

INTERAGENCY AGREEMENT		1. IAA NO. NRC-HQ-60-17-T-0021		PAGE OF 1 2	
2. ORDER NO.		3. REQUISITION NO. RES-17-0282		4. SOLICITATION NO.	
5. EFFECTIVE DATE 08/11/2017		6. AWARD DATE 08/11/2017		7. PERIOD OF PERFORMANCE 08/28/2017 TO 09/30/2018	
8. SERVICING AGENCY OAK RIDGE NATIONAL LAB ALC: DUNS: 012075755 +4: US DEPARTMENT OF ENERGY OAK RIDGE NATION LABORATORY SITE OFFICE BUILDING 4500N MS 6269 PO BOX 2008 OAK RIDGE TN 37831-6269 POC Deborah Garland, CO TELEPHONE NO. (865) 241-9566				9. DELIVERY TO DON ALGAMA US NUCLEAR REGULATORY COMMISSION TWO WHITE FLINT NORTH BUILDING 11545 ROCKVILLE PIKE MAIL STOP T-10B58 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-8E06M 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 O3-E17A ROCKVILLE MD 20852-2738	
12. ISSUING OFFICE US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-8E06M WASHINGTON DC 20555-0001				13. LEGISLATIVE AUTHORITY Energy Reorganization Act of 1974	
				14. PROJECT ID	
				15. PROJECT TITLE SCALE/SHIFT HYBRID DETERMINISTIC/MONTE CARLO	
16. ACCOUNTING DATA 2017-X0200-FEEBASED-60-600003-60B302-1145-33-6-199-253D-33-6-199-1145					
17. ITEM NO.	18. SUPPLIES/SERVICES	19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
NRC-HQ-60-17-T-0021	The NRC and the DOE Laboratory (ORNL) hereby enter into this Task Order Agreement No. NRC-HQ-60-17-T-0021, for the project entitled "SCALE/Shift Hybrid Deterministic/Monte Carlo." NRC COR: Don Algama (301)415-1940 ALT COR: Dr. Mourad Aissa (301)415-0380 ORNL PI: Gregory Davidson (865)574-3921 Kaushik Banerjee (865)241-5733 Continued ...				
23. PAYMENT PROVISIONS			24. TOTAL AMOUNT \$383,666.22		
25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING) <i>Deborah L. Garland</i>			25b. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING) <i>Carolyn A. Cooper</i>		
25c. NAME AND TITLE Deborah L. Garland, Contracting Officer		25d. DATE 8/16/17	25e. CONTRACTING OFFICER CAROLYN A. COOPER		25f. DATE 8/11/2017

The period of performance shall commence on August 28, 2017 and shall end on September 30, 2018. Notwithstanding the agreement effective dates and period of performance start dates stated elsewhere in the agreement, the effective date of the agreement and start date of the period of performance are the last date of signature by the parties.

CONSIDERATION AND OBLIGATION:

- (a) Authorized Ceiling Amount: \$550,000.00
- (b) The amount presently obligated with respect to this task order is \$383,666.22. When and if the amount(s) paid and payable to the DOE Laboratory hereunder equals the amount obligated, the DOE Laboratory shall not be obligated to continue performance of the work unless and until the NRC Contracting Officer increases the amount obligated with respect to this DOE Task Order Agreement. Any work undertaken by the DOE Laboratory in excess of the obligated amount specified above is done so at the DOE Laboratory's sole risk.

The following documents are hereby incorporated as part of this Agreement:

- Attachment No. 1: Statement of Work
- Attachment No. 2: DOE Standard Terms and Conditions

The work hereunder is non-fee recoverable.

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.

Master IAA: NRCHQ6014D0005

STATEMENT OF WORK “SCALE/Shift Hybrid Deterministic/Monte Carlo”

Background

Regulatory Context:

The Nuclear Regulatory Commission (NRC) relies on SCALE as a robust, state-of-the-art nuclear analysis computer code system that allows for independent review of licensee submittals and accurate investigations of reactor and fuel phenomena important to nuclear safety.

This computer code system affects all licensing evaluations that are being performed at the NRC that rely on shielding/fluence calculations. Needed features from the legacy Monaco/MAVRIC code capabilities in SCALE include multiple means of specifying sources, integration with ORIGEN and ORIGEN reactor libraries for direct import of sources, and especially the ability to analyze very large models using hybrid deterministic / Monte Carlo computing techniques.

This work will have an impact on NRC capability to respond to both storage site dose evaluations and plant life extension beyond 60 years.

Technical Context:

Integration of Exnihilo (Shift Monte Carlo and Denovo Sn and/or SPN deterministic solvers) is required for a modern SCALE shielding sequence capable of parallel computing to solve extremely large complex problems related to large spent fuel dry storage sites such as proposed for interim storage facilities and reactor vessel internal (RVI) components fluence damage that cannot be solved with reasonable computational resources and time by the current MAVRIC sequence.

Implementation within Shift will include necessary Monaco/MAVRIC hybrid fixed source capabilities that are not yet available in Exnihilo, especially those needed to calculate fluence on RVI components related to plant aging concerns beyond 60 years of operation. This capability is needed to address plant life extension to 80 years. Other needed features include calculating fission sources from k-eigenvalue calculations, and feeding the calculated fission source into a hybrid Monte Carlo/deterministic fixed-source fluence calculations. Also needed is the ability to analyze very large models using parallel computing in a quality-assured licensing code.

Relationship to Other Projects

NRC-HQ-6015-T0026 “Shift - Integration of SCALE Nuclear Stochastic Methods” is focused on initial implementation of Shift into SCALE for criticality safety applications to replace CSAS/KENO. NRC-HQ-6017-T0019 “Shift Development for Sensitivity/Uncertainty Analysis” will focus on initial implementation of continuous energy sensitivity/uncertainty capabilities to replace TSUNAMI/KENO. This project will focus on initial implementation of hybrid shielding methods to replace MAVRIC/Monaco.

Objective(s) of Proposed Work

The objective of this project is to integrate Exnihilo's Shift and Denovo hybrid deterministic/Monte Carlo radiation transport methodology with parallel computing into SCALE.

Work to Be Performed and Expected Results

Oak Ridge National Laboratory (ORNL) provide all resources necessary to accomplish the tasks and deliverables described in this Statement of Work (SOW).

Task 1. SCALE Exnihilo Modifications

ORNL will integrate Exnihilo (Shift Monte Carlo, Denovo Sn, SPn) hybrid radiation transport methodology into SCALE for analysis of fluence on reactor vessel internal (RVI) components related to plant aging concerns beyond 60 years of operation. ORNL will use the new (previously developed) CSAS-Shift sequence so that fission sources will be rapidly calculated from a k -eigenvalue calculation, employing the new hybrid Sourcerer fission source convergence method. ORNL should then be able to use the resultant converged fission source as an input into a new MAVRIC-Shift sequence that will perform a hybrid deterministic/Monte Carlo fixed-source fluence calculation with the deterministic methods in Denovo and the Monte Carlo methods in Shift. These solution techniques should enable automatic weight window generation. Automatic construction of the deterministic adjoint source both for flux tallies and user-defined response tallies should also be enabled.

ORNL will develop appropriate test cases using SCALE input for relevant application cases that include RVI as well as spent fuel transportation and storage and test the new capability against both the current MAVRIC/Monaco sequence, where practical, as well as against existing methods outside of SCALE, where possible. Performance testing against the current MAVRIC capability and parallel scaling studies shall be included.

Implementation will include the incorporation within Shift and the associated SCALE sequence and user interfaces any needed Monaco/MAVRIC capabilities that are not yet implemented, especially those utilized by the Used Nuclear Fuel – Storage, Transportation, and Disposal Analysis Resource and Data System (UNF-ST&DARDS).

Task 2. Technical Support

Technical support and on-call assistance in the operation of the SCALE system shall be provided to NRC staff requested by the NRC COR. This technical support will include providing assistance with technical issues as they arise during Task 1, and may include interaction with ACRS, and collaborations with other staff and/or contractors, as appropriate.

NOTE: Computer code development must conform to NURG/BR-0167 requirements for Software Quality Assurance as implemented under the SCALE Software Quality Assurance Program.

Key Personnel

Steve Bowman will be the Project Manager, and Greg Davidson and Kaushik Banerjee will be the Principal Investigators for this effort. Other key staff include Cihangir Celik, Charles Daily, and Joel Risner.

Travel

The following travel is anticipated under the task order:

FY18

- One, one-person trip to NRC HQ for project related activities.
- One, one-person trip to a conference related to project activities.

ORNL 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/order. All travel requires prior written approval from the COR.

Foreign travel for ORNL personnel requires a 60-day lead time for NRC approval. For prior approval of foreign travel, the servicing agency shall submit to the COR 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/>. All foreign travel requires prior written approval from the NRC Executive Director for Operations (EDO).

Reporting Requirements and Schedule

Task Number	Deliverable	Deliverable Format	Due Date
1	Technical letter report. The report should detail the developments made, new input deck commands, and testing performed.	Technical letter report shall be in WORD and PDF formats.	9/30/2018
2	Computer Code delivery with SCALE release. Will include updated Shift computer code integrated into SCALE.	6.3 or next earliest release	9/30/2018

ORNL is responsible for structuring the deliverables to follow current agency standards. Deliverables will be technically edited and submitted free of spelling and grammatical errors and conform to requirements stated in this section.

Monthly Letter Status Reports

ORNL will 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 ORNL to accomplish the work contained in this SOW and to provide status of ORNL 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 shall 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.

The COR will acknowledge receipt of deliverables by email.

Period of Performance

The period of performance is from August 8, 2017 through September 30, 2018.

NRC-Furnished Property/Materials

N/A

Access to Non-NRC Facilities/Equipment

No special facilities are required for this project.

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 servicing agency 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 servicing agency concerning technical aspects of the agreement/task order; issue written interpretations of technical requirements, including Government drawings, designs, specifications; monitor the servicing agency's performance and notify the servicing agency of any deficiencies; coordinate availability of NRC-furnished material and/or GFP; and provide site entry of servicing agency personnel.

Contracting Officer's Representative

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Alternate Contracting Officer's Representative

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