

**ORDER FOR SUPPLIES OR SERVICES
SCHEDULE - CONTINUATION**

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

DATE OF ORDER 08/02/2019	CONTRACT NO. NRC-HQ-25-14-E-0004	ORDER NO. 31310019F0075
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ITEM NO. (a)	SUPPLIES/SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	Total Estimated Cost: \$ [REDACTED]					
	Acceptance of 31310019F0075 should be made by having an official, authorized to bind your organization.					
	Numark Authorized Official _____ Date _____ Accounting Info: 2019-X0200-FEEBASED-60-60D001-60B101-1032-11-6-154-252A-11-6-154-1032 Period of Performance: 07/15/2019 to 10/31/2020					
00001	Cost Reimbursement Task 1-4 Line Item Ceiling: \$ [REDACTED] Incrementally Funded Amount: \$ [REDACTED]				[REDACTED]	
00002	Fixed Fee Task 1-4 Line Item Ceiling: \$ [REDACTED] Incrementally Funded Amount: \$ [REDACTED]				[REDACTED]	
10001	Cost Reimbursement (Optional Task 5) Amount: \$ [REDACTED] (Option Line Item) Anticipated Exercise Date 10/31/2020				0.00	
10002	Fixed Fee (Optional Task 5) Amount: \$ [REDACTED] (Option Line Item) Anticipated Exercise Date 10/31/2020				0.00	
	The obligated amount of award: \$ [REDACTED]. The total for this award is shown in box 17(i).					
TOTAL CARR ED FORWARD TO 1ST PAGE (ITEM 17(H))					\$200,652.28	

SECTION B - Supplies or Services/Prices

B.1 BRIEF PROJECT TITLE AND WORK DESCRIPTION

(a) The title of this project is: Support for XFEM component integrity analysis

(b) Summary work description: The objective of this task order is to obtain expert technical assistance services from the contractor to apply in performing analyses using ABAQUS XFEM in complex primary system reactor coolant pressure boundary (RCPB) components and associated primary water stress corrosion cracking (PWSCC) flaw analyses.

(End of Clause)

B.2 CONSIDERATION AND OBLIGATION-TASK ORDERS

CLIN	DESCRIPTION OF SUPPLIES/SERVICES	ESTIMATED COST	FIXED FEE	TOTAL COST PLUS FIXED FEE
0001	Contractor to provide Technical Assistance in accordance with Section C: DESCRIPTION/SPECIFICATION S/STATEMENT OF WORK (Tasks 1 and 4)	\$ [REDACTED]		
0002	Fixed-Fee CLIN		\$ [REDACTED]	\$200,652.28
1001	Contractor to provide Technical Assistance in accordance with Section C: DESCRIPTION/SPECIFICATION S/STATEMENT OF WORK (OPTION Task 5)	\$ [REDACTED]		
1002	Fixed-Fee CLIN (Option)		\$ [REDACTED]	\$96,308.84
	TOTAL (BASIC AND OPTION CLINS)			\$296,961.12.

(a) The ceiling of this order for services is **\$200,652.28**.

(b) This order is subject to the minimum and maximum ordering requirements set forth in the contract.

(c) The amount presently obligated with respect to this order is \$ [REDACTED] of which the sum of \$ [REDACTED] represents the estimated reimbursable costs, and of which \$ [REDACTED] represents the fixed-fee. The obligated amount shall, at no time, exceed the order ceiling as specified in paragraph (a) above. When and if the amount(s) paid and payable to the Contractor hereunder shall equal the obligated amount, the Contractor shall not be obligated to continue performance of the work unless and until the

Contracting Officer shall increase the amount obligated with respect to this order, in accordance with FAR Part 43 - Modifications. Any work undertaken by the Contractor in excess of the obligated amount specified above is done so at the Contractor's sole risk and may not be reimbursed by the Government.

(d) The Contractor shall comply with the provisions of FAR 52.232-22 - Limitation of Funds, for incrementally-funded delivery orders or task orders.

(End of clause)

B.3 PRICE/COST SCHEDULE

CLIN	BASIC	
0001		
0001a	Direct Labor including G&A	[REDACTED]
0001b	Subcontractor Labor Including Sub Handling	[REDACTED]
0001c	ODC's including G&A	[REDACTED]
0001d	Subcontractor Travel including Sub Handling	[REDACTED]
	Total Estimated Costs	[REDACTED]
0002	Fixed Fee	[REDACTED]
	Total	[REDACTED]

CLIN	OPTION	
1001		
1001a	Direct Labor including G&A	[REDACTED]
1001b	Subcontractor Labor Including Sub Handling	[REDACTED]
	Total Estimated Costs	[REDACTED]
1002	Fixed Fee	[REDACTED]
	Total	[REDACTED]

SECTION C - Description/Specifications

C.1 STATEMENT OF WORK (SOW)

1. PROJECT TITLE

Support for XFEM component integrity analysis

2. BACKGROUND

Operating experience has shown that dissimilar metal welds using Alloys 82 and 182 exposed to primary coolant water (or steam) under the normal operating conditions of pressurized water reactors (PWRs) are susceptible to primary water stress corrosion cracking (PWSCC). This cracking typically initiates at the inside surface of these component welds when exposed to reactor coolant and in the presence of high tensile residual stresses introduced by welding (or weld residual stresses), and can progress through the thickness of the component leading to leakage and even rupture. In response to this potential degradation of the reactor pressure vessel boundary the NRC requires augmented inspections of susceptible components in order to identify PWSCC flaws before they compromise component integrity and allow for repair and replacement. When flaws are identified, licensees must then complete a flaw analysis to verify that the flaw will not grow to failure before the next inspection; otherwise, they must repair or replace the component. If the licensee analysis determines that it is safe to continue operating with the flaw in place, the analysis is then reported to the NRC for approval. When regulatory staff review these flaw analyses, independent confirmatory analyses are often required.

Traditionally this flaw analysis is done by first determining the weld residual stresses (WRS), and then analyzing how the crack would grow through that stress field. Current practice involves determining the WRS profile of the component using finite element models, and applying it to standard ASME Code empirically based PWSCC growth models to determine the crack growth rate. Currently, NRC is capable of performing this type of analysis accurately and efficiently in order to assist regulatory staff in a timely manner. However, while useful for estimating crack growth in simple components and geometries that can be approximated using two-dimensional models, this generic approach requires excess conservatism in order to ensure broad applicability, and these simple representations begin to lose their meaning when applied to more complicated three-dimensional components with more complex stress states.

As computational power increases and finite element modeling techniques improve, licensees seek to improve their analyses to eliminate unnecessary conservatisms and analyze more complex components where the standard empirical models are not applicable. In order to do so, traditional flaw growth analyses are being replaced by finite element models to predict crack growth rate.

Historically, simulating cracks and crack growth using conventional finite element analysis (FEA) has proven difficult and time consuming especially for modeling realistic multi-directional crack growth. More recently, methods that allow for realistic crack growth to be modeled using straight forward techniques have been developed. Specifically, the extended finite element method (xFEM) is a FEA tool that allows for

mesh-independent analysis of discontinuities and singularities, and can be used to simulate crack growth in complex geometries in a simplified manner [1]. This capability is currently available to NRC through the use of ABAQUS. ABAQUS' implementation of xFEM is potentially a powerful tool for representing cracks and simulating crack growth in industry relevant models. With the right choice of elements and meshing parameters, xFEM has proven capable of simulating critical and fatigue crack growth rates in complex systems, with results that closely match classic numerical and experimental results [2]. In some cases, xFEM results have shown to be extremely reliable, and have been used in developing industry standards regarding flaw proximity analysis [3], [4], [5]. Authors have also investigated the ABAQUS implementation of xFEM to calculate stress intensity factors for pre-existing cracks, and found good agreement with stress intensity factors generated with traditional FEA meshes [6]. While the use of crack-conforming meshes and procedural re-meshing allow for crack growth simulations with traditional finite element analysis, it is the ability of xFEM to accomplish such simulations without these cumbersome procedures that make xFEM particularly useful.

NRC currently has developed the capability to perform XFEM based PWSCC crack growth analysis in ABAQUS. Technical assistance in examining the capabilities, limitations and applicability of XFEM is required to develop a sound technical basis for performing these analyses. Additionally, NRC is interested in what other tools can be used for this type of analysis and how they compare in terms of performance and results. Technical basis development involves performing the following activities and reporting the results:

- Performing sensitivity analyses to identify important factors in model parameters that can ensure accurate and repeatable XFEM results.
- Thoroughly investigate the applicability of XFEM in complex geometries relevant to commercial nuclear power components
- Perform study to identify and develop benchmark problems to verify ABAQUS XFEM PWSCC crack growth results.
- Identify and investigate alternative, current and modern FEA tools capable of similar XFEM analysis (e.g. ANSYS, MORFEO, GRIZZLY, etc...)

List of References:

- [1] Sukumar, Natarajan, et al., "Modeling holes and inclusions by level sets in the extended finite-element method," *Computer methods in applied mechanics and engineering*, pp. 6183-6200, 2001.
- [2] Shim, Do-Jun, et al., "Application of extended finite element method (XFEM) to stress intensity factor calculations," in *Proceedings of the ASME 2015 Pressure Vessels and Piping Conference*, 2015.
- [3] Lacroix, Valéry, et al., "Alternative Characterization Rules For Quasi-Laminar Flaws Based On 3d X-Fem Calculations," in *Proceedings of the ASME 2015 Pressure Vessels & Piping Conference*, 2015.
- [4] Lacroix, Valéry, et al., "Alternative Characterization Rules For Quasi-Laminar Flaws," in *Proceedings of the ASME 2014 Pressure Vessels & Piping Conference*, 2014.
- [5] Lacroix, Valéry, et al., "Combination Criterion for Multiple Laminar Flaws in Steel

Components," *Key Engineering Materials*, pp. Vol. 741, pp 63-69, 2017.

[6] Singh, I. V., et al., "The numerical simulation of fatigue crack growth using extended finite element method," *International Journal of Fatigue*, pp. Vol. 36, Issue 1, 109-119, 2012.

3. PROJECT DESCRIPTION AND OBJECTIVE(S)

The objective of this task order is to obtain expert technical assistance services from the contractor to apply in performing analyses using ABAQUS XFEM in complex primary system reactor coolant pressure boundary (RCPB) components and associated primary water stress corrosion cracking (PWSCC) flaw analyses.

This requirement falls under EWC IDIQ SOW Paragraph 3.2 – Licensing Support.

4. STATEMENT OF WORK TASKS

Task 1: Perform Literature Review

Within 30 days of award, the contractor shall perform an assessment of the applicability and limitations of XFEM for modeling subcritical crack growth (e.g. fatigue cracking, stress corrosion cracking, etc.) based on publicly available information. Specifically, the contractor shall conduct a literature review in search for cases where XFEM was used for engineering applications pertaining to subcritical crack growth in metallic piping and vessels. The contractor shall document the XFEM applications found, document any specific techniques used to model subcritical crack growth with XFEM, and document any limitations reported in the open literature.

Deliverables for Task 1

The contractor shall prepare and submit a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days after award. The Draft TLR prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.

The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The Final TLR shall be provided no later than 30 days after the COR provides comments to the contractor.

The contractor shall provide to the NRC all the input files and their supporting files created for this task.

Task 2: Conduct Sensitivity Studies

The contractor shall perform analyses using the ABAQUS XFEM to determine those parameters that control the accuracy and repeatability of analysis results. Specifically, using 2-D and simple 3-D models the contractor shall conduct the activities listed below.

- An analysis of the sensitivity of results to mesh parameters. These parameters include overall geometry, size, and orientation. This sensitivity should then be

- compared to results using traditional finite element crack results or other acceptable analytical solutions
- An analysis of the sensitivity of results to crack geometry, and how this relates to the mesh parameters.
 - An analysis of how the crack parameter results compare between static and dynamic crack analyses.

Deliverables for Task 2

The contractor shall prepare and submit a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days of completion of the task. The Draft TLR prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.

The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The Final TLR shall be provided no later than 45 days after the COR provides comments to the contractor.

The contractor shall provide to the NRC all the input files and their supporting files created for this task.

Task 3: Investigate Complex Geometries

The contractor shall perform analyses using the ABAQUS XFEM to determine the applicability of these analyses in complex geometries relevant to the NRC. Specifically, the contractor shall evaluate how ABAQUS XFEM crack parameter results compare to traditional analysis for components including pressure vessel nozzles, branch connections, and J-Groove welds.

Deliverable for Task 3

The contractor shall prepare and submit a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days of completion of the task. The Draft TLR prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.

The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The Final TLR shall be provided no later than 45 days after the COR provides comments to the contractor.

The contractor shall provide to the NRC all the input files and their supporting files created for this task.

Task 4: Develop Benchmarks

The contractor shall perform a study to develop models that can be used to benchmark XFEM for use in PWSCC crack growth analyses. Specifically, the contractor shall conduct the activities listed below.

- Perform literature search for PWSCC crack growth in test sample geometries that can be modeled in ABAQUS to verify results

- Study operating experience of PWSCC to identify potential components geometries that can be modeled, such that analysis results may be compared to observed real world behaviors.
- Develop problem definitions identifying component and crack geometry, operating parameters, and loads which can be used to independently develop models to verify XFEM results.

Deliverable for Task 4

The contractor shall prepare and submit a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days of completion of the task. The Draft TLR prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.

The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The Final TLR shall be provided no later than 45 days after the COR provides comments to the contractor.

The contractor shall provide to the NRC all the input files and their supporting files created for this task.

Option Task 5: Investigate Alternative Tools

This is an optional task, the need for which will be identified by the COR depending on the results of the previous tasks. In this task, the contractor shall investigate the performance of at least one other current and modern FEA tool capable of similar XFEM analysis (e.g. ANSYS, MORFEO, GRIZZLY, etc...). The additional FEA tool(s) investigated for this task shall be agreed upon by both the contractor and COR. The tool should be capable of similar analyses to those that can be performed with ABAQUS. Specifically, the contractor shall conduct the activities listed below.

- Develop and perform a study to identify any difference in the performance and results between ABAQUS and the additional FEA tool(s) being investigated. This examination should include similar sensitivity and geometry studies as described in Tasks 2 and 3.
- Perform a benchmarking study using model definitions developed for Task 4, and perform analysis using ABAQUS and the additional FEA tool(s) being investigated in order to compare results.

Deliverable for Task 5

The contractor shall prepare and submit a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days of completion of the task. The Draft TLR prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.

The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The Final TLR shall be provided no later than 45 days after the COR provides comments to the contractor.

The contractor shall provide to the NRC all the input files and their supporting files created for this task.

5. APPLICABLE DOCUMENTS AND STANDARDS

ASME Boiler & Pressure Vessel Code, Section XI and Section III.

6. DELIVERABLES AND DELIVERY SCHEDULE/REPORTING REQUIREMENTS

The contractor shall provide the deliverables stated in the table below in electronic format unless otherwise directed by the COR. The electronic format shall be provided using a Microsoft-based product, (e.g., Outlook, Word, Excel, PowerPoint) unless the COR and the contractor specifically agree on another format. All deliverables, with the exception of the Monthly Letter Status Report (MLSR) shall be in the format of draft version, revision version with redline/strikeout, and a revised version which shall become the final version. The contractor shall explicitly state in its submittal(s) that the product provided is the deliverable for Task XX, as further described below.

The Contractor shall submit the following deliverables to the task order COR. Unless otherwise directed by the COR or the Contracting Officer (CO), the contractor must provide all deliverables except the MLSR as draft products. The COR will review all draft deliverables (and coordinate any internal NRC staff review, if needed) and provide comments back to the contractor. The contractor shall revise the draft deliverable based on the comments provided by the COR and then deliver a revised version of the deliverable, which will then be considered the Final Version. When mutually-agreed upon between the contractor and the COR, the contractor may submit preliminary or partial drafts to help gauge the contractor’s understanding of the particular work requirement. More than one round of drafts may be needed if the contractor does not successfully incorporate the COR’s comments on the previous draft.

The contractor shall develop, maintain, and control data, files, information, and deliverables pursuant to this task order.

Deliverable Schedule

Task No.	Description	Completion Date
1	Draft TLR covering all work performed for Task-1. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Draft TLR is due in 60 days from the task order award.
1	Final TLR incorporating any comments from the COR.	30 days after the COR comments are received. If applicable, additional revisions are due 15 days after COR request for a revision.
2	Draft TLR covering all work performed for Task-2. The Draft TLR shall summarize	Task-2 duration is 4 months from the task order award.

	the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Draft TLR is due in 60 days from the task completion date.
2	Final TLR incorporating any comments from the COR.	45 days after the COR comments are received. If applicable, revisions are due 30 days after COR request for a revision.
3	Draft TLR covering all work performed for Task-3. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Task-3 duration is 7 months from the task order award. Draft TLR is due in 60 days from the task completion date.
3	Final TLR incorporating any comments from the COR.	45 days after the COR comments are received. If applicable, revisions are due 30 days after COR request for a revision.
4	Draft TLR covering all work performed for Task-4. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Task-4 duration is 10 months from the task order award. Draft TLR is due in 60 days from the task completion date.
4	Final TLR incorporating any comments from the COR.	45 days after the COR comments are received. If applicable, revisions are due 30 days after COR request for a revision.
5 (opt)	Draft TLR covering all work performed for Task-5. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Task-5 duration is 12 months from the task order award. Draft TLR is due in 60 days from the task completion date.
5 (opt)	Final TLR incorporating any comments from the COR.	45 days after the COR comments are received. If applicable, revisions are due 30 days after COR request for a revision.
All	MLSR per Section F.3 and Attachment 5 of the IDIQ contract. Detail the work effort by labor category.	20th. calendar day of the following month

Acceptance Criteria for Deliverables: The above deliverables shall be submitted to the task order COR. Unless otherwise directed by the COR or the CO, the contractor must provide all deliverables except the Monthly Letter Status Reports (MLSR) as draft products. The COR will review all draft deliverables (and coordinate any internal NRC staff review, if needed) and provide comments back to the contractor. The contractor shall revise the draft deliverable based on the comments provided by the COR and then deliver a revised version of the deliverable, which will then be considered the Final Version. When mutually-agreed upon between the contractor and the COR, the contractor may submit preliminary or partial drafts to help gauge the contractor's understanding of the particular work requirement. More than one round of drafts may be needed if the contractor does not successfully incorporate the COR's comments on the previous draft.

The contractor shall submit the raw and processed data and worksheet and/or input files used in analyses with the Draft TLRs, upon request by the COR and with the Final TLRs, in a tabulated Excel format or other format as directed by the COR.

Note: This delivery schedule may be modified after task order award via Technical Direction from the COR, provided Contractor has agreed to the changes incorporated in the Technical Direction letter.

Technical Directions

The COR may issue Technical Directions (TDs) from time to time throughout the duration of the task order. These TDs must be within scope of the task order SOW and shall not constitute new assignments of work or changes of such a nature as to constitute a change to the task order cost or period of performance. Any modifications to the scope of work, cost, or period of performance of this task order must be issued by the task order Contracting Officer (CO) and shall be coordinated with the task order Contracting Officer’s Representative (COR). The COR may issue TDs for the purpose of making adjustments or clarifications to the timing and performance of the tasks/sub-tasks (if applicable) and/or the milestone schedule/delivery schedule of the documents within this task order.

In the event that the contractor believes that a TD issued against this task order has an impact in terms of changing the scope, cost, or period of performance of the task order, the contractor shall immediately inform the task order CO and request appropriate guidance prior to taking action on the TD in question.

7. GOVERNMENT-FURNISHED PROPERTY

None

8. PLACE OF PERFORMANCE

The work to be performed under this task order shall be performed at the Contractor’s facility except for the travel described in Section 11 of this statement of work.

9. SPECIAL CONSIDERATIONS

TRAVEL/MEETINGS

The following travel may occur under this task order –

Travel Description	Task(s)	Location	Date	Days	Attendees
FY 2019					
Kick-off meeting at NRC	All	Rockville, MD	TBD	2	1
FY 2020					

Travel Description	Task(s)	Location	Date	Days	Attendees
Program Review at NRC	All	Rockville, MD	TBD	2	1

Travel Notes --

- a. All contractor travel requires prior written approval from the COR.
- b. Number of trips, number of contractor personnel, duration, location, may be modified based on meeting circumstances and COR's need for contractor support. Contractor shall implement travel cost-sharing measures (for example sharing rental car) if possible.
- c. At the discretion of the COR, meetings may be conducted via telephone, video conference, or at the contractor site.
- d. Contractor will be authorized travel expenses consistent with the substantive provisions of the Federal Travel Regulation (FTR) and the limitation of funds specified in this contract/order. All travel requires written Government approval from the CO, unless otherwise delegated to the COR.
- e. Travel will be reimbursed in accordance with FAR 31.205-46, "Travel costs" and the General Services Administration's Federal Travel Regulations at: <http://www.gsa.gov/portal/content/104790>. At a minimum, for each known trip/meeting, include the following:
- f. All travel requires prior written approval from the COR.

SECURITY

The work will be UNCLASSIFIED.

Work on this task order may involve the handling of documents that contain proprietary information. The contractor shall safeguard documents containing proprietary information against unauthorized disclosure. After completion of work, the contractor shall either destroy the documents or return them to the NRC. If they are destroyed, please confirm this in an e-mail to the COR with a copy to the CO and include the date and manner in which the documents were destroyed.

KEY EQUIPEMENT, CERTIFICATIONS, and ANALYSIS TOOLS

The following analysis tools shall be required to perform the research described in this statement of work:

Analysis Capabilities/Tools:

Finite element analysis capabilities with specialized user-defined subroutines and XFEM using ABAQUS to model and analyze PWSCC crack growth work under this task order. Finite element analysis capabilities to perform equivalent XFEM analyses with at least one other modern and current FEA tool besides ABAQUS (e.g. ANSYS, Morfeo, GRIZZLY, etc.).

LICENSE FEE RECOVERY

All work under this task order is not license fee recoverable.

DATA RIGHTS

The NRC shall have unlimited rights to and ownership of all deliverables provided under this contract/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 contract/order are the property of the Government with all rights and privileges of ownership/copyright belonging exclusively to the Government. These documents and materials may not be used or sold by the contractor without written authorization from the CO. All materials supplied to the Government shall be the sole property of the Government and may not be used for any other purpose. This right does not abrogate any other Government rights. The definition of "unlimited rights" is contained in Federal Acquisition Regulation (FAR) 27.401, "Definitions." FAR clause at FAR 52.227-14, "Rights in Data-General," is hereby incorporated by reference and made a part of this contract/order

SECTION F - Deliveries or Performance

F.1 PERIOD OF PERFORMANCE

This contract shall commence on July 15, 2019 and will expire on October 31, 2020.

(End of Clause)

SECTION H - Special Contract Requirements

H.1 KEY PERSONNEL. (JAN 1993)

2052.215-70 Key personnel. (JAN 1993)

As prescribed at 2015.209-70(a)(1), the contracting officer shall insert in solicitations and contracts the following clause as applicable to the requirement:

KEY PERSONNEL (JAN 1993)

(a) The following individuals are considered to be essential to the successful performance of the work hereunder:

NAME	Labor Category/Position
[REDACTED]	Subject Matter Expert / Principal Investigator
[REDACTED]	Senior Technical Review

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

(b) If one or more of the key personnel, for whatever reason, becomes, or is expected to become, unavailable for work under this contract for a continuous period exceeding 30 work days, or is expected to devote substantially less effort to the work than indicated in the proposal or initially anticipated, the contractor shall immediately notify the contracting officer and shall, subject to the concurrence of the contracting officer, promptly replace the personnel with personnel of at least substantially equal ability and qualifications.

(c) Each request for approval of substitutions must be in writing and contain a detailed explanation of the circumstances necessitating the proposed substitutions. The request must also contain a complete resume for the proposed substitute and other information requested or needed by the contracting officer to evaluate the proposed substitution. The contracting officer and the project officer shall evaluate the contractor's request and the contracting officer shall promptly notify the contractor of his or her decision in writing.

(d) If the contracting officer determines that suitable and timely replacement of key personnel who have been reassigned, terminated, or have otherwise become unavailable for the contract work is not reasonably forthcoming, or that the resultant reduction of productive effort would be so substantial as to impair the successful completion of the contract or the service order, the contract may be terminated by the contracting officer for default or for the convenience of the Government, as appropriate. If the contracting officer finds the contractor at fault for the condition, the contract price or fixed fee may be equitably adjusted downward to compensate the Government for any resultant delay, loss, or damage.

(End of Clause)

H.2 CONTRACTING OFFICER'S REPRESENTATIVE

(a) The contracting officer's authorized representative hereinafter referred to as the

Contracting Officer's Representative (COR) for this contract is:

Contracting Officer's Representative (COR):



Alt Contracting Officer's Representative:

Patrick Raynaud
Patrick.Raynaud@nrc.gov
301-415-1987

(b) Performance of the work under this contract is subject to the technical direction of the NRC COR. The term technical direction is defined to include the following:

(1) Technical direction to the contractor which shifts work emphasis between areas of work or tasks, authorizes travel which was unanticipated in the Schedule (i.e., travel not contemplated in the Statement of Work or changes to specific travel identified in the Statement of Work), fills in details, or otherwise serves to accomplish the contractual statement of work.

(2) Provide advice and guidance to the contractor in the preparation of drawings, specifications, or technical portions of the work description.

(3) Review and, where required by the contract, approve technical reports, drawings, specifications, and technical information to be delivered by the contractor to the Government under the contract.

(c) Technical direction must be within the general statement of work stated in the contract. The project officer does not have the authority to and may not issue any technical direction which:

(1) Constitutes an assignment of work outside the general scope of the contract.

(2) Constitutes a change as defined in the "Changes" clause of this contract.

(3) In any way causes an increase or decrease in the total estimated contract cost, the fixed fee, if any, or the time required for contract performance.

(4) Changes any of the expressed terms, conditions, or specifications of the contract.

(5) Terminates the contract, settles any claim or dispute arising under the contract, or issues any unilateral directive whatever.

(d) All technical directions must be issued in writing by the COR or must be confirmed by the COR in writing within ten (10) working days after verbal issuance. A copy of the written direction must be furnished to the contracting officer. A copy of NRC Form 445, Request for Approval of Official Foreign Travel, which has received final approval from the NRC must be furnished to the contracting officer.

(e) The contractor shall proceed promptly with the performance of technical directions

duly issued by the project officer in the manner prescribed by this clause and within the COR's authority under the provisions of this clause.

(f) If, in the opinion of the contractor, any instruction or direction issued by the COR is within one of the categories defined in paragraph (c) of this section, the contractor may not proceed but shall notify the contracting officer in writing within five (5) working days after the receipt of any instruction or direction and shall request that contracting officer to modify the contract accordingly. Upon receiving the notification from the contractor, the contracting officer shall issue an appropriate contract modification or advise the contractor in writing that, in the contracting officer's opinion, the technical direction is within the scope of this article and does not constitute a change under the "Changes" clause.

(g) Any unauthorized commitment or direction issued by the COR may result in an unnecessary delay in the contractor's performance and may even result in the contractor expending funds for unallowable costs under the contract.

(h) A failure of the parties to agree upon the nature of the instruction or direction or upon the contract action to be taken with respect to the instruction or direction is subject to 52.233-1 - Disputes.

(i) In addition to providing technical direction as defined in paragraph (b) of the section, the project officer shall:

(1) Monitor the contractor's technical progress, including surveillance and assessment of performance, and recommend to the contracting officer changes in requirements.

(2) Assist the contractor in the resolution of technical problems encountered during performance.

(3) Review all costs requested for reimbursement by the contractor and submit to the contracting officer recommendations for approval, disapproval, or suspension of payment for supplies and services required under this contract.

(End of Clause)

SECTION J - List of Documents, Exhibits and Other Attachments

J.1 List of Documents, Exhibits, and Other Attachments

Attachments:

1. Monthly Letter Status Report Template (Furnished Upon Request)
2. Cost Reimbursement Billing Instructions (Furnished Upon Request)