



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 2, 1997

Science and Engineering Associates, Inc.
Attn: Ilene R. Colina
Contract Administrator
6100 Upton Blvd., NE
Albuquerque, New Mexico 87110

Dear Ms. Colina:

Subject: Task Order No. 2, Entitled "Assessment of Debris Accumulation on PWR Sump Performance," Under Contract No. NRC-04-97-036

In accordance with Section G.4(c), of the subject contract, this letter definitizes the subject task order. This effort shall be performed in accordance with the enclosed Statement of Work and the contractor's technical proposal dated December 5, 1996, which is hereby incorporated by reference and made a part of the subject task order.

Task Order No. 2 shall be in effect from January 2, 1997 through July 1, 1997, with a ceiling amount of \$69,420.00. The amount of \$64,442.00 represents the total estimated reimbursable costs and the amount of \$4,988.00 represents the fixed fee.

The obligated amount of this task order shall at no time exceed the task order ceiling. When and if the amount(s) paid and payable to the Contractor hereunder shall equal the obligated amount, the contractor shall not be obligated to continue performance of the work unless and until the Contracting Officer shall increase the amount obligated with respect to this task order. Any work undertaken by the Contractor in excess of the obligated amount specified below is done so at the Contractor's sole risk.

The amount currently obligated by the Government with respect to this task order is \$64,000.00, of which the sum of \$59,480.00 represents the estimated reimbursable costs, and of which \$4,520.00 represents the fixed fee. It is estimated that the amount currently allotted will cover performance through June 16, 1997.

Accounting Data for Task Order No. 2 is as follows:

Commitment No:	RES-C97-318
APPN No:	31X0200.760
B&R No:	76015115050
JOB CODE:	W6650
BOC No:	252A
Obligated Amount:	\$64,000.00

The following individual is considered to be essential to the successful performance of work hereunder:

Dr. V. Rao

9701240273 960108
PDR CONTR
NRC-04-97-036 PDR

The Contractor agrees that key personnel shall not be removed from the task order effort without compliance with Contract Clause H.3, "Key Personnel."

Your contacts during the course of this task order are:

Technical Matters: Michael Marshall
(301) 415-5895

Contractual Matters: Sharon Mearse
(301) 415-6591

The issuance of this task order does not amend any terms or conditions of the subject contract.

Please indicate your acceptance of Task Order No. 2 by having an official, authorized to bind your organization, execute three copies of this document in the space provided and return two copies to the Contracting Officer. You should retain the third copy for your records.

If you have any questions regarding this matter, please contact me on 301/415-6591.

Sincerely,



Sharon D. Mearse, Contracting Officer
Technical Acquisition Branch No. 1
Division of Contracts
Office of Administration

Enclosure:
As stated

ACCEPTED:

Elene R. Colina
NAME

Contract Administrator
TITLE

1/8/96
DATE

Task Order 002
"Assessment of Debris Accumulation on Pressurized Water Reactors Sump Performance"
of NRC Contract NRC-04-97-036
"Technical Assistance in Resolving Generic Safety Issues"
(FIN No. W6650)

BACKGROUND

The United States Nuclear Regulatory Commission (NRC) first addressed the concern with pressurized water reactor (PWR) sump performance as part of the resolution of unresolved safety issue (USI) A-43, "Containment Emergency Sump Performance." The resolution was published in 1985 (Refs. 6, 13, and 15). The USI A-43 evaluation and resolution focused primarily on PWRs, but its results were considered applicable to boiling water reactors (BWRs).

After several suction strainer debris blockage events at BWRs, in 1993, the NRC initiated reevaluation of the potential of loss-of-coolant accident (LOCA) generated debris to block BWR suction strainers and prevent the emergency core cooling system (ECCS) from performing its long-term cooling function. The study (see Ref. 20) concluded that debris during a LOCA may prevent the ECCS from performing its long-term cooling function. Light water reactor licensees are required to ensure long-term cooling to the reactor core in accordance with Code of Federal Regulations (CFR), specifically 10 CFR 50.46 "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors." Based on the study and operational events, the NRC will request (see Refs. 9 and 14) that licensees evaluate their plants and, if necessary, make changes to their plants to prevent any detrimental effects from debris blockages.

In light of the resolution of S-081, "Potential for Loss of Emergency Cooling in BWR Due to LOCA Generated Debris," (i.e., the BWR suction strainer blockage issue) the NRC has decided to reassess debris blockage of PWR sumps to determine if there is a need for further actions to be taken for PWRs beyond the original resolution of USI A-43.

OBJECTIVES

The objectives of this reevaluation are to (1) assess the adequacy of the technical basis of the USI A-43 resolution and (2) assess adequacy of regulatory guide 1.82, Rev. 1 guidance concerning debris blockage of PWR sumps.

SCOPE OF WORK

- Identify and review the physical features of the plant, aspects of the postulated LOCA, calculations, and assumptions used in the technical basis of the resolution of USI A-43.
- Identify information or models used in the USI A-43 evaluation that are obsolete.
- Identify and review the debris sources in PWRs (esp. particulate debris sources).

- Identify and review differences between PWR and BWR guidance.
- Review issues concerning sump blockage raised by Swedish Nuclear Power Inspectorate and Finnish Centre for Radiation and Nuclear Safety.
- The reevaluation should consider the major containment types (i.e., large dry, sub-atmospheric, ice condenser).
- The probabilistic aspect of USI A-43 should not be included in the reevaluation.

REPORTING REQUIREMENTS

No additional reporting requirement beyond those already agreed to in NRC contract NRC-04-97-036.

DELIVERABLES AND DELIVERY SCHEDULE

1. An interim letter report shall be submitted to the NRC Project Officer (PO) and NRC Technical Monitor (TM) three months after the effective date of this task.
2. A draft report shall be submitted to the NRC PO and TM five months after the effective date of this task. A final, camera-ready report shall be submitted to the NRC PO and TM 30-days after receipt of NRC PO's and TM's comments on the draft report. The format of the final report shall meet the design specifications for NUREG/CR reports.

MEETING AND TRAVEL REQUIREMENTS

All travel shall be approved by and coordinated with the NRC PO or TM. Allowances should be made for the following trips:

1. Two two-days, two-people trip to NRC headquarters from contractor site to discuss results of reevaluation.
2. One one-day, two-people trip to NRC headquarters from contractor site to participate in internal NRC review of reevaluation.

ESTIMATED LEVEL OF EFFORT

The estimated level of effort for this task is 620 people-hours.

PERIOD OF PERFORMANCE

The period of performance for this task is 6 months from the effective date of the task order.

TECHNICAL DIRECTION

Technical direction will be provided by Michael Marshall. Mr. Marshall can be reached at (301) 415-5895 (voice), (301) 415-5062 (fax), and mxm2@nrc.gov (email).

REFERENCES AND BIBLIOGRAPHY

1. Knowledge Base for Emergency Core Cooling System Recirculation Reliability, NEA/CSNI/R(95)11, Organization for Economic Cooperation and Development, Nuclear Energy Agency, France, February 1996. (Restricted)
2. Brinckman, K., Results of Hydraulic Tests on ECCS Strainer Blockage and Material Transport in a BWR Suppression Pool, EC-059-1006, Pennsylvania Power & Light Company, Allentown, PA, May 1994.
3. Brocard, D., Buoyancy, Transport, and Head Loss of Fibrous Reactor Insulation, NUREG/CR-2982, (SAND82-7205, Sandia National Laboratories), U. S. Nuclear Regulatory Commission, Washington, DC, July 1983.¹
4. Durgin, W. and Noreika, J., The Susceptibility of Fibrous Insulation pillows to Debris Formation Under Exposure to Energetic Jet Flows, (SAND83-7008, Sandia National Laboratories), U. S. Nuclear Regulatory Commission, Washington, DC, March 1983.¹
5. Fredell, J., Karshamn Tests 1992: Steam Blast on insulated Objects, Logbook, RVE 92-202, ABB Atom, November 1992.
6. Generic Letter 85-22, "Potential for Loss of Post-LOCA Recirculation Capability Due to Insulation Debris Blockage," U. S. Nuclear Regulatory Commission, Washington, DC, December 1985.²
7. Hallstrom, B., Guaranteed Emergency Core and Containment Cooling Laboratory Experiments Concerning Insulation, RVD 92-192, ABB Atom, November 1992.
8. Kamath, P., et. al., An Assessment of Residual Heat Removal and Containment Spray Pump Performance Under Air and Debris Ingesting Conditions, NUREG/CR-2792, (CREARE TM-825, Creare, Inc), U. S. Nuclear Regulatory Commission, Washington, DC, September 1982.¹
9. NRC Bulletin 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling Water Reactors," U. S. Nuclear Regulatory Commission, Washington, DC, May 1996.³
10. Padmanabhan, M., Hydraulic Performance of Performance of Pump Suction Inlets for Emergency Core Cooling Systems in Boiling Water Reactors, NUREG/CR-2772, (ARL-398A, Alden Research Laboratory), U. S. Nuclear Regulatory Commission, Washington, DC, June 1982.¹
11. Persson, B., Downward Transport and Sedimentation of Insulation Material and the

¹ This document is part of the technical basis of the resolution of USI A-43.

² This document is part of the resolution of USI A-43.

³ This document is part of the resolution of S-081.

Build-Up of Pressure Loss in the Suction Filters, OKG, Sweden, March 1992.

12. Rao, D. and Souto, F., Experimental Study of Head Loss and Filtration for LOCA Debris, NUREG/CR-6367, (SEA 95-554-06-A:8, Science and Engineering Associates, Inc.), U. S. Nuclear Regulatory Commission, Washington, DC, February 1990.⁴
13. Regulatory Guide 1.82, Rev. 1, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," U. S. Nuclear Regulatory Commission, Washington, DC, November 1985.²
14. Regulatory Guide 1.82, Rev. 2, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," U. S. Nuclear Regulatory Commission, Washington, DC, May 1996.³
15. Serkiz, A., USI A-43 Regulatory Analysis, NUREG-0869, Rev. 1, U. S. Nuclear Regulatory Commission, Washington, DC, October 1985.¹
16. Souto, F. and Rao, D., Experimental Investigation of Sedimentation of LOCA-Generated Fibrous Debris and Sludge in BWR Suppression Pools, NUREG/CR-6368, (SEA 95-554-06-A:8, Science and Engineering Associates, Inc.), U. S. Nuclear Regulatory Commission, Washington, DC, December 1995.⁴
17. Wysocki, J. and Kolbe, R., Methodology for Evaluation of Insulation Debris Effects, NUREG/CR-2791, (SAND82-7067, Sandia National Laboratories), U. S. Nuclear Regulatory Commission, Washington, DC, September 1982.¹
18. Wysocki, J., Probabilistic Assessment of Recirculation Sump Blockage Due to Loss of Coolant Accidents, NUREG/CR-3394, (SAND83-7116, Sandia National Laboratories), U. S. Nuclear Regulatory Commission, Washington, DC, July 1983.¹
19. Zigler, G. (ed), Experimental Investigation of Head Loss and Sedimentation Characteristics of Reflective Metallic Insulation Debris, SEA No. 95-970-01-A:2, Science and Engineering Associates, Inc., Albuquerque, NM, May 1996.⁴
20. Zigler, Beaty, et. al., Parametric Study of the Potential for BWR ECCS Strainer Blockage Due to LOCA Generated Debris, NUREG/CR-6224, (SEA No. 93-554-06-A:1, Science and Engineering Associates, Inc.), U. S. Nuclear Regulatory Commission, Washington DC, October 1995.⁴

⁴

This document is part of the technical basis of the resolution of S-081.