

<b>INTERAGENCY AGREEMENT</b>		1. IAA NO. NRC-HQ-60-14-D-0031/M0007		PAGE OF 1 2	
2. ORDER NO.		3. REQUISITION NO.		4. SOLICITATION NO. Sandia start is date of SFO CO acceptance	
5. EFFECTIVE DATE 01/09/2018		6. AWARD DATE 01/09/2018		7. PERIOD OF PERFORMANCE <del>05/15/2014</del> TO 08/31/2018	
8. SERVICING AGENCY ALBUQUERQUE SANDIA NATL LAB ALC: DUNS: 155505027 #4: DOENNSASEQ CONTRACTING OFFICER PO BOX 5400 ALBUQUERQUE NM 87185-5400  POC: Christine Whitley TELEPHONE NO. 505-844-3811			9. DELIVER TO LAWRENCE CRISCIONE US NUCLEAR REGULATORY COMMISSION TWO WHITE FLINT NORTH 11545 ROCKVILLE PIKE MAIL STOP T-10A12 ROCKVILLE MD 20852		
10. REQUESTING AGENCY ACQUISITION MANAGEMENT DIVISION ALC: 31000001 DUNS: 040535809 #4: US NUCLEAR REGULATORY COMMISSION TWO WHITE FLINT NORTH 11545 ROCKVILLE PIKE MAIL STOP T-5E3 ROCKVILLE MD 20852-2738 POC Carolyn A. Cooper TELEPHONE NO. 301-415-6734			11. INVOICE OFFICE US NUCLEAR REGULATORY COMMISSION ONE WHITE FLINT NORTH 11555 ROCKVILLE PIKE MAILSTOP 03-E17A ROCKVILLE MD 20852-2738		
12. ISSUING OFFICE US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-5E03 WASHINGTON DC 20555-0001			13. LEGISLATIVE AUTHORITY Energy Reorganization Act of 1974		
			14. PROJECT ID		
			15. PROJECT TITLE HRA METHOD IMPROVEMENT AND GUIDE DEVELOPMENT		
16. ACCOUNTING DATA N/A					
17. ITEM NO.	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
	NRC-HQ-60-14-D-0031 Master IAA: N/A The purpose of this modification is to incorporate a within scope change to the agreement, thereby increasing the authorized ceiling amount by \$173,327.00, from \$1,266,479.00 to \$1,439,806.00; and extending the period of performance from March 31, 2018 through August 31, 2018. Accordingly, the agreement is hereby modified:  TOTAL AMOUNT OF THIS MODIFICATION: \$173,327.00 Continued ...				
23. PAYMENT PROVISIONS			24. TOTAL AMOUNT \$0.00		
25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICED) By Jon E. Holmberg Jon E. Holmberg Date: 2018.01.24 16:59:40 -07'00'			25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING) <i>Carolyn A. Cooper</i>		
25b. NAME AND TITLE Jon E. Holmberg, NNSA Contracting Officer			25b. CONTRACTING OFFICER CAROLYN A. COOPER		25c. DATE 1/9/2018



National Nuclear Security Administration  
Sandia Field Office  
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Rockville, MD 20852-

Letter Number:  
SNL/OFA:18 - 14024

Funding Document: NRCHQ6014D0031-7  
Document Purpose: Performance Period Change to end Aug 31, 2018  
DOE Facility: Sandia National Laboratories, NM  
DOE Contractor: National Technology and Engineering Solutions of Sandia, LLC  
DOE Contact: MARTINEZ, M. CHRISTINA, CHRISTINA.MARTINEZ@NNSA.DOE.GOV  
Proposal Title: HRA METHOD IMPROVEMENT AND GUIDE DEVELOPMENT  
Proposal Number: NRC6014D0031

Dear Sir or Madam:

The Department of Energy (DOE), National Nuclear Security Administration (NNSA), Sandia Field Office (SFO) has accepted the above-referenced funding document subject to the terms and conditions described herein. Previous funding remains certified as available and continues under Contract DE-NA0003525 with National Technology and Engineering Solutions of Sandia, LLC for performance of the referenced project at Sandia National Laboratories. Sandia National Laboratories is hereby authorized to accommodate the requested change without interference to DOE-funded programs as reimbursable work for Other Federal Agencies.

The referenced project shall be performed under the aforementioned operating contract; the U.S. Economy Act of 1932, as amended; and in accordance with other applicable laws and regulations, if applicable or as noted in the attached funding document. Billing for this work will be done in accordance with current DOE policies. Should additional funding be required to complete the project, you will be notified as to the amount and date additional funds are needed.

Questions or concerns regarding this submission should be directed to the DOE contact named above and should reference the proposal number.

Sincerely,  
**Jon E.  
Holmberg**  
Contracting Officer  
Sandia Field Office

Digitally signed by Jon E.  
Holmberg  
Date: 2018.01.24 16:59:09  
-07'00'

TOTAL AMOUNT OF OBLIGATIONS TO DATE:  
\$1,158,548.71 (unchanged)  
TOTAL AUTHORIZED CEILING AMOUNT: \$1,439,806.00  
(changed)

→ The period of performance of the subject agreement is from ~~September 15, 2014~~ through August 31, 2018. (changed) Sandia start is date of SFO CO acceptance

The existing statement of work in the agreement is deleted in its entirety and is replaced with the following document in lieu thereof:

Attachment 1, Revised Statement of Work (SOW)

All other terms and conditions of the subject agreement remain unchanged.

- ALC: 31000001
- DUNS: 040535809
- TAS: 31X0200.320

**REVISED STATEMENT OF WORK**

<b>NRC Agreement Number</b>  NRC-HQ-60-14-D-0031	<b>NRC Agreement Modification Number</b>  Modification No. 7	<b>NRC Task Order Number (If Applicable)</b>  	<b>NRC Task Order Modification Number (If Applicable)</b>  
<b>Project Title</b> "HRA Method Improvement and Guide Development"			
<b>Common Cost Center Code</b>  1052	<b>B&amp;R Number</b> APP-14-RES-0060, Operating Reactors - Research - Reactors Research - Risk Analysis		<b>DOE Laboratory</b> Sandia National Laboratory
<b>NRC Requisitioning Office</b> RES			
<b>NRC Form 187, Contract Security and Classification Requirements</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> Not Applicable		<input checked="" type="checkbox"/> Involves Proprietary Information <input type="checkbox"/> Involves Sensitive Unclassified	
<input checked="" type="checkbox"/> Non Fee-Recoverable		<input type="checkbox"/> Fee-Recoverable (If checked, complete all applicable sections below)	
<b>Docket Number (If Fee-Recoverable/Applicable)</b>  NA		<b>Inspection Report Number (If Fee Recoverable/Applicable)</b>  NA	
<b>Technical Assignment Control Number (If Fee-Recoverable/Applicable)</b>  NA		<b>Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)</b>  NA	

**1.0 BACKGROUND**

This is a DOE agreement for developing Human Reliability Analysis (HRA) guidance for the agency to use. The agreement requests Sandia National Laboratory (SNL) to perform eight tasks to support the NRC's HRA research activities; the tasks are to improve the NRC's newly developed HRA methodology.

In a November 8, 2006 Staff Requirements Memorandum (SRM), resulting from the October 20, 2006 meeting with the Advisory Committee on Reactor Safeguards (ACRS), the Commission directed ACRS to "work with the staff and external stakeholders to evaluate the different Human Reliability models in an effort to propose either a single model for the agency to use or guidance on which model(s) should be used in specific circumstances." The SRM evolved from the observation that many HRA methods are currently available to evaluate personnel performance as an integral part of a Probabilistic Risk Assessment (PRA). There is ample evidence that the analysis results can vary substantially, depending on the selected HRA methodology and different analyst applications of a particular model. The staff decided that development of a single methodology is the best approach.

To address shortcomings in the evaluation of human actions and the quantification of human error probabilities for PRA applications, the staff and the Electric Power Research Institute (EPRI) have collaborated to develop the Integrated Decision-tree Human Error Analysis System (IDHEAS) methodology. This effort has been focused initially on the application of HRA methods and models to evaluate operator response to internal events such as transients, failures of support systems, and losses of reactor coolant that occur during plant power operation. The approach takes advantage of the procedural guidance that is available for many of these actions and the extensive experience among nuclear power plant personnel and HRA experts in evaluating these scenarios. The resulting methods and models are documented in the draft NRC/EPRI report, "An Integrated Decision-Tree Human Event Analysis System (IDHEAS) Method for NPP Internal At-Power Operation." The staff and EPRI are currently extending the HRA collaboration for a methodology that is generally applicable for HRA applications of other types of scenarios such as fires, floods, and seismic events, and for events that occur during other plant operating modes. The expected product for the extended collaboration is "The HRA Generic Methodology."

During the 614<sup>th</sup> meeting of the ACRS, May 8, 2014, the ACRS reviewed the IDHEAS report and made several recommendations. One recommendation is "A formal and complete expert elicitation process should be conducted to develop human error probabilities and associated uncertainty distributions for each combination of contextual factors in the final version of every decision tree." In IDHEAS, the use of expert elicitation is both pragmatic and reasonable. The IDHEAS uses decision trees to estimate the human error probabilities of a list of human error modes. A decision tree is for an error mode (e.g., failure to detect a piece of information). Because human performance is sensitive to context, a decision tree identifies a few factors having significant effects on the failure mode to characterize the context. Each event tree sequence represents a specific context. In an expert elicitation process, the experts carefully assess the likelihood and uncertainty of each failure mode with account of the context which is represented by a set of performance influencing factors. An expert elicitation was performed for IDHEAS in 2013 to obtain the human error probabilities and associated uncertainty distributions of a number of the decision tree sequences but not all. This project is to complete the process for all the decision tree sequences in order for the method to be practically used for HRA applications.

The method also needs to be systematically tested before its deployment. Experience from the development of other complex methodologies, such as those used for the modeling and analysis of plant fires, has demonstrated the value and the need for comprehensive piloting of the methods before deployment. Thus, formal pilot testing of the IDHEAS methodology should be performed. The testing should be conducted by multiple teams of analysts who have a range of practical experience with evaluating human performance in PRA applications. Teams should include members with expertise in nuclear power plant engineering, operations, and the plant-specific PRA, as well as human performance and HRA. Each team should evaluate the same set of PRA event scenarios that cover a range of human actions and anticipated crew failure modes. The testing should demonstrate the advantages and limitations of the method with respect to state-of-practice HRA methods used by the NRC.

After the method is tested and ready for use, a user-friendly manual is necessary. The results of the testing should yield practical guidance for developing the user guidance or user manual. This project includes the development of IDHEAS user's manual.

Currently the staff is also developing the HRA Generic Methodology that intends to be applicable for all HRA scopes (internal events and external event; at-power vs. shutdown; reactor events vs. spent fuel events; and level-1 PRA and level-2/3 PRA, etc.) and risk-informed applications (Standardized Plant Analysis Risk (SPAR) model, Significance Determination Process (SDP), and Accident Sequence Precursor (ASP)). An important aspect of HRA method development is data support. This is challenging because of the insufficient nuclear data to support the wide range of application scope such as severe accidents, external events (seismic, flood, and severe weather condition, etc.), low-power shutdown, and local actions.

Compensating for the lack of nuclear accident data, the generic methodology uses human-centered system-neutral approach to assess human performance. It is possible to use the data in other domains, such as aviation, manufacturing, and cognition and human factors experiments to inform the generic methodology in human error probability estimation. Such data are available in various scientific literature, technical reports, and operational databases. A formal expert elicitation is planned to support the generic methodology development. Extensive data mining analysis is needed to disseminate the data to support the expert elicitation serving as the technical basis for the generic methodology.

The tasks identified above support each other. Together they fit to the NRC's strategic HRA plan. The central theme of the plan is to conduct integrated research activities in HRA method and tool development along with data collection and analysis to support HRA applications. It is important for the activities to be coordinated and performed as an integral research project.

## **2.0 OBJECTIVE**

The objective of this project is to bridge the technical gaps identified to implement the IDHEAS method and the generic HRA methodology in the NRC's HRA applications. Ultimately, the project will complete the work needed to make the IDHEAS method and the HRA generic methodology usable for the NRC's HRA applications. The results of the work are expected to resolve technical issues in the agency's current HRA practices and meet the agency's needs for ongoing and upcoming HRA activities such as Level-3 PRA and work delineated in the post-Fukushima Task Force.

The purpose of this modification is to update Section 7, Travel to document anticipated travel throughout the task order and to add a new task (Task 9) to the SOW for support of the SACADA data analysis workshop. The revisions are indicated herein in "RED."

## **3.0 SCOPE OF WORK**

The DOE Laboratory must provide all resources necessary to accomplish the tasks and deliverables described in this statement of work (SOW). The DOE Laboratory shall perform the following tasks:

### **Task 1. IDHEAS Testing**

Similar to the US HRA benchmark study, the IDHEAS testing will use a number of HRA teams to apply the IDHEAS method to estimate the human error probabilities of the human failure event and scenarios specified by the NRC project manager. In addition to the HRA

teams performing HRAs, there is an evaluation team to analyze the HRA results. It is expected that the NRC will provide three HRA teams, EPRI will provide one, and the nuclear industry will provide one. Collectively, each team should have a range of practical experience with evaluating human performance in PRA applications. Teams should include members with expertise in nuclear power plant engineering, operations, and the plant-specific PRA, as well as human performance and HRA. The test scenarios are expected to include scenarios in the US HRA benchmark study and the past cases of SDP and ASP.

#### Subtask 1.1: HRA team

SNL shall subcontract the industry team identified by NRC to participate in the study. The expected tasks and level of effort for the HRA teams are the following:

- Each HRA team consists of two members.
- Each HRA team receives three-days of training in IDHEAS methodology at NRC headquarters.
- A site visit that could include simulator observation and interviews with plant staff.
- Twelve staff-workdays for a team (two members) in understanding the scenarios, performing analysis, and documenting results.
- Attend a two-day workshop on the HRA evaluation results at NRC headquarters.

The level of effort includes the following two trips:

- One five-day trip to NRC headquarters to received IDHEAS training.
- One three-day trip to the selected site to observe simulator exercises and interview plant staff.
- One four-day trip to NRC headquarters to participate in the evaluation workshop.

The SNL PI shall attend all trips specified above. NRC will work with EPRI to identify the industry team for SNL to subcontract. In addition, NRC will sponsors three NRC teams and EPRI will sponsor one EPRI team to participate in the study. SNL shall work with NRC staff to develop the reporting forms for HRA teams to document their analysis results.

#### Subtask 1.2: Develop material for IDHEAS training and testing

SNL shall work with NRC staff to format the current IDHEAS technical report to a user manual for the analysis. NRC staff will identify the human failure events and scenarios to be used for the testing. SNL staff shall assist the NRC staff to package the information for the HRA teams to perform the analysis.

#### Subtask 1.3: Evaluate HRA analysis results

SNL staff shall support NRC staff in analyzing and documenting the HRA results. The results will be documented as a technical letter report. The document shall, as a minimum, document the HRA teams' analysis results; the strengths and weaknesses identified in applying the IDHEAS method; comparison with the available results of other HRA methods performed on the same HFEs of the same scenarios (e.g., the US HRA benchmark study and the past SDP or ASP cases, or both). Additionally, it should also

document any recommendations for IDHEAS improvements in order to perform HRA for NRC's risk-informed applications.

Deliverable: A letter report to the NRC documenting the testing process and results

Task 2. Support expert elicitations for the quantification models of the IDHEAS and the generic HRA methodology

SNL shall support NRC staff in the preparation, conduction, and documentation of three expert elicitation workshops and document the workshop results. One workshop is on the quantification models of the IDHEAS method. The other two workshops are on the quantification model of the generic HRA methodology. The workshops will be conducted at NRC headquarters. Each workshop takes three days. It is expected that four domain experts will be subcontracted by SNL to participate in the expert elicitation workshop. SNL shall identify the domain experts to participate in the expert elicitation workshops. With NRC PM's approval, SNL shall contract with these experts to attend the expert elicitation workshop and perform related work. The expert elicitation also requires the participation of three operational personnel from US plants; SNL shall coordinate the operational personnel and pay their cost for traveling to the workshops. SNL shall expand the data collection efforts performed in support of the IDHEAS expert elicitation workshop performed in 2013 to identify more data to support the workshops. SNL shall prepare source materials for the workshops, coordinate and facilitate the workshops, and assist the NRC staff in analyzing and integrating data from the elicitation. Finally, SNL shall document the process and results of expert elicitations in a letter report to the NRC.

Deliverable: A letter reports documenting the process and results.

The expected trips in this task include:

- Three Five-person five-day trips to NRCHQs to participate in the expert elicitation workshops

Task 3. Support the development of the IDHEAS User's Manual

The objective of this task is to develop the IDHEAS User's Manual that incorporates the lessons learned from IDHEAS testing. The NRC will identify an industrial HRA expert to be the chief architect for the manual development. SNL shall work with the expert and NRC staff to develop the details of the manual. SNL shall also perform necessary coordination and setup a subcontract for the industrial expert.

Deliverable: A NUREG/CR report for IDHEAS Users' Manual

Task 4. Data mining and analysis of human error data in non-nuclear domains to support the HRA generic methodology

The objective of this task is to mine human error data in non-nuclear domains to benchmark the human error probabilities in the HRA generic methodology. SNL shall work on data mining and analysis according to the scope and guidance provided by the NRC technical monitors. SNL shall also document the data in an Excel file and update the file as the task progresses. SNL shall summarize the results in a letter report to the NRC.



Deliverable: A technical letter report to the NRC documenting the results

Task 5. Project Management

SNL shall maintain close administrative, as well as technical control, over the project. SNL shall maintain a detailed schedule of activities, project personnel assignments, and expected costs pertaining to the tasks during the contract's period of performance. Administrative information shall be provided to the NRC project manager upon request in a timely manner.

Task 6. Peer Review of Updated Draft IDHEAS General Methodology Report

NRC staff has updated the draft IDHEAS General Methodology Report to incorporate work performed to date under this agreement in order to provide a periodic update of the project to the ACRS in June 2016. SNL shall perform a peer review of this updated draft IDHEAS General Methodology Report. The COR will provide SNL a copy of the updated draft IDHEAS General Methodology Report subsequent to award of the agreement modification. SNL shall prepare a technical letter report that synthesizes the comments from all reviewers. The report shall include for each comment, the specific section and page number of the report to which that comment is directed and the basis and assumptions for the comment. SNL shall participate in teleconference(s) with the COR and NRC Staff to discuss the comments.

Deliverable: A technical letter report documenting the results of the peer review of the updated draft IDHEAS General Methodology Report

Task 7. Presentation on IDHEAS

SNL shall prepare a draft paper that synthesizes the results from the IDHEAS tests that were conducted under Task 1. SNL shall submit the draft paper to the COR for review and approval 30 days prior to traveling to the conference in October. The COR will review the draft paper and provide feedback to SNL within one week of receipt. SNL shall revise the draft paper incorporating the comments and submit to the COR for review and approval within one week of receipt. The COR will provide final approval of the paper within one week of receipt of the final paper.

SNL shall travel to Korea to present the paper on the IDHEAS testing results at the 13<sup>th</sup> International Conference on Probabilistic Safety Assessment and Management (PSAM 13). The conference is scheduled to be held during October 2, 2016 through October 7, 2016 in PSAM 13, Korea. While additional conferences are not envisioned at this time, SNL may be tasked with presenting a paper at future conferences, if deemed necessary by NRC management.

All foreign travel for the DOE laboratory personnel requires a 60-day lead time for NRC approval. For prior approval of foreign travel, the DOE laboratory shall submit an NRC Form 445, "Request for Approval of Official Foreign Travel." NRC Form 445 is available in the MD 11.7 Documents library and on the NRC Web site at: <http://www.nrc.gov/reading-rm/doc-collections/forms/>. The following information pertains to the trip to Korea:

- Number of trips – 1
- Purpose of Trip – Present a Paper at the 13<sup>th</sup> International Conference on Probabilistic Safety Assessment and Management (PSAM 13)
- Destination – Korea
- Number of staff – One staff member of the DOE laboratory
- Number of days – 8 days trip with 6 days attending the conference
- Deliverables – Draft and Final Paper to be presented at the conference

RES encourages the publication of the scientific results from RES sponsored programs in refereed scientific and engineering journals as appropriate. If the laboratory proposes to publish in the open literature or present the information at meeting in addition to submitting the required technical reports, approval of the proposed article or presentation should be obtained from the NRC Project Manager. The RES Project Manager will either approve the material as submitted, approve it subject to NRC suggested revisions, or disapprove it. In any event, the RES Project Manager may disapprove or delay presentation or publication of papers on information that is subject to Commission approval that has not been ruled upon or which has been disapproved. Additional information regarding the publication of NRC sponsored research is contained in NRC Management Directives 3.7, "NUREG Series Publications," and 3.9, "NRC Staff and Contractor Speeches, Papers, and Journal Articles on Regulatory and Technical Subjects."

Task 8. Support the development of the IDHEAS-ECA

In order to support NRC staff's ability to perform Event and Condition Assessments (ECA), SNL shall support and cooperate with NRC staff to develop a HRA methodology IDHEAS-ECA according to the developed IDHEAS-G. This task includes following three sub-tasks:

Subtask 8.1: Support the development of the Qualitative Methodology of IDHEAS-ECA User's Manual

The objective of this sub-task is to develop the Qualitative Methodology of IDHEAS-ECA User's Manual that incorporates the qualitative methodology of IDHEAS-ECA and to apply this methodology in three or more actual ECA events as examples.

Deliverable: A NUREG/CR report for Qualitative Methodology of IDHEAS-ECA User's Manual and Examples.

Subtask 8.2: Support the development of the Quantitative Methodology of IDHEAS-ECA.

The objective of this sub-task is to support and cooperate with NRC staff to develop the Quantitative Methodology of IDHEAS-ECA based on the CFMs and PIFs developed in IDHEAS-G.

Subtask 8.3: Support the development of the Dependency Model of IDHEAS-ECA.

The objective of this sub-task is to support and cooperate with NRC staff to develop the Dependency Model applied for IDHEAS-ECA.

Subtask 8.4: Peer review of the draft report of the development of the Dependency Model of IDHEAS-ECA.

SNL shall sub-contract 40 hours to perform a peer review of this methodology in ECA. This peer review includes two parts (1) early input to the formulation of the methodology, (2) review of the draft of the final report.

Deliverable: A NUREG report for IDHEAS-ECA including the qualitative, quantitative, and dependency methodologies and A NUREG/CR report for Qualitative Methodology of IDHEAS-ECA User's Manual and Examples.

Task 9. Support the SACADA Data Analysis Workshop

The NRC will host a SACADA data analysis workshop during the Regulatory Information Conference (RIC) on March 15 and 16, 2018 at the Bethesda North Marriott Hotel and Conference Center (across street from the NRC HQs) for the NRC contractors to present their analysis results of SACADA data for human reliability analysis to the audience. This task includes three subtasks.

Subtask 9.1: Provide an instructor from the South Texas Project Nuclear Operating Company (STP) to attend the SACADA workshop.

SNL shall make travel arrangements (e.g., purchase flight tickets, make hotel reservations and reimburse travel expenses, etc.) for an STP instructor who is familiar with the STP's SACADA operation and data to participate in a RIC session relating to STP's SACADA data. (NOTE: The STP instructor will be reimbursed for travel expenses only and not his or her salary.) The NRC COR will provide the STP instructor's contact information.

Subtask 9.2: Issue a sub-contract to analyze SACADA data

SNL shall issue a sub-contract for analyzing the SACADA data using the Bayesian update technique published by Professor Katrina Groth at the University of Maryland, College Park, in the journal of Reliability Engineering and System Safety 128 (2014). Page 32-40 covers "A Bayesian method for using simulator data to enhance human error probabilities assigned by existing HRA methods" to analyze SACADA data. The NRC COR will provide the SACADA data. The objective is to demonstrate the use of the Bayesian technique to analyze SACADA data to provide anchor HEPs at the SACADA data analysis workshop. The required analysis approach will be slightly different from the approach presented in the journal paper. The NRC COR will provide specific technical requirements for this data analysis.

Subtask 9.3: Facilitate SACADA Data Analysis workshop

If necessary, SNL shall make arrangements to host the SACADA workshop for approximately twenty people at the Bethesda North Marriott Hotel and Conference. The workshop will start from 1:00 PM on March 15 and end at 4:00 PM on March 16. SNL shall work with the NRC COR to coordinate with the hotel for the details of this effort.

#### 4.0 DELIVERABLES AND/OR MILESTONES SCHEDULE

The due date is the duration of calendar date starting from the date that the contract is awarded. Deliverables for individual tasks are described in the table below:

**Table 2. Task Deliverables, Milestones, and Schedule**

Task	Deliverable/Milestone Description	Due Date
1	Complete Task 1. A technical letter report to the NRC documenting the testing process and results	2 months from the end of the testing
2	Complete Task 2. A technical letter report to the NRC documenting the expert elicitation process and results.	3 months after the completion of the expert elicitation process
3	A NUREG/CR report for the IDHEAS User's Manual	12-18 months after task start
4	A technical letter report documents the outcomes of data mining and analysis.  An Excel file that contains all the data identified and organize the data for each search and statistical analysis.	12-18 months after task start
6	A technical letter report documenting the results of the peer review of the updated draft IDHEAS General Methodology Report	May 22, 2016
7	Prepare, finalize and present synopsis paper regarding the synopsis results from the IDHEAS tests	October 2016
8	Prepare a NUREG report for IDHEAS-ECA including the qualitative, quantitative, and dependency methodologies and A NUREG/CR report for <u>Qualitative Methodology of IDHEAS-ECA User's Manual and Examples</u>	March 31, 2018
9	Provide NRC the analysis mentioned in subtask 9.2.	4 months after task start

## 5.0 TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

The principle investigators (PIs) will need to have a broad area of knowledge and experience relative to 1) the US commercial nuclear industry and nuclear power plant (NPP) operation, 2) human reliability analysis, 3) expert elicitation, 4) method testing / validation, and 5) data, statistics, and uncertainty analysis. The PIs are the key to success for the tasks described in the SOW.

In addition to these technical skills, it is best for the government's interest that the contract has existing or recent knowledge in performing tasks similar to the ones described in SOW. In particular, knowledge from recent hands-on experience in conducting expert elicitations or performing method testing can greatly reduce the cost of performing Tasks in the SOW. The use of expert elicitation and expert judgment to obtain PRA related data parameters was, at one time, used very extensively. When WASH-1400, 'The Reactor Safety Study', (the first nuclear power plant PRA) was produced in 1975, expert elicitation and expert judgment was extensively used due to the lack of adequate data. PIs are expected to spend significant time in compiling available data and information and preparing elicitation workshop materials. These materials will reduce the time and costs associated with the expert elicitation. Similarly, the task of IDHEAS method testing will involve a significant amount of work organizing multiple test teams and preparing testing materials. Existing knowledge can be transferred to this task and reduce the cost.

The PIs will also need strong management and organizational skills, and strong technical writing and communication skills. These skills can be demonstrated by the PI's prior experience performing similar types of research contracts.

The DOE Laboratory shall be required to sign a non-disclosure statement, in the form of "Appendix B of RES Office Instruction PRM-010, Revision 0, PEER REVIEW OF RES PROJECTS"

## 6.0 ESTIMATED LABOR CATEGORIES AND LEVELS OF EFFORT FOR SUBCONTRACTING

Task 1 requires the use of one HRA team composed of 2 industrial PRA/HRA analysts. SNL shall initiate a subcontract to recruit the analysts. SNL shall provide the cost estimation for the use of 2 HRA analysts, each with 110 hours of effort and 3 trips.

Task 2 requires the use of a total of 4 PRA/HRA analysts and human performance experts and 3 US plant operational personnel to participate in the expert elicitation process. Expert Panel members should have a working knowledge of HRA, with expertise in the areas of nuclear plant operation. The Expert Panel members are responsible for the following activities:

- Understanding the Problem Statement
- Reading and understanding the source material provided by the Facilitator
- Arranging for their own travel to the Expert Elicitation Panel meeting

- Actively participating in the Expert Panel meeting
- Reviewing the draft report and providing meaningful comments, as appropriate.

The Expert Panel members shall have the necessary expertise required to resolve the issue delineated in the Problem Statement. Expert Panel members are expected to be suggested by the DOE Lab and may be suggested by the NRC. The final selection of expert panel members will be made by the COR, in consult with the core advisory group of the project.

Task 3: (An industrial PRA/HRA expert) to develop IDHEAS User's Manual.

SNL shall describe any technical support effort that is proposed to be performed by a subcontractor or consultant. Identify the level of effort, by task, of any proposed subcontractor or consultant and provide an explanation of the need for subcontracting that portion of the effort. For any subcontract or consultant effort, describe the following:

- the necessity of subcontracting,
- the tasks and subtasks the subcontractor or consultant will perform,
- the level of effort proposed for the subcontract effort,
- the status and expected time frame for selection, and
- the method of selection of the subcontractor or consultant.

Task 6. To perform a peer review on the updated draft IDHEAS General Methodology Report is estimated to require up to six PRA/HRA analysts, each with 40 hours of effort, for a total of up to 240 hours and 100 hours for the SNL Principle investigator.

Task 8. Peer review of the draft report of the development of the Dependency Model of IDHEAS-ECA.

## **7.0 MEETINGS AND TRAVEL**

The following are the anticipated trips:

### Task 1.1:

- One three-person five-day trip to NRC headquarters to complete IDHEAS training.
- One three-person three-day trip to the selected site to observe simulator exercises and interview plant staff.
- One three-person four-day trip to NRC headquarters to participate in the evaluation workshop.

### Task 2:

- Three five-person five-day trips to NRC headquarters to participate in the expert elicitation workshops.

Task 3:

- One two-person four-day trip to NRC headquarters to develop the structure of the User's Manual

Task 5:

- One two-person two-day trip to NRC headquarters for project management in October 2017.
- Occasional (quarterly or less frequent) trips to NRC headquarters as determined necessary by the NRC to coordinate project management. These trips should often coincide with trips necessary for other tasks.

Task 7:

- One one-person eight-day trip to Korea to present a paper on the testing results at PSAM 13 from October 1-8, 2016.

Task 8:

- One two-person two-day trip to NRC headquarters for project management in October 2017. This travel is also being done in support of Task 5 activities.
- Occasional (quarterly or less frequent) trips to NRC headquarters as determined necessary by the NRC to support Task 8. These trips should often coincide with trips necessary for other tasks.

Task 9:

- One one-person four-day trip to NRC headquarters for a STP instructor to attend the SACADA data analysis workshop on March 15 and 16, 2018.

## **8.0 REPORTING REQUIREMENTS**

As a minimum, the following documents shall be required:

### ***Reports for individual tasks***

The DOE Laboratory is responsible for structuring the deliverable to follow agency standards. The current agency standard is Microsoft Office Suite 2010. The current agency Portable Document Format (PDF) standard is Adobe Acrobat 9 Professional. Deliverables must be submitted free of spelling and grammatical errors and conform to requirements stated in this section.

### ***Monthly Letter Status Reports***

In accordance with Management Directive 11.7, NRC Procedures for Placement and Monitoring of Work with the U.S. Department of Energy, the DOE Laboratory must electronically submit a Monthly Letter Status Report (MLSR) by the 20<sup>th</sup> day of each month to

the Contracting Officer Representative (COR) with copies to the Contracting Officer (CO) and the Office Administration/Division of Contracts to [ContractsPOT.Resource@nrc.gov](mailto:ContractsPOT.Resource@nrc.gov). If a project is a task ordering agreement, a separate MLSR must be submitted for each task order with a summary project MLSR, even if no work has been performed during a reporting period. Once NRC has determined that all work on a task order is completed and that final costs are acceptable, a task order may be omitted from the MLSR.

The MLSR must include the following: agreement number; task order number, if applicable; job code number; title of the project; project period of performance; task order period of performance, if applicable; COR's name, telephone number, and e-mail address; full name and address of the performing organization; principal investigator's name, telephone number, and e-mail address; and reporting period. At a minimum, the MLSR must include the information discussed in Attachment 1. The preferred format for a MLSR can also be found in Attachment 1.

## **9.0 CONTRACTING OFFICER'S REPRESENTATIVE**

The COR monitors all technical aspects of the agreement/task order and assists in its administration. The COR is authorized to perform the following functions: assure that the DOE Laboratory performs the technical requirements of the agreement/task order; perform inspections necessary in connection with agreement/task order performance; maintain written and oral communications with the DOE Laboratory concerning technical aspects of the agreement/task order; issue written interpretations of technical requirements, including Government drawings, designs, specifications; monitor the DOE Laboratory's performance and notify the DOE Laboratory of any deficiencies; coordinate availability of NRC-furnished material and/or GFP; and provide site entry of DOE Laboratory personnel.

### Contracting Officer's Representative

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Technical Monitors

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**10.0 MATERIALS REQUIRED**

At this time, the purchase of hardware, software, or materials considered critical for the success of the project is not anticipated. However, if materials are determined to be required during Tasks 1 & 2; obtaining the materials will be the responsibility of the NRC.

**11.0 NRC-FURNISHED PROPERTY/MATERIALS**

Any property or material to be furnished by the NRC will be specified by the COR. The following guidance will be used, to the extent practicable, to provide any property or material to be furnished by the NRC.

- Identify previously purchased NRC-furnished property or services, including support, data, equipment, or facilities that will be provided to the DOE Laboratory.
- Provide instructions for the handling of NRC-furnished materials and/or documents (e.g., proprietary information).
- Identify specific reports, journals, documents, or other items that NRC intends to provide to the DOE laboratory so that the DOE Laboratory can perform the specified work.
- Identify the date this property/material will be provided by NRC and the method of delivery.

Before offering to provide any property/material, staff will make sure that it will be available when required, where required, and in the condition required by the agreement/task order. Failure to meet NRC-furnished property/material requirements can adversely affect the DOE Laboratory's performance.

NRC Furnished Property/Material will be documented by the COR and as a minimum the following information will be recorded if used.

- NRC-Furnished Property/Material
- Quantity
- Date provided to DOE Laboratory
- Method of Shipment/Delivery

## **12.0 RESEARCH QUALITY**

The quality of NRC research programs are assessed each year by the Advisory Committee on Reactor Safeguards. Within the context of their reviews of RES programs, the definition of quality research is based upon several major characteristics:

Results meet the objectives (75% of overall score)

- Justification of major assumptions (12%)
- Soundness of technical approach and results (52%)
- Uncertainties and sensitivities addressed (11%)

Documentation of research results and methods is adequate (25% of overall score)

- Clarity of presentation (16%)
- Identification of major assumptions (9%)

It is the responsibility of the DOE Laboratory to ensure that these quality criteria are adequately addressed throughout the course of the research that is performed. The NRC COR will review all research products with these criteria in mind.

## **13.0 STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS**

N/A

## **14.0 OTHER CONSIDERATIONS**

### References

An initial set of references believed to be required for the satisfactory completion of the project will be provided by the COR. If additional references are identified during Tasks 1-4, the COR will work with the contractor to determine the best method to obtain the reference(s).

All references will be provided in digital format only by the NRC via CD-ROM or an email attachment within 10 working days following the date of the award. Other methods of document delivery proposed by the DOE Laboratory will be considered by the COR.

Access to Non-NRC Facilities/Equipment

It is not anticipated that the DOE Laboratory will need to obtain access to non-NRC facilities/equipment.

Applicable Publications

Any publications, manuals, and/or regulations that the DOE Laboratory must adhere to or comply with will be provided by the COR.

Controls over document handling and non-disclosure of materials

The DOE Laboratory is required to sign a non-disclosure statement, in the form of "Appendix B of RES Office Instruction PRM-010, Revision 0, PEER REVIEW OF RES PROJECTS." Additionally, Task 1 & 2 include Coordination and Planning Activities. The tasks requires the DOE laboratory to obtain a signed non-disclosure statement from panel participants who have been selected in the form of "Appendix B of RES Office Instruction PRM-010, Revision 0, PEER REVIEW OF RES PROJECTS."