

INTERAGENCY AGREEMENT		1. IAA NO. NRC-HQ-60-15-T-0001/M0009			PAGE OF 1 2	
2. ORDER NO.		3. REQUISITION NO. RES-18-0095		4. SOLICITATION NO.		
5. EFFECTIVE DATE 03/15/2018		6. AWARD DATE 04/04/2018		7. PERIOD OF PERFORMANCE 12/15/2014 TO 09/30/2018		
8. SERVICING AGENCY BROOKHAVEN NATIONAL LABORATORY ALC: DUNS: 027579460 +4: BROOKHAVEN SITE OFFICE PO BOX 5000 BLDG 464 UPTON NY 11973-5000 POC Kim Nekulak TELEPHONE NO. 631-344-7439				9. DELIVER TO TAREK ZAKI US NUCLEAR REGULATORY COMMISSION 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 Rachel Glaros TELEPHONE NO. 301-415-0063				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 SEE BLOCK 18		
16. ACCOUNTING DATA 2018-X0200-FEEBASED-60-60D003-60B301-1147-17-6-161-253D-17-6-161-1147						
17. ITEM NO.	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT	
	Project Title: Review of NuScale Scaling Methodology and the State-of-the-Art Review of Thermal-hydraulic Scaling for New Reactor Designs Master IAA: NRCHQ2514D0002 The purpose of this modification is to: (1) revise the Statement of Work at no cost impact; (2) extend the period of performance from March 31, 2018 to September 30, 2018, at no cost impact; and (3) provide incremental funding in the amount of \$68,849.89, thereby increasing the total obligations for this task order from \$441,111.11 to \$509,961.00. Continued ...					
23. PAYMENT PROVISIONS				24. TOTAL AMOUNT \$68,849.89		
25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)				25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING) [REDACTED]		
25b. NAME AND TITLE		25c. DATE		26b. CONTRACTING OFFICER MICHAEL A. TURNER		26c. DATE 04/04/2018

Accordingly the task order is modified as follows:

Attachment No. 1 Statement of Work is deleted in its entirety and replaced with the attached Revised Statement of Work.

Total Obligations to Date: \$509,961.00 (Changed)
Task Order Ceiling: \$509,961.00 (Unchanged)

All other terms and conditions of the task order remain unchanged.

DUNS: 040535809

ALC: 31000001

TAS: 31X0200

REVISED STATEMENT OF WORK

NRC Agreement Number	NRC Agreement Modification Number	NRC Task Order Number (If Applicable)	NRC Task Order Modification Number (If Applicable)
NRC-HQ-25-14-D-0002	N/A	NRC-HQ-60-15-T-0001	M0009
Project Title			
Technical Assistance for the Review of NuScale Scaling Methodology and the State-of-the-Art Review of Thermal-hydraulic Scaling for New Reactor Designs			
Job Code Number	B&R Number	DOE Laboratory	
	2015-60-17-6-100	BNL	
NRC Requisitioning Office			
RES			
NRC Form 187, Contract Security and Classification Requirements			
<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 checked="" type="checkbox"/> Fee-Recoverable (If checked, complete all applicable sections below)	
Docket Number (If Fee-Recoverable/Applicable)		Inspection Report Number (If Fee Recoverable/Applicable)	
9992043		N/A	
Technical Assignment Control Number (If Fee-Recoverable/Applicable)		Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)	
000471		NuScale General Pre-Application Activities	

1.0 BACKGROUND

Over the next several years, a number of small modular reactor (SMR) vendors, e.g. NuScale, mPower, and Westinghouse, are planning to submit design certification applications. Therefore, as a preliminary step toward these submittals, the vendors have begun engaging in pre-application activities and have submitted to the NRC several topical reports related to new reactor designs. These designs are unique and untested, so the topical reports, particularly those that include thermal-hydraulic scaling information, require increased scrutiny by NRC staff to understand and verify the acceptability of the novel scaling concepts. Some of the vendors are employing new thermal-hydraulic scaling techniques to design the experimental test facilities that will be used to verify the new reactor design concepts.

In 2016, NuScale submitted for review a scaling methodology based on the NRC-developed Hierarchical 2-Tier Scaling (H2TS) framework as part of the design certification application, The Office of Nuclear Regulatory Research (RES) was tasked to support the Office of New Reactors (NRO) in reviewing the scaling methodology. In November 2016, RES and NRO completed the

initial review of the methodology and accepted the corresponding licensing topical report (LTR) for formal review.

RES was also requested to perform a technical evaluation of the NuScale Scaling Analysis Technical Report and associated reports, and to participate in the licensing review processes which includes the development of Requests for Additional Information (RAIs) and the RAI response resolution. This work is to be performed under Tasks 1 and 3.

Coincident with the SMR application activities, RES has agreed to participate in the Working Group on Analysis and Management of Accidents (WGAMA) to conduct a state-of-the-art review (SOAR) on scaling-related subjects. The end product of this SOAR project will be a report that documents, by chapters, the findings on a number of scaling-related subjects. The SOAR report will cover scaling issues encountered over the past few decades, scaling techniques, and scaling as it applies to system codes and licensing. RES has been given the responsibility of leading the review of the scaling issues, designated as Chapter 2 in the report. In this chapter, the significance of scaling in the licensing process will be emphasized. In some sections of Chapter 3 and 4, the merits and limitations of commonly used scaling techniques will be critically reviewed and documented. Therefore, the work RES is responsible for is looked upon as an opportunity to provide the staff with the necessary skills to close knowledge gaps in the evaluation of the various SMR scaling designs including NuScale.

The RES staff teamed up with BNL subject matter experts and started the SOAR effort in 2014 through an NRO agreement with BNL (Q4231, Task Order 4, Subtask 4E). This agreement enabled the staff and BNL to produce the first milestone of the SOAR project, the draft Chapter 2 report. The work on the SOAR project is continued with this SOW.

2.0 OBJECTIVE

The objective of this task order is to obtain:

- 1) Technical expertise from BNL to assist the NRC staff in closing the knowledge and skill gaps in thermal hydraulic scaling technology. BNL shall assist the staff in reviewing the NuScale Scaling Analysis Technical Report and associated reports and performing a confirmatory analysis. In the SOAR review, BNL shall draw conclusions on the merits and limitations of currently available scaling methods which will be applied in future licensing reviews related to thermal hydraulic scaling, and
- 2) Technical support from BNL in the review of the NuScale scaling analysis and consultation during the SOAR project. BNL shall support the NRC by generating a technical evaluation report (TER) based on the NuScale Scaling Analysis Technical Report and associated reports review, refining Chapter 2 of the SOAR report and in drafting the scaling related sections in other chapters of the SOAR report.

3.0 SCOPE OF WORK

For the subject task order, BNL shall provide all personnel, equipment, facilities, and other resources necessary to accomplish the specific tasks outlined below and the deliverables described in Sections 4 and 5 of this statement of work (SOW).

4.0 SPECIFIC TASKS

Task 1 Review of the NuScale Scaling Analysis Technical Report

BNL shall perform a safety evaluation of the NuScale Scaling Analysis Technical Report and Scaling Distortion Report, provide inputs to the staff evaluation reports, support meetings with the licensee, and provide input for the development of Requests for Additional Information (RAIs). The contractor shall prepare a draft TER that includes inputs to the SER.

Task 2: Develop Independent Scaling Analysis Procedure and Perform Confirmatory Scaling Analysis (Pending Technical Direction from COR)

Deleted

Task 3: Perform Confirmatory Scaling Analysis

BNL shall support the NRC staff in reviewing and evaluating the RAI responses, resolving any outstanding RAIs, and investigating any scaling-related problems in the NuScale licensing topical reports. BNL shall perform confirmatory scaling analysis, based on the RAI responses, for assessment of the NucScale scaling methodology. BNL shall also prepare a final TER that includes inputs to the SER.

Note: The completion of the Task 1 depends on the submittal of the NuScale Scaling Analysis Report and associated reports, and Task 3 depends on receiving all RAI responses.

Task 4: Refine Chapter 2 and Draft Sections in Other Chapters of the SOAR Report

BNL shall continue the work started under Interagency Agreement Q4231, Task Order 4, Subtask 4E and refine Chapter 2 of the draft SOAR report by consolidating comments and topical contributions from NRC staff and other participating WGAMA members into a final version. In addition, the contractor shall draft write-ups on topics related to scaling that belong to chapters other than Chapter 2; review all chapters in the draft full report, and provide consultation on scaling related subjects, as needed. The topics will be determined by the start of contract. This task is completed.

Task 5: Review the Draft SOAR Report and Provide Consultation

BNL shall support NRC in reviewing all chapters of the draft SOAR report and provide consultation during the review. The contractor shall provide a two-hour seminar on thermal hydraulic scaling to NRC staff. This task is completed.

5.0 DELIVERABLES AND/OR MILESTONES SCHEDULE

Task #	Deliverable	Due Date
1.	Draft TER that includes inputs to SER <u>Standard:</u> Submit documents in Microsoft Word and submit to COR via email.	8 months after the NuScale Scaling Analysis Report and associated reports are received.
2.	Deleted	
3.	Final TER that includes inputs to the SER <u>Standard:</u> Submit documents in Microsoft Word and submit to COR via email.	3 months after all RAI responses are received
4.	Provide a final Chapter 2 of the SOAR report and draft sections in other chapters of the SOAR report. <u>Standard:</u> Submit document in Microsoft Word electronic format by email to the COR.	Due dates for the draft and final reports will be established prior to 09/30/2015 (Completed)
5.	Review comments and revisions to the draft SOAR report and consultation to the NRC staff. Provide a two-hour seminar on thermal hydraulic scaling to the NRC staff. <u>Standard:</u> Submit document in Microsoft Word electronic format by email to the COR.	Due dates to be established prior to 09/30/2015 (Completed)

Note: Deliverable 1 depends on the submittal of the NuScale Scaling Analysis Report and associated reports, and Deliverable 3 depends on receiving all RAI responses.

6.0 TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

This work shall be performed by someone with expert knowledge in thermal-hydraulic scaling, strong theoretical background in mathematics, and experience in developing an independent scaling analysis procedure. The expert should also have in-depth experience in implementing traditional scaling techniques in scaled test facilities and should be familiar with the licensing requirements of addressing scaling uncertainties in new advanced reactors. The publications listed under References in Section 16 of this SOW demonstrate some of the past BNL experience in scaling.

7.0 MEETINGS AND TRAVEL

The contractor shall plan to attend five one-day work meetings at the USNRC offices in Rockville, Maryland. The following table provides the meeting schedule.

Schedule	Date
Kick-off meeting and seminar on thermal hydraulic scaling (Task 5)	Within 10 business days after task award
Three meetings to discuss deliverables (1 and 3)	Exact dates to be determined but before each milestone deliverable.
Meeting to discuss final version of Chapter 2 and draft report sections in other chapters.	Exact date to be determined

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

8.0 REPORTING REQUIREMENTS

BNL shall provide draft and final reports as specified in Section 5, Deliverables and/or Milestones, of this SOW. The deliverable dates for both draft and final reports are listed under the Due Date column in Section 5.

The DOE Laboratory is responsible for structuring the deliverables 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

As specified in Section 7.1 of the SOW for EWA NRC-HQ-25-14-D-0002 with BNL.

In addition, as specified in Section 7.0 of this SOW the level of effort will include fee-recoverable as well as none fee-recoverable components. Therefore, BNL shall list the monthly cost of each component in the MLSR. The COR will provide appropriate TACs to use for invoicing.

9.0 PERIOD OF PERFORMANCE

The period of performance for this task order is December 15, 2014 through September 30, 2018.

10.0 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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Express mail should be sent to:
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Technical Point of Contact

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11.0 MATERIALS REQUIRED

N/A

12.0 NRC-FURNISHED PROPERTY/MATERIALS

The contractor will have access to the NuScale Scaling Analysis Technical Report and associated reports.

13.0 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 and Technical Contact will review all research products with these criteria in mind.

14.0 STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS

The U.S. Nuclear Regulatory Commission (NRC) began to capture most of its official records electronically on January 1, 2000. The NRC will capture each final NUREG-series publication in its native application. Therefore, please submit your final manuscript that has been approved by your NRC Project Manager in both electronic and camera-ready copy.

The final manuscript shall be of archival quality and comply with the requirements of NRC Management Directive 3.7 "NUREG-Series Publications." The document shall be technically edited consistent with NUREG-1379, Rev. 2 (May 2009) "NRC Editorial Style Guide." The goals of the "NRC Editorial Style Guide" are readability and consistency for all agency documents.

All format guidance, as specified in NUREG-0650, "Preparing NUREG-Series Publications," Rev. 2 (January 1999), will remain the same with one exception. You will no longer be required to include the NUREG-series designator on the bottom of each page of the manuscript. The NRC will assign this designator when we send the camera-ready copy to the printer and will place the designator on the cover, title page, and spine. The designator for each report will no longer be assigned when the decision to prepare a publication is made. The NRC's Publishing Services Branch will inform the NRC Project Manager for the publication of the assigned designator when the final manuscript is sent to the printer.

For the electronic manuscript, the Contractor shall prepare the text in Microsoft Word, and use any of the following file types for charts, spreadsheets, and the like.

File Types to be Used for NUREG-Series Publications	
File Type	File Extension
Microsoft®Word®	.doc
Microsoft® PowerPoint®	.ppt
Microsoft®Excel	.xls
Microsoft®Access	.mdb
Portable Document Format	.pdf

This list is subject to change if new software packages come into common use at NRC or by our licensees or other stakeholders that participate in the electronic submission process. If a portion of your manuscript is from another source and you cannot obtain an acceptable electronic file type for this portion (e.g., an appendix from an old publication), the NRC can, if necessary, create a tagged image file format (file extension.tif) for that portion of your report. Note that you should continue to submit original photographs, which will be scanned, since digitized photographs do not print well.

If you choose to publish a compact disk (CD) of your publication, place on the CD copies of the manuscript in both (1) a portable document format (PDF); (2) a Microsoft Word file format, and (3) an Adobe Acrobat Reader, or, alternatively, print instructions for obtaining a free copy of Adobe Acrobat Reader on the back cover insert of the jewel box.

15.0 OTHER CONSIDERATIONS

References

1. Zuber, N., Rohatgi, U. S., Wulff, W., and Catton, I., 2007, "Application of Fractional Scaling Analysis (FSA) to Loss of Coolant Accidents (LOCA): Methodology Development," Nucl. Eng. Des., 237, pp. 1593–1607.

2. Wulff, W., Zuber, N., Rohatgi U. S., and Catton, I., " Application of Fractional Scaling Analysis to Loss of Coolant Accidents, System Level Scaling for System Depressurization, " Journal of Fluids Engineering, AUGUST 2009, Vol. 131 / 081402-13

3. Catton, I., Wulff, W., Zuber, N., and Rohatgi, U. S., 2005, "Application of Fractional Scaling Analysis to Loss of Coolant Accidents (LOCA), Part 3:Component Level Scaling for Peak Clad Temperature," Proceedings of the 11th International Topical Meeting on Nuclear Thermal Hydraulics (NURETH-11), Popes' Palace Conference Center, Avignon, France.

Access to Non-NRC Facilities/Equipment

N/A

Applicable Publications

N/A

Controls over document handling and non-disclosure of materials

All work under this project is expected to be unclassified. Some documents or scaling methods for potential applicants may be categorized as Sensitive Unclassified Non-Safeguards Information (SUNSI) or proprietary information and shall be managed in accordance with applicable NRC policies and procedures.

16.0 ASSUMPTIONS AND UNDERSTANDINGS

- It is assumed that the laboratory has access to the NRC furnished material available on the Internet.
- It is understood that the scope of the review includes conference calls with the NRC staff to discuss:
 - a. any issues that may arise during the laboratory's efforts, or
 - b. to obtain additional information needed to complete the tasks described in this task order.
- It is understood that this task order involves reviews of NuScale LTR, full SOAR draft report, and refinement of SOAR Chapter 2 draft report. The deliverables and milestones in Section 5 are based on the assumption that the applicant will submit the LTR in early 2015 and the SOAR draft report will be ready by 2014. The tasks may be delayed or cancelled in case the aforementioned reports are postponed or cancelled for any unexpected reason.