AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

BPA NO.	1. CONTRACT ID CODE	PAGE	OF PAGES
		1	2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
002	See Block 15C.	RES-03-074 M002	

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
U.S. Nuclear Regulatory Commission Div of Contracts Two White Flint North - MS T-7-I-2 Attn: Rachel Glaros (301) 415-0115 Washington, DC 20555	3100	U.S. Nuclear Regulatory Commission Div of Contracts Two White Flint North - MS T-7-I-2 Attn:Rachel Glaros (301) 415-0115 Washington, DC 20555	3100

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)	(X)	9A. AMENDMENT OF SOLICITATION NO.
ENERGY RESEARCH, INC. 6167 EXECUTIVE BLVD. ROCKVILLE MD 208523901		9B. DATED (SEE ITEM 11)
		10A. MODIFICATION OF CONTRACT/ORDER NO. GS23F0110M DR-04-03-074
CODE / FACILITY CODE	X	10B. DATED (SEE ITEM 13) 09-10-2003

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 of 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)
B&R No:. 46015115107 Job Code: Y6933 BOC: 252A
Appropriation No.: 31X0200.460 Increase Amount: $29,992

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: GS-23F-0110M - FAR 52.212-4(c)
	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.)

See Page No. 2 for description of modification

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)	16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)
MOHSEN KHATIB-RAHBAR, PRESIDENT	ROBERT B. WEBBER CONTRACTING OFFICER
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED
Mohsen Khatib-Rahbar	8/24/04
16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED
RBW	8/30/04

STANDARD FORM 30 (REV. 10-83)

TEMPLATE - ADM001

ADM002

The purpose of this modification are to: (1) increase the scope of work under Statement of Work Section C.1.3.3; (2) Revise the delivery schedule for the tasks under Statement of Work Section C.1.3.4 and Section C.1.3.6; and (3) Extend the overall period of performance for the delivery order. Specific Changes to the delivery order are stated below.

1. Attachment One, Statement of Work, is deleted in its entirety and replaced with the attached Statement of Work dated August 16, 2004.

2. The total quantity, as identified on the SF 1449, Block No. 21, is increased by 340 hours, from 3,294 hours to 3,634 hours.

3. Item No. 1.2 is deleted in its entirety and replaced with the following:

Fiscal Year 2004 Labor Rates and Labor Hours
Executive - $128.15 - 610 hours
Senior Engineer Scientist - $70.82 - 1,214 hours
Engineer/Scientist - $52.39 - 536 hours

4. Item No. 1.3 is deleted in its entirety and replaced with the following:

Fiscal Year 2005 Labor Rates and Labor Hours
Executive - $132.64 - 220 hours
Senior Engineer/Scientist - $73.30 - 320 hours
Engineer Scientist - $54.22 - 260 hours

5. The total labor costs is increased by $29,992, from $276,371.16 to $306,363.16.

6. The fixed ceiling price of the delivery order is increased by $29,992, from $292,519.16 to $322,511.16.

7. The total obligated amount is increased by $29,992, from $292,519.16 to $322, 511.16.

8. The period of performance is revised to September 10, 2003 through December 31, 2006.

9. All other terms and conditions of the delivery order remain unchanged.

ATTACHMENT ONE

STATEMENT OF WORK
EVALUATION OF SEVERE ACCIDENT PHENOMENA
RS- RES-03-074
REVISED AUGUST 16, 2004

C.1.1 BACKGROUND

In 2002, the contract to perform severe accident analysis for AP1000 was competed. ERI was chosen to perform the AP1000 severe accident analysis because of its existing technical expertise and extensive experience in performing similar severe accident analysis for NRC.

Since then, the U.S. Nuclear Regulatory Commission (NRC) has entered into discussions with the General Electric Company and the AECL Technologies Inc. for pre-application review of the ESBWR and ACR-700 reactors respectively. To plan for the anticipated technical review of these reactor designs, RES is to undertake some MELCOR severe accident analysis similar to those that have been undertaken for AP1000 design certification.

ESBWR is an advanced boiling water reactor (BWR). Its design is generally based on the technology of the operating BWRs but with some passive safety systems to maintain core and containment cooling. Some of these passive systems are similar in principle to passive systems used in AP1000. In the area of severe accident evaluation, just like AP1000, ESBWR is relying on retention of molten core materials inside the pressure vessel by flooding outside of the pressure vessel with water. In the event, in-vessel melt retention is not successful, ex-vessel fuel-coolant interaction and molten core and concrete interaction have to be investigated. Hence, RES plans to perform similar severe accident analysis for ESBWR as has been done for AP1000.

The ACR-700 reactor has unique features that are different from the U.S. light water reactors (PWRs and BWRs). The ACR-700 reactor has a series of horizontal parallel pressure tubes rather than a single pressure vessel. The tubes are horizontally positioned in a calandria (tank) of heavy water moderator. Natural and slightly enriched uranium oxide fuel are located in CANFLEX bundles. Because of the unique features of ACR-700, the events leading to severe accidents and system response to severe accidents are expected to be different from U.S. light water reactors. Hence, some of the severe accident phenomena (e.g., the fuel and fuel channel behavior under degraded coaling conditions, fuel and fuel channel failure) are believed to be vastly different, while some of them are expected to be similar (e.g., source term releases, aerosol deposition, and transport; core concrete interaction and non-condensable gas production). Hence, RES plans to explore the difference between ACR-700 and U.S. LWRs for severe accident analysis.

C.1.2 OBJECTIVE

The objective of this contract is to peer review the ERI severe accident analysis for AP1000 and revise them accordingly, perform severe accident analyses for risk dominant sequences including sensitivity studies, and to investigate both in-vessel and ex-vessel fuel coolant interaction phenomena for advanced reactors.

C.1.3 SCOPE

The contractor shall perform the following tasks as described in C.1.1.

C.1.3.1 Peer review AP1000 severe accident analysis

Conduct a peer-review of the ERI AP1000 severe accident analysis. Revise reports including revised or additional analysis as required to address peer reviewers' comments.

Deliverable: Letter report: 10/15/03
Revised analysis reports: 11/15/03
Estimated Level-of-Effort: 2 staff months

C.1.3.2 Review ESBWR documentation

The ESBWR design documentation shall be reviewed for the purpose of identifying the need of information required to perform subsequent subtasks 1.3.3 and 1.3.4.

Deliverable: Letter report: 12/31/03
Estimated Completion date: 3/31/04
Estimated Level-of-Effort: 1 staff months

C.1.3.3 Severe Accident Analysis

Review ESBWR experimental data to ensure that the analytical codes are validated for full scale ESBWR application. This is to ensure that the initial and boundary conditions for code analysis are appropriate for ESBWR applications. Update an BWR MELCOR input deck for ESBWR. Perform baseline analysis for a risk significant sequence. Perform preliminary sensitivity studies of key parameters affecting in-vessel retention (e.g., CHF correlations derived from experiments; RASPLAV and MASCA experimental results), postulated core-concrete interaction (CCI), and impacts of the non-safety related containment spray system on containment behavior (i.e.,H_2 combustion, pressure, and source terms).

Deliverable: **Report on ESBWR experimental data assessment:**
Draft – 3 months after receipt of all GE experimental, design, and scaling analysis and other related data
Final – 1.5 months after submission of draft report
ESBWR input deck: **7/31/05**
Draft letter report on baseline analysis: **10/15/05**

Final letter report on baseline analysis: **11/30/05**
Draft letter report on sensitivity analysis: **12/15/05**
Final letter report on sensitivity analysis: **1/15/06**
Draft letter report on all analysis: **2/28/06**
Final letter report on all analysis: **3/31/06**
Estimated Completion date: **5/31/06**
Estimated Level-of-Effort: **6 staff months**

C.1.3.4 ESBWR Fuel-Coolant Interaction (FCI) analysis

Perform ESBWR specific Fuel-Coolant Interaction (FCI) analysis.

Deliverable: Draft letter on analysis: **1/15/06**
Final letter report on analysis: **3/15/06**
Estimated Completion date: **5/31/06**
Estimated Level-of-Effort: 2 staff months

C.1.3.5 Preliminary assessment of modeling issues for ACR-700

Review ACR-700 design and identify modeling issues (e.g., steam oxidation kinetics of pressure tube, melt progression through pressure tube and calandria, fuel and cladding creep during heatup, energetic interactions of molten fuel and Zr with water in calandria, hydrogen production during core degradation) for ACR-700 needed for MELCOR code modeling.

Deliverable: Letter report: 6/30/04
Estimated Completion date: 6/30/05
Estimated Level-of-Effort: 4 staff months

C.1.3.6 Technical Assistance

Provide consultation and support (including further analysis and peer-review) on an as-needed basis. Assistance in meetings with the ACRS, ACRS subcommittees, and other interested parties as requested by NRC.

Deliverable: As required
Estimated Completion date: **12/31/06**
Estimated Level-of-Effort: 6 staff months

C. 1.4 MEETINGS AND TRAVEL REQUIREMENTS

For each contract year, the contractor shall attend five meetings for up to three persons for two-days meeting on advanced reactors (ESBWR, ACR-700, etc.) at NRC Headquarters. For each contract year, up to two trips for two persons for two-days (U.S., and Canada) to review experiments and/or analysis related to advanced reactors (ESBWR, ACR-700, etc.,).

C. 1.5 PERIOD OF PERFORMANCE

The delivery order shall be effective from date of award through **December 31, 2006.**

C.1.6 NRC-FURNISHED MATERIALS

The contractor shall be provided the following information for use during performance: 1. ERI AP1000 analysis; 2. ESBWR and ACR-700 design; and 3. Responses to NRC Request of Additional Information on ESBWR and/or ACR-700 as required.