation Model and analysis methods is provided in SRP 15.0.2, “Review of Transient and Accident Analysis Methods” and in Regulatory Guide 1.203, “Transient and Accident Analysis Methods.”

The above requirements and review guidance are available on the U. S. Nuclear Regulatory Commission’s public website at [www.nrc.gov](http://www.nrc.gov).

**DELIVERABLES AND DELIVERY SCHEDULE/REPORTING REQUIREMENTS**

All items to be delivered or milestones to be achieved are listed in Section 4. Except as noted for Tasks 7 and 8, deliverables may be provided by e-mail to the COR. For Task 7, the deliverable must be provided in Microsoft WORD and Adobe Acrobat format. Presentation slides for Task 8 must be provided in Microsoft PowerPoint format.

Monthly Letter Status Reports must include the information discussed in the base contract.

**6. REQUIRED LABOR CATEGORIES/ ESTIMATED LEVEL OF EFFORT(Except for Information Technology Services)**

**Labor categories/.Level of effort table**

<b>Labor Category</b>	<b>Minimum Qualification Requirement</b>	<b>Estimated Labor Hours</b>	<b>Additional Labor Hours (M0002)</b>	<b>Additional Labor Hours (M0006)</b>
Project Manager	Note 1	114	150	<b>32</b>
Subject Matter Expert	Note 1	240	0	<b>112</b>
Senior Technical Reviewer	Note 1	780	380	<b>36</b>
Technical Reviewer	Contractor's discretion	260	380	<b>0</b>
Administrative Support	Contractor's discretion	120	90	<b>0</b>
<b>Total</b>		<b>1514</b>	<b>1000</b>	<b>180</b>

**Note 1:** All key technical staff, including the project manager, must have the following technical qualifications:

- Extensive expertise in use of RELAP5/MOD3.3 code to perform realistic PWR LOCA and AOO analyses;
- Extensive knowledge of RELAP5/MOD3.3 code internal numerical schemes and physical models;
- Extensive expertise in the realistic evaluation methodology and the concept of "Code Scalability, Applicability, and Uncertainty (CSAU)."
- Extensive regulatory analysis and review experience with SRP Chapter 15 and associated PWR safety systems.
- Extensive expertise in use of the CONTEMPT4/MOD5 code or comparable containment analysis codes.
- Past experience in maintaining RELAP5/MOD3 code for U.S NRC or at least 20 years of industry experience using RELAP5 series of codes to evaluate operating PWR and BWR ECCS performance.
- Past experience performing LOCA topical report reviews for new or operating reactor designs for NRC or experience in responding to NRC requests for additional information (RAIs) regarding vendor LOCA topical reports or technical reports.

**7. GOVERNMENT-FURNISHED PROPERTY**

**N/A.**

## **8. PERIOD OF PERFORMANCE**

The estimated period of performance for this work is from October 1, 2014 through December 31, 2018.

## **9. PLACE OF PERFORMANCE**

All work may be performed at the contractor's site, with the exception of Task 4 (audit of the Applicant's calculations), which must be performed at the Applicant's U. S. office in Vienna, Virginia, and Task 13 (Technical support to the NRC staff during ACRS meeting), which will be held at NRC's Rockville, Maryland Headquarters.

## **10. SPECIAL CONSIDERATIONS**

### **TRAVEL/MEETINGS**

Task 4: One, 2-person, 3-day meeting at the Applicant's Vienna, Virginia office  
**(COMPLETE)**

**Task 12:** One, 1-person, 1-day meeting at the NRC's Rockville, Maryland headquarters

All travel requires prior written approval from the COR.

### **SECURITY**

Work on this task order will involve the handling of proprietary information

### **KEY PERSONNEL**

The NRC will rely on representations made by the contractor concerning the qualifications of the personnel assigned to this task order, including assurance that all information contained in the technical and cost proposals, including resumes, is accurate and truthful. The resume for each professional proposed to work under this task order (contractor, subcontractor, or consultant) shall describe the individual's experience in applying his or her area of engineering specialization to work in the proposed area. The use of particular personnel on this contract is subject to the COR's. This includes any proposed changes to key personnel during the life of the task order.