

**SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL ITEMS  
OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, 30**

1. REQUISITION NO. RES-03-074				BPA NO.	
2. CONTRACT NO. GS-23F-0110M		3. AWARD/EFFECTIVE DATE 09-10-2003		4. ORDER NO. DR-04-03-074	
5. SOLICITATION NO. N/A		6. SOLICITATION ISSUE DATE N/A			
7. FOR SOLICITATION INFORMATION CALL:		a. NAME Robert B. Webber		b. TELEPHONE NO. (No Collect Calls) 301.415.6520	
9. ISSUED BY  U.S. Nuclear Regulatory Commission Div of Contracts Two White Flint North - MS T-7-I-2 Contract Management Center No. 2 Washington, DC 20555		10. THIS ACQUISITION IS <input type="checkbox"/> UNRESTRICTED <input type="checkbox"/> SET ASIDE: 0 % FOR <input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> HUBZONE SMALL BUSINESS <input type="checkbox"/> 8(A) NAICS: 541330 SIZE STANDARD:		11. DELIVERY FOR FOB DESTINATION UNLESS BLOCK IS MARKED <input type="checkbox"/> SEE SCHEDULE <input type="checkbox"/> 13a. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) 13b. RATING: N/A 14. METHOD OF SOLICITATION <input type="checkbox"/> RFO <input type="checkbox"/> IFB <input type="checkbox"/> RFP	
15. DELIVER TO  U.S. Nuclear Regulatory Commission Office of Research Attn: Richard Lee Mail Stop T10K8 Washington DC 20555		16. ADMINISTERED BY  U.S. Nuclear Regulatory Commission Div of Contracts Two White Flint North - MS T-7-I-2 Contract Management Center No. 2 Washington, DC 20555			
17a. CONTRACTOR/OFFEROR  Energy Research, Inc. P.O. Box 2034 Rockville, Maryland 20847		18a. PAYMENT WILL BE MADE BY  U.S. Nuclear Regulatory Commission Payment Team, Mail Stop T-9-R-4 Attn: DR-04-03-074 Washington DC 20555			
TELEPHONE NO. 301.881.0866		18b. SUBMIT INVOICES TO ADDRESS SHOWN IN BLOCK 18a UNLESS BLOCK BELOW IS CHECKED <input checked="" type="checkbox"/> SEE ADDENDUM			
<input type="checkbox"/> 17b. CHECK IF REMITTANCE IS DIFFERENT AND PUT SUCH ADDRESS IN OFFER					

19. ITEM NO.	20. See CONTINUATION Page SCHEDULE OF SUPPLIES/SERVICES	21. QUANTITY	22. UNIT	23. UNIT PRICE	24. AMOUNT
1	<p>The contractor shall 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 investigate both in-vessel and ex-vessel fuel coolant interaction phenomena for advanced reactors. All professional engineering services shall be performed in accordance with contract GS-23F-0110M and Attachment One - Statement of Work.</p> <p>Labor hour order with a fixed ceiling of \$292,519.16. Order includes labor, travel and other direct costs. Refer to the following page for delivery order labor rates/hours.</p> <p>NRCAR clause 2052.209-72 entitled, "Contractor Organizational Conflicts of Interest" is incorporated herein. Billing Instructions are found in Attachment Two.</p> <p>Funds in the amount of \$200,000 are presently obligated. The period of performance is September 10, 2003 through September 30, 2005.</p>				\$292,519.16
SUBTOTAL					\$292,519.16

25. ACCOUNTING AND APPROPRIATION DATA 36015115107 Y6933 252A 31X0200.360 \$200,000.00				26. TOTAL AWARD AMOUNT (For Govt. Use Only) \$292,519.16	
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<input type="checkbox"/> 27a. SOLICITATION INCORPORATES BY REFERENCE FAR 52.212-1, 52.212-4. FAR 52.212-3 AND 52.212-5 ARE ATTACHED. ADDENDA		<input type="checkbox"/> ARE <input type="checkbox"/> ARE NOT ATTACHED.	
<input type="checkbox"/> 27b. CONTRACT/PURCHASE ORDER INCORPORATES BY REFERENCE FAR 52.212-4. FAR 52.212-5 IS ATTACHED. ADDENDA		<input type="checkbox"/> ARE <input checked="" type="checkbox"/> ARE NOT ATTACHED	
28. CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN <u>2</u> COPIES TO ISSUING OFFICE. CONTRACTOR AGREES TO FURNISH AND DELIVER ALL ITEMS SET FORTH OR OTHERWISE IDENTIFIED ABOVE AND ON ANY ADDITIONAL SHEETS SUBJECT TO THE TERMS AND CONDITIONS SPECIFIED HEREIN.		29. AWARD OF CONTRACT: REFERENCE _____ OFFER DATED _____ YOUR OFFER ON SOLICITATION (BLOCK 5), INCLUDING ANY ADDITIONS OR CHANGES WHICH ARE SET FORTH HEREIN IS ACCEPTED AS TO ITEMS:	

30a. SIGNATURE OF OFFEROR/CONTRACTOR <i>Mohsen Khatib-Rahbar</i>		31a. UNITED STATES OF AMERICA (SIGNATURE OF CONTRACTING OFFICER) <i>Robert B. Webber</i>	
30b. NAME AND TITLE OF SIGNER (TYPE OR PRINT) Mohsen Khatib-Rahbar		31b. NAME OF CONTRACTING OFFICER (TYPE OR PRINT) ROBERT B. WEBBER	
30c. DATE SIGNED 9/9/03		31c. DATE SIGNED 9/8/03	

**TEMPLATE - ADM002**

**ADM002**

19. ITEM NO	20. SCHEDULE OF SUPPLIES/SERVICES	21. QUANTITY	22. UNIT	23. UNIT PRICE	24. AMOUNT
1.1	FISCAL YEAR 2003 LABOR RATES AND LABOR HOURS EXECUTIVE - \$124.13 - 128 hours EXECUTIVE ENGINEER SCIENTIST - \$113.81 - 40 hours SENIOR ENGINEER/SCIENTIST - \$68.60 - 152 hours ENGINEER/SCIENTIST - \$50.75 - 64 hours SENIOR CONSULTING ENGINEER - \$147.61 - 90 hours				
1.2	FISCAL YEAR 2004 LABOR RATES AND LABOR HOURS EXECUTIVE - \$128.15 - 510 hours SENIOR ENGINEER SCIENTIST - \$70.82 - 1074 hours ENGINEER/SCIENTIST - \$52.39 - 476 hours				
1.3	FISCAL YEAR 2005 LABOR RATES AND LABOR HOURS EXECUTIVE - \$132.64 - 200 hours SENIOR ENGINEER/SCIENTIST - \$73.30 - 300 hours ENGINEER SCIENTIST - \$54.22 - 260 hours  TOTAL LABOR COSTS-\$276,371.16 TOTAL ODC COSTS-\$16,148.00				

32a. QUANTITY IN COLUMN 21 HAS BEEN

RECEIVED   
  INSPECTED   
  ACCEPTED, AND CONFORMS TO THE CONTRACT, EXCEPT AS NOTED: \_\_\_\_\_

32b. SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE	32c. DATE	32d. PRINTED NAME AND TITLE OF AUTHORIZED GOVERNMENT REPRESENTATIVE
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32e. MAILING ADDRESS OF AUTHORIZED GOVERNMENT REPRESENTATIVE	32f. TELEPHONE NUMBER OF AUTHORIZED GOVERNMENT REPRESENTATIVE
32g. E-MAIL OF AUTHORIZED GOVERNMENT REPRESENTATIVE	

33. SHIP NUMBER	34. VOUCHER NUMBER	35. AMOUNT VERIFIED CORRECT FOR	36. PAYMENT <input type="checkbox"/> COMPLETE <input type="checkbox"/> PARTIAL <input type="checkbox"/> FINAL	37. CHECK NUMBER
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38. S/R ACCOUNT NUMBER	39. S/R VOUCHER NUMBER	40. PAID BY
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41a. I CERTIFY THIS ACCOUNT IS CORRECT AND PROPER FOR PAYMENT	42a. RECEIVED BY (Print)	
41b. SIGNATURE AND TITLE OF CERTIFYING OFFICER	41c. DATE	42b. RECEIVED AT (Location)
		42c. DATE REC'D (YY/MM/DD)
		42d. TOTAL CONTAINERS

## ATTACHMENT ONE

### STATEMENT OF WORK EVALUATION OF SEVERE ACCIDENT PHENOMENA RS-RES-03-074

#### 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 cooling 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

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<sub>2</sub> combustion, pressure, and source terms).

Deliverable: ESBWR input deck: 3/31/04  
Draft letter report on baseline analysis: 6/15/04  
Final letter report on baseline analysis: 7/30/04  
Draft letter report on sensitivity analysis: 8/15/04  
Final letter report on sensitivity analysis: 9/15/04  
Draft letter report on all analysis: 10/30/04  
Final letter report on all analysis: 11/31/04  
Estimated Completion date: 12/31/04  
Estimated Level-of-Effort: 4 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: 9/15/04  
Final letter report on analysis: 10/31/04  
Estimated Completion date: 11/30/04  
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: 12/31/05  
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-day meetings 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 September 30, 2005.

**C.1.7 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.

Attachment  
two

(MARCH 1996)  
Page 1 of 3

BILLING INSTRUCTIONS FOR  
FIXED PRICE CONTRACTS

General: The contractor shall prepare vouchers or invoices as prescribed herein. FAILURE TO SUBMIT VOUCHERS/INVOICES IN ACCORDANCE WITH THESE INSTRUCTIONS WILL RESULT IN REJECTION OF THE VOUCHER/INVOICES AS IMPROPER.

Form: Claims shall be submitted on the payee's letterhead, voucher/invoices, or on the Government's Standard Form 1034, "Public Voucher for Purchases and Services Other than Personal," and Standard Form 1035, "Public Voucher for Purchases Other than Personal--Continuation Sheet." These forms are available from the U.S. Government Printing Office, 710 North Capitol Street, Washington, DC 20401.

Number of Copies: An original and three copies shall be submitted. Failure to submit all the required copies will result in rejection of the voucher/invoice as improper.

Designated Agency Billing Office: Vouchers/Invoices shall be submitted to the following address:

U.S. Nuclear Regulatory Commission  
Division of Contracts - T-7-I-2  
Washington, DC 20555-0001

A copy of any invoice which includes a purchase of property valued at the time of purchase at \$5000 or more, shall additionally be sent to:

Chief, Property Management Branch  
Division of Facilities and Property Management  
Mail Stop - T-7-D-27  
Washington, DC 20555-0001

HAND-DELIVERY OF VOUCHERS/INVOICES IS DISCOURAGED AND WILL NOT EXPEDITE PROCESSING BY THE NRC. However, should you choose to deliver vouchers/invoices by hand, including delivery by any express mail service or special delivery service which uses a courier or other person to deliver the vouchers/invoices in person to the NRC, such vouchers/invoices must be addressed to the above Designated Agency Billing Office and will only be accepted at the following location:

U.S. Nuclear Regulatory Commission  
One White Flint North - Mail Room  
11555 Rockville Pike  
Rockville, MD 20852

HAND-CARRIED SUBMISSIONS WILL NOT BE ACCEPTED AT OTHER THAN THE ABOVE ADDRESS

10. For Indefinite Delivery contracts or contracts under which progress payments are authorized, the final voucher/invoice shall be marked "FINAL VOUCHER" OR "FINAL INVOICE."

Currency: Billings may be expressed in the currency normally used by the contractor in maintaining his accounting records and payments will be made in that currency. However, the U.S. dollar equivalent for all vouchers/invoices paid under the contract may not exceed the total U.S. dollars authorized in the contract.

Supersession: These instructions supersede any previous billing instructions.

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