AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

BPA NO.	1. CONTRACT ID CODE	PAGE	OF
		1	7

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
M006	See Block 15c.	RES-11-268 FAIMIS: N/A	

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
U.S. Nuclear Regulatory Commission Div. of Contracts Attn: Jennifer A. DeFino, 301-492-3637 Mail Stop: TWB-01-B10M Washington, DC 20555	3100	U.S. Nuclear Regulatory Commission Div. of Contracts Mail Stop: TWB-01-B10M Washington, DC 20555	3100

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)	(X)	9A. AMENDMENT OF SOLICITATION NO.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY M I T 77 MASSACHUSETTS AVE CAMBRIDGE MA 021394301		9B. DATED (SEE ITEM 11)
		10A. MODIFICATION OF CONTRACT/ORDER NO. NRC-04-09-151
CODE 001425594 FACILITY CODE	X	10B. DATED (SEE ITEM 13) 09-30-2009

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)
See CONTINUATION Page

B&R: 2011-60-17-6-100 JCN: N6860 BOC: 252A APPR NO: 31X0200.960
NAICS: 611310 PSC: C118 DUNS: 001425594 FAIMIS: N/A
OBLIGATE: $0.00 (THIS MODIFICATION DOES NOT OBLIGATE FUNDS)

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: MUTUAL AGREEMENT OF THE PARTIES
SOW, POP, AND KEY PERSONNEL REVISIONS

D. OTHER (Specify type of modification and authority)

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.)

SEE PAGE TWO (2) FOR DESCRIPTION OF CONTRACT MODIFICATION TO REVISE THE STATEMENT OF WORK (SOW), EXTEND THE PERIOD OF PERFORMANCE (POP), AND REVISE THE KEY PERSONNEL.

Total Contract Ceiling: $741,090.22 (unchanged)
Total Obligated Amount: $608,000.00 (unchanged)
Period of Performance: 09/30/2009 - 04/30/2012 (changed)

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)
Michael P. Corcoran Assistant Director Office of Sponsored Programs	Jennifer A. DeFino Contracting Officer
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED 9/8/11
16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED 09/01/2011

NSN 7540-01-152-8070
PREVIOUS EDITION NOT USABLE

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA - FAR (48 CFR) 53.243

TEMPLATE - ADM001

SUNSI REVIEW COMPLETE SEP 12 2011

ADM002

The purpose of this contract modification is to: (1) revise the statement of work in accordance with the attached changes (see Attachment #1); (2) extend the period of performance from November 30, 2011 to April 30, 2012; and (3) revise the Key Personnel to appoint Dr. Charles Oman as the Principal Investigator. Accordingly, the contract is hereby modified as follows:

1) Section C- DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK is revised in accordance with the changes show on Attachment #1 to this modification.

2) Section F.7 DURATION OF CONTRACT PERIOD (MAR 1987) is deleted in its entirety and replaced with the following:

"This contract shall commence on **September 30, 2009** and will expire on **April 30, 2012**."

3) Section H.2 2052.215-70 KEY PERSONNEL (JAN 1993), Paragraph (a) is deleted in its entirety and replaced with the following:

"(a) The following individual is considered to be essential to the successful performance of the work hereunder:

Dr. Charles M. Oman
Director, MIT Man Vehicle Laboratory and Senior Lecturer
Department of Aeronautics & Astronautics

The contractor agrees that personnel may not be removed from the contract work or replaced without compliance with paragraphs (b) and (c) of this section."

All other terms and conditions of this contract remain unchanged including the contract ceiling of $741,090.22.

A summary of obligations, from award date through the date of this action, is given below:

Total FY09 Obligations	$100,000.00
Total FY10 Obligations	$265,000.00
Total FY11 Obligations	$243,000.00
Total NRC Obligations	$608,000.00

This modification does not obligate funds.

ATTACHMENT 1

MODIFIED STATEMENT OF WORK FOR COMMERCIAL
CONTRACT # NRC-04-09-151
JCN # N6860

TITLE: Automation and HSI Complexity in Advanced Reactors

SCOPE OF WORK

The tasks for the two topics in this project will be described separately. Tasks A1-3 are for the automation topic.

Task A1: Develop metrics of automation evaluation for NPP control rooms

Many human performance considerations associated with the use of automation have been raised in the literature. Methods assessing these considerations include generic measures such as workload, situation awareness, trust, and task-specific measures. However, the relationship between these measures is unclear, including construct validity, and the applicability for NPP systems. The goal of this activity is to develop a minimal but sufficient set of metrics to assess NPP automation and its interaction with operational personnel. Subtasks to achieve this goal include:

1a) Review literature to generalize human performance considerations associated with automation and assess their applicability to the NPP domain.

1b) Review literature and develop metrics of automation evaluation to assess the roles of personnel and automation; identify methods and tools that measure each metric, analyze the applicability, limitations, pros and cons, and cost/benefit of the methods/tools.

1c) Develop guidance on how to select and use the methods/tools for safety evaluations.

Deliverables:	~~NUREG/CR report~~Letter Report	May 1, 2010
Level of Effort:	2 Senior (faculty) staff months and 6 graduate student months 3 Undergraduate Student Months	

Task A2: Develop methods or tools to assess the acceptability of level of automation.

LOA determines functional allocation between human and automation. The purpose of functional allocation is to optimize performance and reduce errors. Many functional allocation methods have been proposed in the literature. However, there is a lack of systematic analysis that addresses whether existing or hypothesized role and function allocations are achieving desired states and whether the allocations have negative safety impacts on performance. The goal of this task is to provide regulators with methods or tools for evaluating the acceptability of LOA for given tasks and resources in NPP control rooms. Subtasks to achieve the goal include:

2a) Conduct literature review to identify or adapt methods or tools for evaluating LOA applicable to NPP control room tasks.

2b) Perform cognitive task analysis of NPP control rooms and use that knowledge to develop test beds to simulate control room automation systems.

2c) Conduct simulation experiments to test and validate the identified methods/tools for LOA evaluation.

Deliverables:	~~NUREG/CR~~ Letter report	~~August 31~~March 31, ~~2011~~2012
Level of Effort:	~~2~~1.5 Senior (faculty) staff month and 18 graduate student months ~~3~~ 6 Undergraduate Student Months 12 Research Scientist Months	

Tasks B1-4 are for the complexity topic.

Task B1: Develop technical basis and review guidelines for evaluating NPP HSI complexity and its safety aspects

The goal of this task is to identify factors that contribute to complexity in plant systems, functional tasks, HSI, and operator information processing in order to develop review guidelines. A knowledge base is needed to understand how complexity of plant systems propagates through HSI to impact operator's performance and how to mitigate the complexity and its propagation. Activities to achieve the goal include:

1a) Review and analyze the complexity literature - There has been considerable research in the area of perceived complexity in a number of industrial and academic domains that can be analyzed to determine its applicability to NPP design and operations.

1b) Obtain Subject Matter Expert (SME) input - Contacting SMEs currently studying complexity would ensure the most current approaches and that models of complexity are identified.

1c) Conduct review of operational experience - Review NPP accident/incident reports and possibly contact operators and NRC inspectors to understand complexity in NPP operations.

1d) Develop a descriptive model of complexity in plant systems, functional tasks, HSI, and information processing of operations crew, and work with the NRC research staff to develop a guideline for evaluating complexity of NPP control room systems.

Deliverables:	~~A NUREG/CR~~ Letter Report	March 1, 2010
Level of Effort:	0.5 Senior Staff (professor) month and 6 Research Scientist (postdoctoral staff) months	

Task B2: Develop measures (methods or tools) to assess HSI complexity

Measures to assess complexity are needed to be used as part of a safety evaluation. This effort will focus on measures of HSI complexity because NPP systems and functional tasks impact operational personnel through HSI. Input from the literature, subject matter experts, and the

complexity models can be used as the technical basis to develop the measures. Activities to achieve the goal include:

2a) The measures should be adaptable to the level of information details available.

2b) The measures may take several forms depending on cost/benefit requirements. For example, a simple checklist can give a quick, simple assessment; a questionnaire may require participants of operations crews; while experimental measures require development of test interface, scenario, and tasks, as well as expertise in data collection and analysis.

2c) The measures should accommodate different types of HSI in NPP systems. The safety-related HSIs in NPP control rooms include alarm systems, control systems, computer-based procedures, and decision-support systems. The effect of complexity on operational personnel can vary with these systems.

Deliverables: ~~Part I of a NUREG/CR~~Letter Report ~~November 30, 2010~~August 31, 2011

Level of Effort: 1 Senior Staff months and
6 Research Scientist months

Task B3: Conduct simulation experiments to test and validate the complexity measures.

DELETE TASK B3.

NOTE: LOE for Task B3 is being transferred to Task A2. Overall LOE and cost do not change.)

Expected results:

The results of Task A1-3 for the automation topic will be documented in ~~two~~ three ~~NUREG/CRs~~Letter Reports, ~~a Letter Report to the NRC,~~ and the software of the test beds for NPP control system simulations. The ~~NUREG/CRs~~Letter reports will document the methods and tools applicable to evaluating control room automation systems, as well as the experimental design, test beds, and results that link the methods/tools to human performance. Insights and recommendations to the HRA of control room automation will also be documented in a Letter Report to the NRC. In addition, the NRC research staff will develop a user's guide to facilitate knowledge transfer of this project to NRC operations.

The results of Task B1-4 for the complexity topic will be documented in ~~two~~ three ~~NUREG/CRs~~Letter Reports, ~~a Letter Report to the NRC,~~ and the software of the test beds simulating human-system interfaces of NPP control systems. The ~~NUREG/CR~~LETTER REPORTs will document the technical basis, guideline, methods and tools applicable to evaluating safety aspects of HSI complexity in NPP control rooms, as well as the experimental design, test beds, and results that link the methods/tools to human performance. Insights and recommendations to complexity in HRA will also be documented in a Letter Report to the NRC.

PERIOD OF PERFORMANCE September 30, 2009 through ~~Nov 30, 2011~~April 30, 2012

REPORTING REQUIREMENTS

The following reports are required:

Task A1: Develop metrics of automation evaluation for NPP control rooms: ~~NUREG/CR report~~ Letter Report	May 1, 2010
Task A2: Develop methods of evaluating LOA and experimental testing: ~~NUREG/CR~~Letter report	~~Aug 31~~Mar 31, ~~2011~~2012
Task A3: Insights into HRA of automation: Letter Report	Nov 30, 2011
Task B1: Develop technical basis and review guidelines for evaluating HSI complexity: ~~NUREG/CR~~Letter report	March 1, 2010
Task B2 ~~& 3~~: Develop assessment tools and experimental testing: ~~NUREG/CR~~Letter report	Aug 31, 2011
Task B4: Insights into complexity in HRA: Letter Report	Nov 30, 2011

DELIVERABLES/SCHEDULES AND/OR MILESTONES

The final deliverable will be ~~2 NUREG CR and 1 Letter Report~~3 letter reports that describe the findings from Tasks A1-3, ~~2 NUREG CRs and 1~~3 Letter Reports that describe the findings from the Tasks B1-4.

Task A1: Develop metrics of automation evaluation for NPP control rooms: ~~NUREG/CR~~Letter report	May 1, 2010
Task A2: Develop methods of evaluating LOA and experimental testing: ~~NUREG/CR~~Letter report	~~Aug~~ Mar 31, ~~2011~~2012
Task A3: Insights into HRA of automation: Letter Report	Nov 30, 2011
Task B1: Develop metrics of complexity evaluation for NPP control rooms: ~~NUREG/CR~~ Letter report	March 1, 2010

Task B2: ~~& B3:~~ Develop assessment methods and experimental testing:

ATTACHMENT 1

~~NUREG/CR~~ Letter report	Aug 31, 2011
Task B4: Insights into complexity in HRA : Letter Report	Nov 30, 2011