INTERAGENCY AGREEMENT	1. IAA NO. 31310018N0011/P00002	PAGE 1 OF 15

2. ORDER NO.	3. REQUISITION NO.	4. SOLICITATION NO.
	RES-19-0225	

5. EFFECTIVE DATE	6. AWARD DATE	7. PERIOD OF PERFORMANCE
06/12/2019	06/12/2019	08/29/2018 TO 12/31/2020

8. SERVICING AGENCY
ALBUQUERQUESANDIA NATL LAB
ALC:
DUNS: 155505027 +4:
DOENNSASFO
PO BOX 5400
ALBUQUERQUE NM 87185-5400

POC [redacted]
TELEPHONE NO.

9. DELIVER TO
LAUREN NING
US NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH
11555 ROCKVILLE PIKE
ROCKVILLE MD 20852

10. REQUESTING AGENCY
ACQUISITION MANAGEMENT DIVISION
ALC: 31000001
DUNS: 040535809 +4:
US NUCLEAR REGULATORY COMMISSION
ONE WHITE FLINT NORTH
11555 ROCKVILLE PIKE
ROCKVILLE MD 20852-2738

POC Sandra Nesmith
TELEPHONE NO. 301-415-6836

11. INVOICE OFFICE
US NUCLEAR REGULATORY COMMISSION
ONE WHITE FLINT NORTH
11555 ROCKVILLE PIKE MAILSTOP O3-E17A
ROCKVILLE MD 20852-2738

12. ISSUING OFFICE
US NRC - HQ
ACQUISITION MANAGEMENT DIVISION
MAIL STOP TWFN-07B20M
WASHINGTON DC 20555-0001

13. LEGISLATIVE AUTHORITY
Energy Reorganization Act of 1974

14. PROJECT ID

15. PROJECT TITLE
HRA SUPPORT FOR THE LEVEL 3 PRA PROJECT - II

16. ACCOUNTING DATA
2019-X0200-FEEBASED-60-60D002-60B205-1052-11-6-182-253D-11-6-182-1052

17. ITEM NO.	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
	Master IAA: N/A SUMMARY OF CHANGES: The purpose of this modification is to: (1) provide a within scope change increasing the level of effort for Task 1; (2) increase the authorized ceiling by $75,691; and (3) provide incremental funding in the amount of $95,000.00; Accordingly, this agreement is modified as follows: Continued ...				

23. PAYMENT PROVISIONS	24. TOTAL AMOUNT
	$95,000.00

25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)		26a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING)	
		Sandra R. Nesmith	
25b. NAME AND TITLE	**25c. DATE**	**26b. CONTRACTING OFFICER**	**26c. DATE**
		SANDRA R. NESMITH	06/21/2019

1. Reference to the "Statement of Work," is hereby deleted in its entirety and replaced with the following Statement of Work attached to this Modification No. 2.

2. The new authorized ceiling is $221,338.00

3. Incremental funding in the amount of $95,000.00 is provided, thereby increasing the total obligations for this agreement from $96,636.00 to $191,636.00

All other terms and conditions remain unchanged.

Attachment: Statement of Work

SNL Principal Investigator: [redacted]

NRC COR: Lauren Ning

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

This agreement is entered into pursuant to the authority of the Energy Reorganization Act of 1974, as amended (42 U.S.C 5801 et seq.). This work will be performed in accordance with the NRC/DOE Memorandum of Understanding dated November 24, 1998. To the best of our knowledge, the work requested will not place the DOE and its contractor in direct competition with the domestic private sector.

STATEMENT OF WORK (SOW)

NRC Agreement Number	NRC Agreement Modification Number	NRC Task Order Number (If Applicable)	NRC Task Order Modification Number (If Applicable)
31310018N0011			2

Project Title
Human Reliability Analysis Support for the Level 3 Probabilistic Risk Assessment Project - II

Job Code Number	B&R Number	Servicing Agency
		Sandia National Laboratories

NRC Requisitioning Office	Period of Performance
RES	8/20/2018 – 12/31/2020
NRC Form 187, Contract Security and Classification Requirements ☐ Applicable ☒ Not Applicable	☒ Involves Proprietary Information ☐ Involves Sensitive Unclassified
☒ Non Fee-Recoverable	☐Fee-Recoverable (If checked, complete all applicable sections below)
Docket Number (If Fee-Recoverable/Applicable) N/A	**Inspection Report Number (If Fee Recoverable/Applicable)** N/A
Technical Assignment Control Number (If Fee-Recoverable/Applicable) N/A	**Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)** N/A

CONTRACTING OFFICER'S REPRESENTATIVE

Contracting Officer's Representative

Name: Lauren Ning
Agency: U.S. Nuclear Regulatory Commission
Office: RES
Mail Stop: T10-A12
Washington, DC 20555-0001
E-Mail: Lauren.Ning@nrc.gov
Phone: 301-415-2439

Alternate Contracting Officer's Representative

Name: Walter Leschek
Agency: U.S. Nuclear Regulatory Commission
Office: RES
Mail Stop: T10-A12
Washington, DC 20555-0001
E-Mail: Walter.Lescheck@nrc.gov
Phone: 301-415-0844

GOVERNMENT-FURNISHED PROPERTY (GFP)

N/A

--- End of Executive Summary ---

STATEMENT OF WORK (SOW)

(Interagency Agreements)

Contents

DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

(Interagency Agreements)

1.0 BACKGROUND

Regulatory Context

A full-scope site Level 3 probabilistic risk assessment (PRA) for a nuclear power plant site can provide valuable insights into the relative importance of various risk contributors by assessing accidents involving the reactor core as well as other site radiological sources (i.e., spent fuel pools, dry storage casks, and multiple units). These insights can be used to further enhance regulatory decision-making and to help focus limited agency resources on issues most directly related to the agency's mission to protect public health and safety.

Although Level 3 PRAs have been performed to some extent within both the United States and international nuclear industries, the U.S. Nuclear Regulatory Commission (NRC) has not sponsored development of a Level 3 PRA for a nuclear power plant site since NUREG-1150[1]. In the nearly three decades that have passed since the NUREG-1150 Level 3 PRAs were performed, numerous technical advances have been made that were not reflected in the NUREG-1150 PRA models. The NRC staff has also identified additional scope considerations not previously considered that could be addressed by performing a new full-scope site Level 3 PRA.

During the Annual Commission Meeting on Research Programs, Performance, and Future Plans on February 18, 2010, the staff proposed a scoping study to evaluate the feasibility of performing a new full-scope site Level 3 PRA for a nuclear power plant site. In a March 19, 2010 SRM[2], the Commission expressed conditional support for Level 3 PRA related activities and directed the staff to provide the Commission with various options for proceeding with this work that included costs and perspectives on future regulatory uses for Level 3 PRAs. On July 7, 2011, the NRC staff responded[3] to the SRM by providing three proposed options for proceeding with the Level 3 PRA development project. These three options consisted of; 1) maintaining the

[1] NUREG-1150, "Severe Accident Risk: An Assessment for Five U.S. Nuclear Power Plants," December 1990.

[2] SRM 100218, "Staff Requirements—Briefing on Research Programs, Performance, and Future Plans," dated March 19, 2010 (ADAMS Accession № ML100780578).

[3] SECY-11-0089, "Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities," dated July 7, 2011 (ADAMS Accession № ML11090A039).

status quo (i.e., continuing with evolutionary development of PRA technology), 2) conducting focused research to address identified gaps in existing PRA technology before performing a full-scope site Level 3 PRA, and 3) conducting a full-scope site Level 3 PRA. On September 21, 2011, the Commission approved[4] a modified version of the third option which extended the completion schedule.

Technical Context

A full-scope site Level 3 PRA is a complex model that consists of many technical aspects. Each aspect of the PRA must be adequately developed so that the entire PRA may serve its intended function. Some of these technical aspects include, but are not limited to, initiating event analysis, event tree development and analysis, system reliability model (e.g., fault tree) development and analysis, human reliability analysis (HRA), data analysis, accident sequence quantification, and uncertainty analysis. A PRA is considered to be full-scope when the technical aspects are adequately developed for all major hazard groups (e.g., internal fire, internal flooding, seismic) and low-power and shutdown (LPSD) modes of reactor operation. Additionally, a site PRA is considered to include the risk contributions from initiating events that impact more than one unit at the site; the impact of accidents at one unit on any other units at the site; and non-reactor sources of radiological material, such as spent fuel pools and dry storage casks.

A Level 3 PRA includes a Level 1 analysis portion (which focuses on the likelihood of core damage), a Level 2 analysis portion (which builds on the Level 1 work and focuses on severe accident progression and radiological release), and a Level 3 analysis portion (which builds on the Level 2 work and focuses on offsite consequence analysis).

To support the NRC staff in completing the Full-Scope Site Level 3 PRA Project (Level 3 PRA Project or L3PRA), HRA must be performed. While previous Level 3 PRA studies have been performed before, the scope of this particular study (e.g., analysis of spent fuel pool risks, multi-unit risk) and the depth of analysis (e.g., consideration of Technical Support Center [TSC] use of Severe Accident Management Guidelines [SAMGs]) are beyond that which has been addressed previously in much detail.

Consequently, there are a variety of previously unaddressed technical issues associated with providing HRA support to the Level 3 PRA Project. For at-power, internal events Level 1 PRA, HRA methods and guidance is mature and widely applied. Also, more recently, HRA guidance has been published to support at-power, fire PRA (i.e., NUREG-1921). For all other PRA

[4] SRM-SECY-11-0089, "Staff Requirements—SECY-11-0089—Options for Proceeding with Future Level 3 Probabilistic Risk Assessment (PRA) Activities," dated September, 21, 2011 (ADAMS Accession № ML112640419).

hazards, operating modes (e.g., low power and shutdown), and levels (especially, Level 2 PRA), HRA work (previous to the L3PRA project) is limited or non-existent with respect to the requirements of the NRC Level 3 PRA Project.

The NRC staff has been working to leverage existing HRA guidance and methods, where possible, to address HRA needs for the Level 3 PRA Project. For example, the fire HRA guidance is useful for other PRA hazards that involve spatial effects (e.g., damage) on the plant, resulting in a potential impact on any operator actions outside the main control room.

In some cases (e.g., operator and TSC responses to accidents sequences that occur after core melt, or Level 2 PRA), the relevant human performance issues are so novel that general psychological literature and a more general knowledge of human behavior in serious events is needed. In such cases, development of recommendations for this project is informed and, when appropriate and possible, consistent with existing HRA methods, guidance, applications, and research.

Sandia National Laboratories (SNL) began work on the L3PRA project March 29, 2013 under contract number NRC-HQ-60-13-D-0009 (Job Code Number: V6404) where they have supported the NRC in developing the HRA for the Level 3 site PRA model. This contract will continue assistance to the NRC staff in the development of a full-scope site Level 3 PRA for the subject nuclear power plant, Units 1 and 2.

2.0 OBJECTIVE

The objective of this project is to support NRC in addressing new or incompletely addressed issues for HRA in support of the Level 3 PRA Project. Overall, the intent is to develop strategies or approaches and associated technical support to address such new or incompletely addressed issues. These developments will be documented in draft reports which may be incorporated into larger NRC reports or documents. Also, the strategies or approaches will be used as the basis for HRA inputs to the various elements of the overall Level 3 PRA study.

3.0 SCOPE OF WORK/TASKS

The SNL must provide all resources necessary to accomplish the tasks and deliverables described in this Statement of Work (SOW). The servicing agency must provide technical support to the NRC during the development of HRA for the L3PRA Project.

The SNL must provide technical support. Services include support for HRA issues associated with site-wide accident sequences and supporting the overall implementation and integration of HRA in the L3PRA Project. The SNL must provide the support and document it in the Monthly Letter Status Reports.

The following tasks will support the development of strategies, approaches, or basic knowledge that can assist NRC staff in performing the necessary HRAs. However, the recommendations for each task should be consistent with an overall strategy or approach for HRA and provide a defensible basis for the HRA approaches and strategies expected to be used by NRC staff in supporting the Level 3 PRA project.

The timing of the tasks described below are intended to correspond with when different HRA support will be needed. In addition, the timing of draft reports has been determined such that deadlines for the different PRA levels, hazards, and operational modes can be met by NRC staff responsible for performing the supporting HRA. However, it is recognized that some clarifications or updates regarding the approaches may need to occur as the Level 3 PRA Project continues its development and later review. For this reason, support for review activities has been identified to capture any clarifications or updates to recommendations for relevant HRA approaches to be implemented by NRC staff.

Task 1 HRA issues associated with site-wide accident sequences

SNL must support RES staff on HRA issues associated with site-wide accident sequences. A previously unaddressed HRA issue for the NRC site-wide L3PRA Project is the assessment of multiple, potential sources of radiological hazards. In particular, there are two nuclear power plants (NPPs) on the specific site being addressed by this NRC project. In addition, both units have a spent fuel pool and storage of spent fuel in dry casks commenced in 2013. Consequently, main control room staff, auxiliary or local operators, and the TSC staff could be trying to address accident sequences for various combinations of reactors, spent fuel pools, and dry cask storage simultaneously. Recommendations in this task should include relevant contextual elements and performance influencing factors, as well as explanatory behavior models. Additionally, support associated with site-wide HRA issues shall be provided for Level 3 PRA Project review activities.

Deliverables:

Draft report input:	6 months after work start
Final report input:	2 weeks following receipt of NRC comments on draft input

Task 2 Overall implementation and integration of HRA

The DOE Laboratory shall serve as the lead for the implementation and integration of the human reliability analysis in the Level 3 PRA project, including HRA, as related to reactors, for internal fires, external hazards, post-core-damage (i.e., Level 2 PRA), low-power and shutdown modes of operation; dry cask storage; and spent fuel pools. To the extent practical, this work will rely on the state-of-the-practice. As part of the integration activities, contractor shall ensure consistency in the implementation of HRA across the full scope of the Level 3 PRA project, including a focus on the appropriate treatment of dependencies between various portions of the study.

Deliverables:

Draft report input:	6 months after work start
Final report input:	2 weeks following receipt of NRC comments on draft input

4.0 LIST OF DELIVERABLES

In order to meet the various needs of the HRA supporting the Level 3 PRA Project, a series of deliverables have been defined, as stated above. Also, in recognition of the time-phasing of various parts of the overall Level 3 PRA project, completion dates for these deliverables will be distributed over time. In addition, draft reports have been identified as deliverables so that initial results of the Tasks defined above can be more quickly provided to NRC staff responsible for performing the HRA in support of the Level 3 PRA study.

The table below summarizes the deliverables, by task, with milestone due dates included. Because considerable interaction between NRC staff and laboratory staff expected and the schedule for the Level 3 PRA Project is aggressive, formal NRC reviews will not be performed.

Task Number	Deliverable and Acceptance Criteria	Deliverable Format	Due Date
1, 2	*Per SOW Section 8.1, Monthly Letter Status Reports (MLSRs)* *Acceptance Criteria: Report contains all required information* *(include on distribution: COR at Lauren.Ning@nrc.gov and Alternate COR: Anders.Gilbertson@nrc.gov)*	*Microsoft Word or Adobe PDF*	*No later than 20th of the following month*
1, 2	*Report Input – For those project elements where SNL is assigned a supporting role, provide report input. These projects elements may include HRA related to:* • *reactors, for internal fires, external hazards, post-core-damage (i.e., Level 2 PRA), low-power and shutdown modes of operation;* • *dry cask storage; and* • *spent fuel pools.* *Acceptance Criteria: Report Input contains all required information (include assumptions and decisions, with their technical bases).* *(include on distribution: COR at Lauren.Ning@nrc.gov and Alternate COR: Anders.Gilbertson@nrc.gov)*	*Microsoft Word*	*For Report Inputs – participate in selected portions of the below process, as directed by COR* • *SNL submits Draft Input to NRC: 6 months after work start** • *NRC technical review comments provided to SNL: 3 weeks after draft input submitted* • *SNL submits Revised Draft Input: 2 weeks after NRC technical review comments received* • *SNL supports review of Final Report as needed (6 months after revised Draft Input)*

** "Work start" is the date the PM authorizes the work to begin.*

5.0 ESTIMATED LABOR CATEGORIES, KEY PERSONNEL AND LEVELS OF EFFORT

In order to perform the work described below and address the issues discussed in the Background and Objective, this activity requires a Senior HRA Analysts who has a very strong technical background in HRA as described below in section 5.1. Additionally, support staff is expected to assist the Senior HRA Analyst as needed.

If site access is required (to the subject nuclear power plant), the NRC will coordinate and provide instructions on the acquisition of the site access authorization.

5.1 Labor Categories, Requirements and Key Personnel. Personnel working under this agreement/order shall meet the minimum requirements for experience and education, as follows:

The SNL principal investigator will have experience and expertise in the following HRA and related technical areas is needed:

- Fire HRA: Experience and expertise shall include a thorough knowledge and understanding of the intent and application of EPRI/NRC-RES Fire HRA Guidelines (e.g., NUREG-1921[1])
- Spent Fuel Handling HRA: Experience and expertise shall include a thorough knowledge and understanding of qualitative HRA for spent fuel handling (e.g., NUREG/CR-7016[1] and NUREG/CR-7017[1])
- HRA related behavior science and psychology: Experience and expertise shall include a thorough knowledge and understanding of behavior science and other psychological literature as relevant to recent NRC/RES HRA research developments and as may be applicable to unaddressed HRA issues identified in the statement of work above.
- HRA for NPP and non-NPP facilities (including Level 2 PRA): Experience and expertise shall include HRA applications for a variety of technologies and hazards, and Level 2 PRA.

5.2 Key Personnel

[redacted].

6.0 CERTIFICATION AND LICENSE REQUIREMENTS

N/A

7.0 MEETINGS AND TRAVEL

Travel associated with this Statement of Work is expected to be minimal, since attendance at most meetings will be via teleconference or video teleconference. Any travel needed for the performance of this project is expected to only be domestic travel. No foreign travel will be necessary.

A total of 3 (three) trips are anticipated in support of the work as described above. It is anticipated that one SNL staff member will attend and that the trips will each last three days. The meetings are expected to be held with NRC staff at NRC headquarters in Rockville, MD and support Advisory Committee on Reactor Safeguards.

All travel requires written Government approval from the CO, unless otherwise delegated to the COR.

SNL personnel will be authorized travel expenses consistent with the Federal Travel Regulation (FTR) and the limitation of funds specified for the travel within this agreement..

8.0 REPORTING REQUIREMENTS

The SNL is responsible for structuring the deliverables to current agency standards. The SNL must submit deliverables free of spelling and grammatical errors and shall conform to requirements stated in this section.

8.1 Monthly Letter Status Report (MLSR)

The SNL must provide a Monthly Letter Status Report which consists of a technical progress report and financial status report. This report will be used by the sponsoring agency to assess the adequacy of the resources utilized by the servicing agency to accomplish the work contained in this SOW and to provide status of the servicing agency progress in achieving tasks and producing deliverables. The report shall include agreement/order summary information, work completed during the specified period, milestone schedule information, problem identification and resolution, travel plans, and staff hour summary. Copies must be sent to the COR and AMD at ContractsPOT.Resource@nrc.gov.

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 the NRC’s [preferred] MSLR template.

8.2 Report Inputs

The key deliverables for this contact consist of documentation associated with the development of HRA for the L3PRA Project PRA. SNL must provide report input for those project elements where SNL is assigned a supporting role. See SOW section 4.0 for details regarding timing and directions for submitting report inputs.

For report inputs, SNL must adhere to the documentation requirements of the applicable ASME/ANS PRA Standards to the extent practicable and include all assumptions and decisions, with their technical bases.

9.0 REQUIRED MATERIALS, FACILITIES, HARDWARE/SOFTWARE

The NRC COR will provide SNL with any applicable documents associated with the licensee's documented PRA model after the licensee provides them to the NRC.

10.0 APPLICABLE PUBLICATIONS (CURRENT EDITIONS)

N/A

11.0 DATA RIGHTS

The NRC shall have unlimited rights to and ownership of all deliverables provided under this agreement/order, including reports, recommendations, briefings, work plans and all other deliverables. All documents and materials, to include the source codes of any software, produced under this agreement/order are the property of the NRC with all rights and privileges of ownership/copyright belonging exclusively to the NRC. These documents and materials may not be used or sold by the servicing agency without prior written authorization from the CO. All materials supplied to the NRC shall be the sole property of the NRC and may not be used for any other purpose. This right does not abrogate any other Government rights.

Classification and Sensitivity

This project in itself is "unclassified." However, the L3PRA project model includes "proprietary" or "company confidential" information. If "proprietary" or "company confidential" information is involved in completing the work under this agreement, the SNL agrees to safeguard such information in accordance with 10 Code of Federal Regulations (CFR) 2.790. The SNL agrees to not release such information to any person not directly involved in the performance of work under this agreement, unless such release is authorized in writing by the NRC COR. Upon completion or termination of the contract, all data and information (hardcopy or electronic media) classified as "proprietary" or "company confidential" will be returned to the NRC.

Publication of Research Results

RES encourages the publication of scientific results from RES-sponsored programs in refereed scientific and engineering journals as appropriate. If the SNL proposes to publish in the open

literature or present the information at meetings in addition to submitting the required technical reports, approval of the proposed article or presentation shall be obtained from the NRC COR. The NRC COR shall approve the material as submitted, approve it subject to NRC-suggested revisions, or disapprove it. In any event, the NRC COR 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.

If the presentation or paper is in addition to the required technical reports, and the NRC COR determines that it will benefit the RES project, the NRC COR may authorize payment of travel and publishing costs, if any, from the project funds. If the NRC COR determines that the article or presentation would not benefit the RES project, the costs associated with the preparation, presentation, or publication will be borne by the SNL. For any publications or presentations falling into this category, the NRC reserves the right to require that such presentation or publication not identify the NRC's sponsorship of the work