

**ORDER FOR SUPPLIES OR SERVICES**

PAGE OF PAGES

1 21

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

1. DATE OF ORDER 08/14/2017		2. CONTRACT NO. (If any) NRC-HQ-25-14-E-0004		6. SHIP TO: a. NAME OF CONSIGNEE NUCLEAR REGULATORY COMMISSION	
3. ORDER NO. NRC-HQ-60-17-T-0001		4. REQUISITION/REFERENCE NO. RES-17-0239		b. STREET ADDRESS NUCLEAR REGULATORY COMMISSION	
5. ISSUING OFFICE (Address correspondence to) US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-5E03 WASHINGTON DC 20555-0001				c. CITY WASHINGTON	
				d. STATE DC	e. ZIP CODE 20555-0001
7. TO: PAUL EDELSTEIN				f. SHIP VIA	
a. NAME OF CONTRACTOR NUMARK ASSOCIATES INC				8. TYPE OF ORDER	
b. COMPANY NAME				<input type="checkbox"/> a. PURCHASE	<input checked="" type="checkbox"/> b. DELIVERY
c. STREET ADDRESS 1220 19TH ST NW STE 500				REFERENCE YOUR:  Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet, if any, including delivery as indicated.	
d. CITY WASHINGTON		e. STATE DC	f. ZIP CODE 200362444		
9. ACCOUNTING AND APPROPRIATION DATA See Schedule				10. REQUISITIONING OFFICE OFFICE OF NEW REACTORS	

11. BUSINESS CLASSIFICATION (Check appropriate box(es))					12. F.O.B. POINT
<input checked="" type="checkbox"/> a. SMALL	<input type="checkbox"/> b. OTHER THAN SMALL	<input type="checkbox"/> c. DISADVANTAGED	<input type="checkbox"/> d. WOMEN-OWNED	<input type="checkbox"/> e. HUBZone	
<input type="checkbox"/> f. SERVICE-DISABLED VETERAN-OWNED	<input type="checkbox"/> g. WOMEN-OWNED SMALL BUSINESS (WOSB) ELIGIBLE UNDER THE WOSB PROGRAM	<input type="checkbox"/> h. EDWOSB			
13. PLACE OF		14. GOVERNMENT B/L NO.	15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)		16. DISCOUNT TERMS
a. INSPECTION Destination	b. ACCEPTANCE Destination				30

**17. SCHEDULE (See reverse for Rejections)**

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	Task Order Entitled, " Technical Assistance in Support of LBB Regulatory Guide Technical Basis Development Using xLPR Code," under Enterprise-Wide Contract NRC-HQ-25-14-E-0004.  Continued ...					

18. SHIPPING POINT		19. GROSS SHIPPING WEIGHT		20. INVOICE NO.		17(h) TOTAL (Cont. pages)
21. MAIL INVOICE TO:						
a. NAME	US NUCLEAR REGULATORY COMMISSION				\$0.00	▲
b. STREET ADDRESS (or P.O. Box)	ONE WHITE FLINT NORTH 11555 ROCKVILLE PIKE MAILSTOP O3-E17A					17(i) GRAND TOTAL
c. CITY	d. STATE	e. ZIP CODE			\$3,005,192.82	▲
ROCKVILLE	MD	20852-2738				

22. UNITED STATES OF AMERICA BY (Signature)		08/14/2017		23. NAME (Typed)	
▲ <i>Monique B. Williams</i>				MONIQUE B. WILLIAMS TITLE: CONTRACTING/ORDERING OFFICER	

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

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

DATE OF ORDER	CONTRACT NO. NRC-HQ-25-14-E-0004	ORDER NO. NRC-HQ-60-17-T-0001
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ITEM NO. (a)	SUPPLIES/SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	<p>This task order is incrementally funded in the amount of \$770,883.70.</p> <p>Base and Exercised Options: [REDACTED] Base and All Options: \$3,005,192.82</p> <p>Contracting Officer's Representative (COR) Shah Malik Phone: [REDACTED] email: shah.malik@nrc.gov</p> <p>Contractor POC: Paul Edelstein Phone: 202-466-2700 Email: PEdelstein@numarkassoc.com</p> <p> August 11, 2017</p> <p>Numark Authorized Rep. _____ Date _____</p> <p>Accounting Info: 2017-X0200-FEEBASED-60-60D001-60B101-1032-11-6-213-252A-11-6-213-1032 Period of Performance: 08/14/2017 to 08/13/2020</p>					

TOTAL CARRIED FORWARD TO 1ST PAGE (ITEM 17(H))

\$0.00

**TASK ORDER – Unrestricted Business EWC IDIQ for Numark Associates Inc.**

**SECTION B - SUPPLIES OR SERVICES AND PRICE/COSTS**

**B.1 BRIEF PROJECT TITLE AND WORK DESCRIPTION**

(a) The title of this project is: Technical Assistance is Support of LBB Regulatory Guide Technical Basis Development Using xLPR Code.

(b) Summary work description: The objective of this task order is to obtain expert technical assistance services from the contractor to apply the xLPR Version 2 computer code to conduct analyses and develop and/or confirm the technical basis for a regulatory guide related to LBB in primary system reactor coolant pressure boundary (RCPB) components and associated primary water stress corrosion cracking (PWSCC) mitigation assessments.

**B.2 CONSIDERATION AND OBLIGATION-TASK ORDERS**

(a) The ceiling of this order for services is [REDACTED].

(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 **\$770,883.70** ([REDACTED] in Cost, [REDACTED] in 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.

(e) Fixed Fee Holdback Amount: [REDACTED]

(End of clause)

**B.3 PRICE/COST SCHEDULE**

Base Period of Performance: Date of Award – August 13, 2020

CLIN	DESCRIPTION	ESTIMATED COST
0001	Labor	[REDACTED]
0002	Subcontractor Costs	[REDACTED]
0003	Travel	[REDACTED]
0004	ODC	[REDACTED]
<b>SUBTOTAL (rounded)</b>		[REDACTED]

0004	Indirect Cost Pool (includes G&A, Fringe, Overhead and Subcontractor Handling)	
<b>SUBTOTAL (rounded)</b>		
0005	Fixed-Fee	
<b>TOTAL</b>		

Optional Task 3: Date Exercised – August 13, 2020

CLIN	DESCRIPTION	ESTIMATED COST
0001	Labor	
0002	Subcontractor Costs	
0003	Travel	
0004	ODC	
<b>SUBTOTAL (rounded)</b>		
0004	Indirect Cost Pool (includes G&A, Fringe, Overhead and Subcontractor Handling)	
<b>SUBTOTAL (rounded)</b>		
0005	Fixed-Fee	
<b>TOTAL</b>		

Optional Task 6: Date Exercised – August 13, 2020

CLIN	DESCRIPTION	ESTIMATED COST
0001	Labor	
0002	Subcontractor Costs	
0003	Travel	
0004	ODC	
<b>SUBTOTAL (rounded)</b>		
0004	Indirect Cost Pool (includes G&A, Fringe, Overhead and Subcontractor Handling)	
<b>SUBTOTAL (rounded)</b>		
0005	Fixed-Fee	
<b>TOTAL</b>		

Total Order Cost (Inclusive of Options)  
Total Order Fixed Fee (Inclusive of Options)  
**Total Order Ceiling (Inclusive of Options)**

**\$3,005,192.82**

# DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

## TASK ORDER STATEMENT OF WORK (SOW)

### *“Technical Assistance in Support of LBB Regulatory Guide Technical Basis Development Using xLPR Code”*

#### 1. EWC TASK ORDER TITLE

Technical Assistance in Support of LBB Regulatory Guide Technical Basis Development Using xLPR Code

#### 2. BACKGROUND

The Nuclear Regulatory Commission (NRC) Standard Review Plan 3.6.3 (SRP 3.6.3) describes Leak-Before-Break (LBB) assessment methodologies that are acceptable to the NRC. Specifically, it describes a deterministic assessment procedure that can be used to demonstrate compliance with the 10CFR50 Appendix A, General Design Requirement 4 (GDC 4), that the primary system pressure piping exhibit an extremely Low Probability of Rupture (xLPR).

SRP 3.6.3 does not allow for assessment of piping systems with active degradation mechanisms. However, it is known that Primary Water Stress Corrosion Cracking (PWSCC), an active degradation mechanism, is occurring in systems that have been granted LBB exemptions to remove pipe-whip restraints and jet impingement shields. Recent activities have been undertaken by the industry to demonstrate that public safety is maintained despite a deviation from the SRP 3.6.3 prohibition against active degradation mechanisms. These activities include the following:

- Qualitative arguments have been made by the industry that the great majority of observed cracking is of limited extent and shallow depth. These factors tend to mitigate the risk of piping rupture.
- PWSCC mitigation activities have been implemented by the industry (e.g. reduction of mechanical stresses via the application of weld overlays or inlays over the PWSCC-susceptible welds), and
- The design-basis break size from the so-called double-ended guillotine break (DEGB) have been re-defined and reduced by the industry in recognition of its extremely low likelihood.

Given recent advances in probabilistic methodologies, the NRC believes that performing a probabilistic fracture mechanics analysis of primary system piping that fully addresses and quantifies uncertainties and directly demonstrates compliance with GDC 4 is more appropriate than conservative deterministic analyses. A robust probabilistic software tool, developed cooperatively by the NRC and industry, called xLPR Version 2, has just been completed and is undergoing comprehensive testing [*References 1, 2 and 3*]. This tool is aimed at meeting this goal, and will result in improvement in licensing, regulatory decision-making and design. The tool is comprehensive with respect to known challenges, vetted with respect to scientific

adequacy of models and inputs, flexible enough to permit analysis of a variety of in-service situations and adaptable to accommodate evolving and improving knowledge.

The xLPR Version 2 code is now ready to be applied extensively to develop technical basis for a LBB regulatory guide for pressurized water reactor (PWR) plants when active degradation mechanisms are present in primary system piping. Technical basis development involves performing the following activities and making any identified code corrections and improvements as needed:

- Performing extensive sensitivity analyses to rank important inputs with respect to uncertainty in output. These analyses would be performed on plants that have experienced service cracking, as well as other plants selected from the LBB database, and other selected pilot plants.
- Developing a defense-in-depth strategy where multiple levels of safety are present in plants when active degradation mechanisms such as PWSCC are present. This would include determining the effectiveness of various mitigation strategies, as well as severe accident scenarios and beyond-design-basis events.
- Developing a generalization of the results to the other plants in the U.S. Fleet and applying the acceptance criterion.
- Developing a LBB technical basis document and supporting input for preparing a regulatory guide based on the xLPR results.
- Any findings based on the xLPR work conducted under this investigation that may affect the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code rules and code cases would be brought to the attention of the relevant BPV code committees for consideration.

List of References:

[1]: "Weld Residual Stress Inputs For A Probabilistic Fracture Mechanics Code," PVP2014-28030, Michael L. Benson, Frederick W. Brust, Robert E. Kurth; Proceedings of the ASME 2014 Pressure Vessels and Piping Conference.

[2]: "Uncertainty Sampling of Weld Residual Stress Fields in Probabilistic Analysis: Part II Example," Robert E. Kurth, Cedric J. Sallaberry, Frederick W. Brust, Elizabeth A. Kurth, Michael L. Benson, David L. Rudland; PVP2016-63963, Proceedings of the ASME 2016 Pressure Vessels and Piping Conference.

[3]: "Development of the Extremely Low Probability of Rupture (xLPR) Version 2.0 Code," D. Rudland, C. Harrington, R. Dingreville; PVP2015-45134, Proceedings of the ASME 2015 Pressure Vessels and Piping Conference.

### **3. OBJECTIVE(S)**

The objective of this task order is to obtain expert technical assistance services from the contractor to apply the xLPR Version 2 computer code to conduct analyses and develop and/or confirm the technical basis for a regulatory guide related to LBB in primary system reactor coolant pressure boundary (RCPB) components and associated primary water stress corrosion cracking (PWSCC) mitigation assessments.

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

#### **4. STATEMENT OF WORK TASKS**

##### Task 1: Conduct Sensitivity Studies

The contractor shall perform deterministic and probabilistic analyses using the xLPR code, as supplemented by the NRC-sponsored PROMETHEUS code, to determine those parameters that drive uncertainty. Specifically, the contractor shall conduct the activities listed below. This list includes, but is not limited, to the following:

- A. Determine and rank those parameters that drive uncertainty within the xLPR code. There are many uncertain parameters to consider, including those related to welding residual stresses (WRS), crack initiation, leak rate, inservice inspection (ISI), operating conditions, loading, etc.
- B. Identify the impacts of different, but reasonable, lower and upper bounds for the input parameters.
- C. Identify the impacts of different, but reasonable, distributions to represent uncertainty in the input parameters.
- D. Identify inherent problems with the definition of uncertainty in the inputs by performing probabilistic simulations using the xLPR code with the separation of aleatory and epistemic uncertainties.
- E. Study the effectiveness of the various types of mitigation capable of being analyzed with the code. The contractor shall include insights gained from mitigation studies considered in sensitivity studies completed in prior NRC-supported work.
- F. Establish xLPR code performance for low probability events using importance sampling and convergence of results.
- G. Establish ways in which PROMETHEUS can be used as a solution tool and pre-processor for the xLPR code.

This work will be combined into a collaborative set of sensitivity studies performed by the NRC staff and other xLPR team members.

##### Deliverables for Task 1

The contractor shall prepare and submit input in the form of sections to a draft Technical Letter Report (TLR) covering all work performed under this task within 60 days of completion of the task. The Draft TLR sections prepared by the contractor shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified. The contractor shall write the sections on the work it performs and assemble them with sections prepared by other xLPR team members. The specific sections to be authored by the contractor will be discussed and approved by the COR prior to writing. The contractor shall prepare input to a Final TLR incorporating any comments on the Draft TLR from the COR. Input to the Final TLR shall be provided no later than 45 days after the COR provides comments to the contractor.

##### Task 2: Perform Piping Systems Analyses

Under this task, the contractor shall quantify the change in the level of risk when considering the potential effects of PWSCC in piping systems previously approved for leak-before break. Specific activities include, but are not limited, to the following:

- A. In consultation with the COR, the contractor shall identify sets of welds that are representative of one or two piping systems previously approved for leak-before-break.

- B. The contractor shall develop and document xLPR code input sets, including providing quality assurance for the inputs, for each weld or group of welds in the piping system, as appropriate. In some cases, the contractor shall assemble the input values from provided documentation. In other cases, the contractor shall analyze data to develop the input values. This may include, upon acceptance from the COR, performance of finite element analyses to develop WRS profiles.
- C. The contractor shall use the xLPR code to perform deterministic and probabilistic analyses of the input sets developed under the above Task 2.B. As part of these analyses, at the discretion of the contractor, it may be necessary for the contractor to complete sensitivity studies similar to those performed in Task 1. For each piping system, the contractor shall assess the effects of PWSCC on core damage frequency by conducting the analyses both with and without consideration of the effects of PWSCC, and then compare the results of the two analyses to quantify the change in risk. The contractor shall also consider the impacts of applicable PWSCC detection and mitigation techniques.
- D. The contractor shall exercise the acceptance criteria prepared during the xLPR Code developmental effort for this task. The acceptance criteria can be accessed through the NRC Agencywide Documents Access and Management System (ADAMS) Accession No. ML16271A436 (“Acceptance Criteria for Use with xLPR Version 2 Code,” November 2016). The contractor shall provide recommendations concerning potential implementation of these criteria.

#### Deliverables for Task 2

The contractor shall prepare draft interim TLRs encompassing progress accomplished every 6-month period from the task start date. The contractor shall then prepare and submit a complete Draft TLR covering all work performed under this task within 60 days of completion of the task. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified. The contractor shall prepare a final TLR incorporating any comments from the COR on the draft TLR. The contractor shall provide the Final TLR no later than 45 days after the receipt of comments.

#### Optional Task 3: Perform a Generalization Study

This is an optional task, the need for which will be identified by the COR depending on the results of Task 2. Upon option exercise, the contractor shall use the xLPR code to conduct a generalization study of the entire fleet of the U.S. PWRs to determine whether any changes are needed to current regulatory requirements and guidance related to leak-before-break. Specific activities include, but are not limited to, the following:

- A. The contractor shall review and categorize PWR piping systems previously approved for leak-before-break. PWSCC mitigation techniques, enhanced inspections, etc. shall be considered in this process.
- B. The contractor shall develop inputs for, and perform analyses using xLPR that bound each category of piping system identified in Task 3.A above. The contractor shall compare the results of these analyses against the acceptance criteria in NRC Regulatory Guide 1.174.

- C. Based on the results from Task 3.B above, the contractor shall prepare an assessment of current regulatory requirements and guidance related to leak-before-break.

#### Deliverables for Optional Task 3

The contractor shall prepare a draft interim TLR encompassing progress accomplished in the first 6-month period from the start of the task. The contractor shall then prepare and submit a Draft TLR covering all work performed under this task within 60 days of completion of the task. The Draft TLR 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 contractor shall provide the Final TLR no later than 45 days after it receives comments from the COR.

#### Task 4: Perform Defense-in-Depth Studies

After the completion of Task 2, the contractor shall conduct defense-in-depth studies for piping systems subject to active degradation mechanisms, such as PWSCC. Specific activities include, but are not limited to, the following:

- A. In consultation with the COR, the contractor shall identify scenarios for study where there might be an increased likelihood of an accident. These scenarios may include upset conditions, severe accident conditions, beyond design basis events, and rare events.
- B. The contractor shall develop and document xLPR code inputs for the scenarios determined under Task 4.A above. The contractor may use inputs developed for analyses conducted under previous tasks, as applicable.
- C. The contractor shall use the xLPR code to perform deterministic and probabilistic defense-in-depth analyses of the input sets developed under Task 4.B above. As necessary, the contractor shall complete sensitivity studies similar to those performed in Task 1. Subject to approval of the COR, the contractor may also employ other analytical techniques.
- D. The contractor shall prepare an assessment of defense-in-depth measures related to the probabilistic analysis of piping systems subject to active degradation mechanisms.

#### Deliverables for Task 4

The contractor shall prepare and submit a Draft TLR covering all work performed under this task within 60 days of completion of the task. The draft TLR shall summarize the efforts completed, propose conclusions, and identify any recommendations for any issues identified. The contractor shall prepare a Final TLR no later than 45 days incorporating any comments received from the COR on the Draft TLR.

#### Task 5: Provide Probabilistic Fracture Mechanics Code Development Expertise and Related Technical Support

##### Task 5-A: Provide PROMETHEUS Code Development

NRC has sponsored the development of the PROMETHEUS code through the use of contractors at the Engineering Mechanics Corporation of Columbus (EMC<sup>2</sup>). The PROMETHEUS Code is a Probabilistic Fracture Mechanics (PFM) code. NRC has certain

rights to the PROMETHEUS code that allow it to use and modify PROMETHEUS, as well as distribute it to the contractor to perform future work with PROMETHEUS, including application of PROMETHEUS and future development of PROMETHEUS.

The contractor shall use the PROMETHEUS code in Tasks 1 through 4 to perform pre-processing and scoping studies in support of xLPR code analyses, and also to augment xLPR code results. The contractor may determine that some limited improvements are necessary to complete the PROMETHEUS code depending on analysis results and results of sensitivity studies. The contractor shall discuss proposed improvements to PROMETHEUS with the COR before implementation, and the contractor shall obtain written confirmation from the COR prior to making any such improvements. The contractor shall complete and modify the Graphical User Interface (GUI) for PROMETHEUS as discussed in this paragraph. The contractor shall also finalize the PROMETHEUS User Manual and PROMETHEUS Theory Manual. If the changes proposed by the contractor in the PROMETHEUS code are major and would affect the cost or schedule, then the contractor shall bring it to CO's attention for further guidance.

#### Deliverables for Task 5.A

The contractor shall provide the final source code and executables for the PROMETHEUS code within 30 days of completing the PROMETHEUS code. The contractor shall provide the final GUI for the PROMETHEUS code within 30 days of completing the GUI. The contractor shall prepare and submit a draft User Manual and Theory Manual for PROMETHEUS within 60 days following completion of the final version of PROMETHEUS. The contractor shall make a proposal for the point at which PROMETHEUS is declared final, and this proposal shall be subject to approval by the COR. The contractor shall prepare a final User Manual and Theory Manual within 60 days of receiving NRC comments on the drafts, incorporating any comments from the COR.

#### Task 5.B: Provide PROMETHEUS Technical Training

The contractor shall provide one training session (duration to be agreed upon between the COR and the contractor) to the NRC staff on the use of the PROMETHEUS code. The training session shall cover the information contained in the PROMETHEUS Theory Manual as well as the PROMETHEUS User Manual. The contractor shall also provide guided sample problems as part of the training. The contractor shall provide all training materials to the NRC at the time of the training session. The contractor is advised that the COR may opt to video record this training for further training use at the NRC.

#### Deliverables for Task 5.B

The contractor shall provide all training material to the NRC COR at the time of the training, including slides and sample problem files.

#### Task 5.C: Provide ASME BPV Code Technical Support

The new developments and results obtained using the xLPR code are expected to have a significant impact on ASME Boiler and Pressure Vessel (BPV) code requirements. Some of these developments will need to be introduced to the code committees. In addition, the NRC anticipates that new code cases may be developed based on the analyses carried out under this project. This task requires the contractor to participate in ASME code committees within Section XI, Section III, and other appropriate code groups, as instructed by the NRC COR.

Some of the issues of importance include aging effects on nuclear materials and fracture mechanics issues associated with Section XI of the ASME code. This support requires contractor attendance at the ASME BPV code meetings, summarizing meeting minutes and reporting to the NRC COR preparation for meetings including work to support code cases, and other ASME code related activities as specified by the COR.

#### Deliverables for Task 5.C

The contractor shall prepare and submit a letter report summarizing the meeting minutes and the presentations made at the ASME meetings no later than 2 weeks after each meeting.

#### Task 5.D: Analyze Technical Gaps in xLPR Code and Additional Inputs

The work performed in Tasks 1 to 4 may identify improvements, gaps, errors, and possible omissions in the xLPR code itself or in its implementation. The contractor shall investigate and document these areas, and rank them by importance with regard to xLPR code predictions. Changes to the xLPR code shall be made as requested in writing by the COR. Some of the possible gaps to be investigated by the contractor include, but are not limited to:

- I. End constraint corrections for crack stability, crack growth, and crack opening displacement (COD)
- II. Weld residual stress (WRS) effect on COD
- III. Conservatisms in applied loads (overtop WRS fields)
- IV. Treatment of severe events
- V. Improvements of leak rate morphology
- VI. Other input support and development as needed and specified by the NRC COR.

#### Deliverables for Task 5.D

The contractor shall prepare and submit a Draft TLR covering all work performed under this task no later than 60 days of the agreed-upon completion date. The Draft TLR shall summarize the technical gaps identified and potential improvements in the code or its implementation, as well as any efforts to remediate these gaps. The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The contractor shall provide the Final TLR no later than 60 days after the receipt of comments.

#### Optional Task 6: Provide Ad-Hoc Technical Support

The contractor shall provide ad-hoc technical assistance to the NRC as directed by the COR. This technical assistance may include, but is not limited to, the following topics:

- I. Benchmarking studies.
- II. Providing training to NRC staff on xLPR-related topics.
- III. Support for emerging needs on piping probabilistic fracture mechanics (PFM) issues. On average, a new aging issue occurs within commercial nuclear plants every 7 years. This topic permits the contractor to aid NRC staff when such problems arises.
- IV. Severe accident considerations on piping PFM issues. Severe accidents, such as seismic damage or high temperature faulted conditions may occur that require help from the contractor to investigate.
- V. Confirmatory analyses on an as-needed basis.

- VI. Emergency needs for rapid assistance on piping related technical issues as they arise.
- VII. Materials testing to enhance xLPR code input databases as specified by the COR. This may include:
  - a. Fracture testing of materials to increase xLPR materials database statistics or to add missing data (Alloy 152 toughness, for example)
  - b. Cyclic testing for mixed hardening WRS fields
  - c. Creep test update for post-weld heat treatment (PWHT) improvements
  - d. Other material testing for the xLPR input needs

#### Deliverables for Optional Task 6

For each technical assistance request from the COR, the contractor shall prepare and submit a Draft TLR covering all work performed no later than 30 days of completion of the work. Each Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified. If the contractor performs material testing, the Draft TLR shall also include thorough descriptions of any material testing performed under this task, including test procedures and matrices, and all test results. The contractor shall also provide any test results in their raw data form and in Excel. The contractor shall prepare a Final TLR incorporating any comments on the Draft TLR from the COR. The contractor shall provide the Final TLR no later than 30 days after the receipt of comments from the COR.

### **5. APPLICABLE DOCUMENTS AND STANDARDS**

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

### **6. DELIVERABLES/MILESTONE SCHEDULE AND 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 with a change-control appendix, and a revised version which shall become the final version. The contractor shall maintain appropriate version control in an electronic format. The contractor shall explicitly state in its submittal(s) that the product provided is the deliverable for Task/Subtask 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/MILESTONE SCHEDULE

<b>Task No.</b>	<b>Description</b>	<b>Due Date</b>
1	Input to a 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.	Task-1 duration is 7 months from the task order award. Input to the Draft TLR is due in 60 days from the task completion date.
1	Final TLR input 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.
2	Draft interim-TLRs encompassing progress accomplished every 6-month period from the task start date.	Task-2 duration is 15 months from task order award. Draft interim-TLRs are due every 6 months after the task start date
2	Draft TLR covering all work performed for Task-2. The Draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Task-2 duration is 15 months from task order award. Draft TLR is due no later than 60 days after 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 interim-TLR encompassing progress accomplished in the first 6-month period from the start of the task.	If exercised, Task-3 will start after the completion of Task 2. Task-3 duration is 12 months from the task start date. Draft interim TLR is due no later than 6 months after the task start date
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.	If exercised, Task 3 will start after the completion of Task 2.The Task-3 duration is 12 months from the task start date. Draft TLR is due no later than 60 days after 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.

<b>Task No.</b>	<b>Description</b>	<b>Due Date</b>
4	Draft interim-TLR encompassing progress on the defense-in-depth studies accomplished in the first 6-month period from the start of the task.	Task 4 will start after the completion of Task 2. The Task 4 duration is 12 months from the task start date. Draft interim TLR on the defense-in-depth studies is due no later than 6 months after the task start date
4	Draft TLR covering all defense-in-depth studies work performed for Task-4. The draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Task 4 will start after the completion of Task 2. The Task 4 duration is 12 months from the task start date. Draft TLR on the defense-in-depth studies is due no later than 60 days after the task completion date.
4	Final TLR on the defense-in-depth studies incorporating any comments from the COR and NRC lead staff for the project.	45 days after the COR comments are received. If applicable, revisions are due 30 days after COR request for a revision
5-A	Final version of the PROMETHEUS code incorporating all improvements confirmed by the COR.	Improvements to the PROMETHEUS code may occur throughout the duration of Tasks 1 through 4. The point at which the PROMETHEUS code is declared final shall be proposed by the contractor, and is subject to approval by the COR.
5-A	Draft User Manual and Theory Manual for the PROMETHEUS code.	60 days following completion of the agreed-upon final version of the PROMETHEUS code.
5-A	Final User Manual and Theory Manual incorporating any comments from the COR and NRC lead staff for the project on the drafts.	60 days after the COR comments are received
5-B	One training session along with associated training materials is to be provided to the NRC staff on the use of the PROMETHEUS code. The contractor shall provide all training material to the COR at the time of the training, including slides and sample problem files.	The training session is to be scheduled no later than 90 days after completion of the final User Manual and Theory Manual. All training material is to be provided to the COR at the time of the training, including slides and sample problem files.
5-C	Draft ASME BPV code meeting presentation material	No later than 2 Weeks before each of the ASME meetings
5-C	Final ASME meeting presentation material	No later than 1 Week before each of the ASME meetings
5-C	Letter report summarizing the meeting minutes and the presentations made at the ASME meetings.	No later than 2 Weeks after each of the ASME meetings

<b>Task No.</b>	<b>Description</b>	<b>Due Date</b>
5-D	Draft TLR covering all work performed under task 5-D. The draft TLR shall summarize the technical gaps identified and potential improvements in the code or its implementation, as well as any efforts to remediate these gaps.	Draft TLR shall be provided no later than 30 days after the agreed-upon completion date of this subtask.
5-D	Final TLR incorporating any comments from the COR.	The final TLR shall be provided no later than 30 days after contractor's receipt of COR comments. If applicable, revisions are due 30 days after COR request for a revision.
6	Draft TLR covering all work performed in response to each technical assistance request from the COR. Each draft TLR shall summarize the efforts completed, propose conclusions, and identify recommendations for any issues identified.	Duration for support in response to each technical assistance request is to be agreed-upon with the COR. Draft TLRs are due no later than 30 days after of completion of the work.
6	Final TLR incorporating any comments from the COR.	30 days after contractor receipt of COR comments. 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

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.

## **7. 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.

**8. GOVERNMENT-FURNISHED PROPERTY**

Access to all deliverables from previous NRC xLPR task orders, as needed for this project per the COR’s determination, including all past test data, analyses, and letter reports.

EPRI technical reports and data obtained through the NRC-EPRI Memorandum of Understanding on xLPR code development research, as needed for this project per the COR’s determination.

**9. 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 10.1 of this statement of work.

**10. SPECIAL CONSIDERATIONS**

**10.1 TRAVEL**

The following travel may occur under this task order –

<b>Travel Description</b>	<b>Task(s)</b>	<b>Location</b>	<b>Date</b>	<b>Days</b>	<b>Attendees</b>
<b>FY 2017</b>					
Program Review at NRC	Various	Rockville, MD	TBD	2	3
ASME Code Meeting	5-B	Anchorage, AK	05/2017	3	1
ASME Code Meeting	5-B	Minneapolis, MN	08/2017	3	1
<b>FY 2018</b>					
Program Review at NRC	Various	Rockville, MD	TBD	2	3
ASME Code Meeting	5-B	Phoenix, AZ	11/2017	3	1
ASME Code Meeting	5-B	TBD	02/2018	3	1
ASME Code Meeting	5-B	Dallas, TX	05/2018	3	1
ASME Code Meeting	5-B	TBD	08/2018	3	1
<b>FY 2019</b>					
Program Review at NRC	Various	Rockville, MD	TBD	2	3
ASME Code Meeting	5-B	Atlanta, GA	11/2018	3	1
ASME Code Meeting	5-B	TBD	02/2019	3	1
ASME Code Meeting	5-B	TBD	05/2019	3	1
ASME Code Meeting	5-B	TBD	08/2019	3	1

Travel Description	Task(s)	Location	Date	Days	Attendees
<b>FY 2020</b>					
Program Review at NRC	Various	Rockville, MD	TBD	2	3
ASME Code Meeting	5-B	TBD	11/2019	3	1
ASME Code Meeting	5-B	TBD	02/2020	3	1
ASME Code Meeting	5-B	TBD	05/2020	3	1
ASME Code Meeting	5-B	TBD	08/2010	3	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. All travel conducted pursuant to this task order is billable at Federal per diem rates, in accordance with Federal Travel Regulations.

**10.2 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.

**10.3 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 and probabilistic analyses capabilities with specialized user-defined subroutines using ABAQUS and GoldSim computer codes to model and analyze probabilistic fracture mechanics work under this task order.

**SECTION F - Deliveries or Performance**

**NRCF030A PERIOD OF PERFORMANCE ALTERNATE I**

This order shall commence on August 14, 2017 and will expire on August 13, 2020. (See FAR 52.216-18 - Ordering).

(End of Clause)

**SECTION H - Special Contract Requirements**

**2052.215-70 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]	[REDACTED]

\*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)

## **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:

NRC COR:

Name: Shah Malik

Office: Office of Regulatory Research

Street Address: 11555 Rockville Pike,  
Rockville, MD 20852, Mail Stop: TWFN/ 10 A36

E-Mail: [Shah.Malik@nrc.gov](mailto:Shah.Malik@nrc.gov)

Phone: [REDACTED]

NRC Alternate COR:

Name: Matthew Homiack

Office: Office of Nuclear Material Safety and Safeguards (NMSS)

Street Address: 11555 Rockville Pike,  
Rockville, MD 20852, Mail Stop: TWFN/ 10 A36

E-Mail: [Matthew.Homiack@nrc.gov](mailto:Matthew.Homiack@nrc.gov)

Phone: [REDACTED]

(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**

Attachments:

1. Monthly Letter Status Report Template
2. Cost Reimbursement Billing Instructions