

Proposal Evaluation and Proposal Preparation Instructions

CORAL-2 RFP 6400015092, Attachment 2



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CORAL: Collaboration of Oak Ridge, Argonne, and Lawrence Livermore National Laboratories

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Proposal Evaluation and Proposal Preparation Instructions
Version Change Control Table

Version	Creation Date	Description	Approval Date
12	November 2017	Original	04/09/2018
13	April 25, 2018	a. Table 1, Volume 3 updated to reflect that it is to include "Section 6 Other Research & Development". b. Section 5.2. 7 th paragraph revised to correctly reflect hardware maintenance at 9x5 and 12x7. The reference for 24x7 has been removed.	04/25/2018

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1. PROPOSAL FORMAT

Offerors must submit ONE electronic copy of their entire proposal to the UT-Battelle Procurement Officer as indicated in the CORAL-2 RFP Cover Letter. Printed proposals are not required. Submission of a proposal by electronic media will be considered by the Laboratories to be a certification that the media is virus free. All proposals should be prepared using an 8-1/2 by 11 in. paper format and a minimum font size of 11 points. “Page limit” is defined as consecutively numbered pages. Page limits for each proposal volume are stated in Table 1. Electronic copies of the complete proposal must be in Microsoft Office 2007 or later (Word, Excel, PowerPoint, Project), PDF format, or Rich Text format. To reduce the review time by the Laboratories, the proposal must include an editable file of the documents in Word, Excel, PowerPoint, etc.

An Offeror’s proposal submission should be structured in accordance with Table 1.

- Proposal volumes should NOT be consolidated; each volume should be a separate file. Electronic folders should include the Offeror’s company name.
- Electronic file titles should identify the Offeror’s company name, corresponding volume number, and description.
- Electronic files up to 25MB can be received via UT-Battelle’s email system. Files may be zipped and compressed.

Table 1. CORAL-2 Proposal(s) Format

VOLUME—SECTION NUMBER
<p>Volume 1 CORAL-2 Build Technical Proposal (200-page limit total; 300-page limit total for a response that combines the technical proposals for ORNL and LLNL/ANL systems)</p> <p>Section 1. Introduction Section 2. Program Overview and Mission Need Section 3. CORAL-2 High-Level System Requirements Section 4. CORAL-2 Application Benchmarks Section 5. CORAL-2 Compute Partition Section 6. Input/Output Subsystem Section 7. CORAL-2 High-Performance Interconnect Section 8. Base Operating System, Middleware and System Resource Management Section 9. Front-End Environment Section 10. System Management and RAS Infrastructure Section 11. CORAL-2 Maintenance and Support Section 12. CORAL-2 Facilities Requirements Section 13. Project Management Section 14. Appendix A: Glossary</p>
<p>Volume 2 Business Proposal (40-page limit total)</p> <p>Section 1. Supplier Attributes Section 2. Proposed Open Source Development Partnerships</p>
<p>Volume 3 CORAL-2 Non-Recurring Engineering (NRE) Technical Proposal (50-page limit total and 70 pages for combined proposals)</p> <p>Section 1. Overview Section 2. Specific NRE Activities and Objectives Section 3. Impacts of NRE on CORAL-2 Machine Section 4. Project Management Section 5. Subcontracting Section 6 Other Research & Development</p>

Table 1. CORAL-2 Proposal(s) Format (continued)

VOLUME—SECTION NUMBER
<p>Volume 4 CORAL-2 Build and NRE Price Proposal (no page limit) Section 1. NRE Fixed Price Section 2. Build – CORAL-2 Machine Fixed Prices Section 3. Build – Mandatory Option and Technical Option Fixed Prices Section 4. Lower-Tier Subcontractor Prices Section 5. Milestone Payment Schedule</p>
<p>Volume 5 Other Documents (no page limit) Section 1. Royalty Information Section 2. Small Business Subcontracting Plans for the Proposed NRE Section 3. Software Branding and Licenses, If Applicable Section 4. System Warranty Information Section 5. Representations and Certifications Section 6. EEO Pre-Award Clearance Request Form (Applies Only to ORNL) Section 7. Facility Clearance and Foreign Ownership, Control, or Influence (FOCI) Determination (Applies Only to LLNL) Section 8. Workplace Substance Abuse Program Plan (Applies Only to LLNL) Section 9. Safety-Related Requirements</p>
<p>Volume 6 Offeror Financial Information (no page limit)</p>
<p>Volume 7 Performance of the System (no page limit) Section 1. Benchmarks, Makefiles, Scripts, and Output Results Section 2. CORAL-2_Benchmark_Results Spreadsheet Section 3. Scaling benchmark results to CORAL-2 Report Section 4. CORAL-2_Summary_Matrices Spreadsheet</p>

2. CORAL-2 BUILD TECHNICAL PROPOSAL (VOLUME 1)

For the purposes of preparing the CORAL-2 Build Technical Proposal, Offerors should assume that they will only be selected for one CORAL-2 NRE award (see Section 4). This assumption allows the Offeror to put forward the most advantageous proposal. The Offeror's CORAL-2 NRE Technical Proposal should indicate the areas where the Offeror's CORAL-2 Build Technical Proposal depends on specific CORAL-2 NRE activities and the impact if those specific CORAL-2 NRE activities are not funded.

In the CORAL-2 Build Technical Proposal, the Offeror should describe the proposed CORAL-2 machine. This should be written in the form of an integrated narrative **and should include a point-by-point response to the technical requirements contained in the Statement of Work (SOW) with the same numbering scheme as the SOW**. SOW text should be included but may be formatted with a smaller font (but no smaller than 6 point). The Offeror does not need to make any changes to Sections 1 and 2. The Offeror's proposal should include text font no smaller than 11-point, except as stated above when providing SOW text. Each section should start on a new page. The CORAL-2 Build Technical Proposal should be divided into tabbed sections as described in the CORAL-2 Proposal Format, Table 1.

The Offeror's CORAL-2 Build Technical Proposal (Volume 1, Sections 3 through 13) should contain a detailed point-by-point response to Sections 3 through 13 of the SOW with the same numbering scheme as the SOW. This response, which should immediately follow the corresponding SOW text, should include a detailed discussion of **how** all the mandatory requirements (MRs), mandatory option requirements (MOs), proposed technical options (TO-1, TO-2, and TO-3) and proposed target requirements (TR-1, TR-2, and TR-3) will be met or exceeded, as well as a discussion of any Offeror-identified additional performance features included in the technical solution.

For any technical option (TO-1, TO-2, or TO-3) or target requirement (TR-1, TR-2, or TR-3) that will not be met, the Offeror should include an explicit statement to that effect, an explanation of the choice not to meet the technical option or target requirement, and any proposed remediation.

The Laboratories will assess the technical appropriateness or viability of the proposed technical response to each requirement. The Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Complies" type of content-free and judgmental response. Responses should be direct, explicit, concise, self-contained, and understandable by technically sophisticated reviewers. Broad discussions and marketing hype should be avoided.

If Offeror is submitting a single proposal that covers both the ORNL and LLNL/ANL systems, then Offeror must detail all differences between the two systems (if any). Each difference should be clearly identified in the relevant subsection of Offerors CORAL-2 Build Technical Proposal. The single proposal must assume that Offeror is selected for only one of the two systems. Offeror may also choose to identify differences that would arise in the proposed systems if Offeror is selected for both systems.

2.1 SECTION 3: SYSTEM OVERVIEW

The Offeror's CORAL-2 Build Technical Proposal response (Volume 1, Section 3) should contain an executive summary of the proposed hardware and software systems. The executive summary should provide a brief overview of what will be delivered, major functional and performance capabilities, and fully completed summary matrices. Details on what information should be included for each of these items are listed in the following subsections.

The Offeror should complete the tables summarizing all major system characteristics in the CORAL-2_Summary_Matrices spreadsheet as described in Sections 2.1.1, 2.1.3, 3.1.3, 3.1.4, and 3.1.5. The completed tables should be included at the beginning of Volume 1, Section 3. As discussed in Section 8.4, the completed spreadsheet must also be submitted as part of Volume 7. The Offeror should include any additional tables necessary to summarize the system fully in addition to the specific tables described in the following sections. All entries should be cross-referenced to the section and/or page numbered in the proposal that contains this information. If an entry is not applicable to a specific aspect being described, then the entry for that type should be “N/A” followed by a brief explanation of why the entry is not applicable.

If the proposal is a combined proposal that has different solutions for the ORNL system and LLNL/ANL system, then the summary matrices must have separate columns for ORNL system and LLNL/ANL system that assume Offeror is selected for only one of the two systems. Offeror may also choose to include two additional columns that detail differences that would arise in the proposed systems if Offeror is selected for both systems.

The following definitions apply throughout these tables. FLOPs are “FLoating point Operations.” By default, FLOPS are assumed to be double precision (64-bit) FLOPS or DFLOPS. When referring to single precision and half precision for Machine Learning/Deep Learning (ML/DL), Offeror will use SFLOPS and HFLOPS, respectively. FLINs is “FLoating point Instructions.” The F in the B:F ratio is FLOP/s (FLOPs per second).

2.1.1 Socket Summary Matrices

The Socket Summary Matrix tab in the CORAL-2_Summary_Matrices spreadsheet should be duplicated and completed in its entirety for each type of socket (e.g., CPU, GPU, SoC, FPGA, or other compute accelerator) proposed. <TYPE OF SOCKET> should be replaced with the type of the socket that is being described. The Processor Type entry should clearly identify the type of processor. If sockets with multiple types of processors are proposed, Offeror should duplicate and complete rows 3 through 12 for each type of processor contained in that socket type. For each processor type, Offeror should duplicate and complete rows 10 through 12 for each level of cache and <LEVEL> should be replaced with the level (e.g., L1 or L2). The In-Package Memory Type entry should clearly identify the type of memory (e.g., HBM2, HBM3, MCDRAM, DDR4, DDR5, 3D-XPOINT, PCM, ReRAM, or STT-MRAM) that is being described. If sockets with multiple types of in-package memory are proposed, Offeror should duplicate and complete rows 15 through 22 for each memory type contained in that socket type. The In-Package Memory only includes memory that is byte-addressable by a process and does not include storage for the I/O Subsystem. If the socket type includes an integrated System Interconnect (e.g., InfiniBand, OPA, Gen-Z, or Ethernet), Offeror should complete rows 23 through 38 for each system interconnect type contained in that socket type. If the socket does not have a system interconnect, Offeror should remove these rows. The Interconnect Type entry should clearly identify the type of interconnect that is being described. The Native API refers to the low-level user API used to access the interconnect (e.g., libfabric, Portals4, PSM[2], UCX, or Verbs) directly. The Software Access refers to the expected distributed software layer (e.g., MPI). The Coherent with Processor Types entry should list any Processor Types with which this interconnect is coherent, if any. In lines 39–41, Offeror should list the socket's mean time between failure (MTBF), thermal design power (TDP), and maximum FLOPs at that TDP. Lines 42–43 should describe the PCIe connectivity per socket. If support for different generations or speeds (e.g., Gen4 at 16 Gb/s and Gen4 at 25 Gb/s), duplicate 42–43 for each version of PCIe. The provisioning rules indicate how lanes can be allocated/bundled (e.g., in powers of two). Similarly, Offeror should indicate any non-Pcie connectivity (e.g., CCIX, Gen-Z, or proprietary processor interconnect) and any provisioning rules (e.g., in groups of eight and multiple groups up to four). Offeror should duplicate and complete rows 46 through 52 for each Storage Memory type included within the socket type. Storage

Memory Durability should be expressed in write Program Erase (P/E) cycles. Offeror should indicate in line 53 which nodes include this socket type. The node types should mirror the <TYPE OF NODE> in the next section. Offeror should include any additional socket characteristics that will assist in the evaluation of the proposed architecture.

2.1.2 Node Summary Matrices

The Node Summary Matrix tab in the CORAL-2_Summary_Matrices spreadsheet should be duplicated and completed in its entirety for each type of node (e.g., compute node (CN), I/O node (ION), or front-end node (FEN)) proposed. <TYPE OF NODE> should be replaced with the type of the node being described. The Socket Type entry should identify the type of socket, while the Number of Sockets per Node should indicate the count for that socket type. The Off-Package Memory Type entry should clearly identify the type of memory (e.g., HBM2, HBM3, DDR4, DDR5, 3D-XPOINT, PCM, ReRAM, or STT-MRAM) that is being described. If nodes with multiple types of off-package memory are proposed, Offeror should duplicate and complete rows 13–21 for each memory type contained in the node type. The Off-Package Memory only includes memory that is byte-addressable by a process and does not include storage for the I/O Subsystem. Offeror should duplicate and complete rows 22 through 38 for each System Interconnect type relevant to that node type. The System Interconnect Type entry should clearly identify the type of interconnect that is being described (e.g., InfiniBand, OPA, Ethernet, or Gen-Z). The Native API refers to the low-level user API used to access the interconnect (e.g., libfabric, Portals4, PSM[2], UCX, or Verbs) directly. The Software Access refers to the expected distributed software layer (e.g., MPI). For line 37, Offeror should indicate if the interconnect connects directly (i.e., point-to-point) to one or more sockets or if it connects to a bus-based or switch-based socket interconnect. The Coherent with Socket Types entry should list any Socket Types with which this interconnect is coherent, if any. In lines 39–41, Offeror should list the node's MTBF, maximum power in Watts, and maximum FLOPs at the maximum node power. For lines 42–43, duplicate and complete a row for each PCIe and non-Pcie slot. Offeror should duplicate and complete rows 44 through 51 for each Storage Memory type included within the node type. Storage Memory Durability should be expressed in write P/E cycles. Offeror should include any additional node characteristics that will assist in the evaluation of the proposed architecture.

2.1.3 Interconnect Summary Matrices

The Interconnect Summary Matrix tab in the CORAL-2_Summary_Matrices spreadsheet should be duplicated and completed in its entirety for each type of interconnect proposed, whether between nodes of the same or different types (e.g., compute interconnect or storage interconnect). <TYPE OF INTERCONNECT> should be replaced with the same identifier used for the type of interconnect in any node summary tables relevant to the interconnect type.

2.1.4 I/O Subsystem Summary Matrices

The Offeror should complete the ORNL system and/or LLNL/ANL system I/O Subsystem Summary Matrix tabs in the CORAL-2_Summary_Matrices spreadsheet depending on whether the proposal is for ORNL system only, LLNL/ANL system only, or both. If proposal is for both, then the information in the tabs should assume Offeror is selected for only one of the two systems. Offeror may also choose to include an additional column in each of the I/O Subsystem Summary Matrix tabs that detail differences that would arise in the proposed systems if Offeror is selected for both systems. Some items refer to tiers. Tiers may be virtual; if the solution has a single physical tier, then use it for both the closest/performance tier and the Usable/Aggregate Capacity. The SOW requirements are driven by the most common usage scenarios rather than by "hero" numbers (e.g., maximum bandwidth). For many of the performance measurements, the requirements state that the number of files is the maximum number of ranks used to achieve any of the scalable science benchmarks. The Offeror should use this number for the number of

files in the file per process and shared file measurements. These measurements include both metadata operations and I/O operations and thus are impacted by the number of ranks. Offeror should provide details on any other aspects of the tier required to scale each type of storage. Offeror should include any additional storage tier characteristics that will assist in the evaluation of the proposed architecture.

2.1.5 System Summary Matrix

The System Summary Matrix tab in the CORAL-2_Summary_Matrices spreadsheet should be completed in its entirety for the proposed final CORAL-2 system(s).

2.1.6 Scale the System Size (Section 3.7.1 SOW)

The Offeror should provide details on options for scaling the total size of the system. These details should discuss whether scaling the system requires changes to the system other than the number of compute nodes. The details should also include any limitations on the scaling, such as, only certain multiples of compute nodes are viable choices or any upper or lower limit on the number of compute nodes. Overall, the Offeror should provide sufficient details such that the Laboratories can assess the performance and, combined with related information in the CORAL-2_Price_Schedule spreadsheet, cost implications of the scaling choices. In addition to the full proposed system, the Offeror should provide configurations and pricing for systems starting at 500 PF in approximately 100 PF increments up to 1.3 EF and in 200 PF increments from 1.3 EF to 2.1 EF.

2.1.7 Scale the System Memory (Section 3.7.2. SOW)

The Offeror should provide details on options for scaling the CORAL-2 system memory. These details should discuss memory options for each node type. The details should include any implications for other memory characteristics listed in the summary matrix for that node type. Overall, the Offeror should provide sufficient details such that the Laboratories can assess the performance and, combined with related information in the CORAL-2_Price_Schedule spreadsheet, cost implications of the memory scaling options.

2.1.8 Scale the System Interconnect (Section 3.7.3. SOW)

The Offeror should provide details on options for scaling the CORAL-2 system interconnect(s). These details should discuss interconnect options for each node type. The details should include any implications for other interconnect characteristics listed in the summary matrix for that interconnect type or any of the node-type summary matrices. Overall, the Offeror should provide sufficient details such that the Laboratories can assess the performance and, combined with related information in the CORAL-2_Price_Schedule spreadsheet, cost implications of the interconnect scaling options.

2.1.9 Scale the I/O Subsystem Capacities and Performance (Section 3.7.4. SOW)

Offeror should provide details on options for scaling the CORAL-2 I/O subsystem. These details should discuss capacity and performance scaling options for each storage tier if multiple tiers are proposed. The details should include any implications for other I/O subsystem characteristics or tiers listed in the summary matrix for that storage tier or any of the node type or interconnect summary matrices. Overall, Offeror should provide sufficient details such that the Laboratories can assess the performance and, combined with related information in the CORAL-2_Price_Schedule spreadsheet, cost implications of the I/O subsystem scaling options. Offeror should provide options for additional licenses as described in 6.1.8.2.1 and 6.2.8.3.

2.1.10 Scale the Integrated Telemetry Database (Section 3.7.5. SOW)

Offeror should provide details on options for scaling the CORAL-2 Integrated Telemetry Database (ITD). These details should discuss storage options required to handle additional log data. The details should include any implications for other database or database node characteristics. Overall, Offeror should provide sufficient details such that the Laboratories can assess the performance and, combined with related information in the CORAL-2_Price_Schedule spreadsheet, cost implications of the ITD scaling options.

2.2 CORAL-2 APPLICATION BENCHMARKS (SECTION 4. SOW)

The Offeror's CORAL-2 Build Technical Proposal (Volume 1, Section 4) should contain a detailed point-by-point response to Section 4 of the SOW with the same numbering scheme as the SOW. Most benchmarking results will be reported (without page limits) in Volume 7. See Section 8 for proposal preparation instructions on what should be reported in Volume 7 of the Offeror's proposal.

For Volume 1, Section 4, the Offeror should provide the following detailed information. For each benchmark, the Offeror should describe any modifications to source code, makefile or scripts written to run the benchmarks, and why these modifications were required and consistent with the allowed modifications described in SOW Section 4.5.6. The Offeror should explain the methodology used to obtain all projected results.

2.3 SECTION 6. INPUT/OUTPUT SUBSYSTEM

For Volume 1, Section 6, Offeror should provide the following detailed information. If Offeror's CORAL-2 Build Technical Proposal is for a ORNL system only, then Section 6.1 should be completed in its entirety, while Section 6.2 should only include the SOW text. If Offeror's CORAL-2 Build Technical Proposal is for a LLNL/ANL system only, then Section 6.2 should be completed in its entirety, while Section 6.1 should only include the SOW text. If Offeror's CORAL-2 Build Technical Proposal is for both a ORNL system and a LLNL/ANL system, then both Section 6.1 and Section 6.2 should be completed in their entirety; in this case, the sections should assume Offeror is selected for only one of the two systems. Offeror may also choose to explicitly detail in those sections differences that would arise in the proposed systems if Offeror is selected for both systems.

2.4 CORAL-2 MAINTENANCE AND SUPPORT (SECTION 11. SOW)

This section should describe in detail the proposed hardware and software maintenance strategies throughout the life of the CORAL-2 Build subcontract. Include the level of service the Offeror intends to provide at various points during the CORAL-2 Build subcontract period (i.e., system build, system installation, acceptance testing, capability period, and general availability period). Specific roles and responsibilities for the Laboratories, Offeror, and lower-tier subcontractor personnel should be delineated. Identify the number of full-time maintenance personnel dedicated to servicing the systems as well as their level of experience on the equipment and software being provided, their training, and other relevant qualifications. Include problem escalation procedures and the process for generating, tracking, and closing trouble tickets. Identify the job category level of the analysts to be provided as well as the company's job description of that job category. The Laboratories will provide office space for on-site support personnel and storage space for spare parts and, in the case of LLNL, Q-clearance allocations. Specific elements of the spare parts cache should be itemized. A failed hardware return mechanism and parts cache refresh policy should be discussed. Software maintenance procedures should be delineated.

2.5 FACILITIES REQUIREMENTS (SECTION 12. SOW)

The Offeror's CORAL-2 Build Technical Proposal (Volume 1, Section 12) should contain a detailed point-by-point response to Section 12 of the SOW with the same numbering scheme as the SOW. Include detailed information about projected power loads that will be present based on the proposed systems, not projected "fully configured" estimates. Give the basis for the estimates. In other words, are these theoretical estimates or are they based on component or full rack measurements? If estimates are provided, indicate how and when these estimates will be improved over time.

A separate floor plan should be provided, including any subsystems (e.g., I/O cabinets, disks, cabling, and external networking) for each laboratory. The floor plan will include a diagram of asset placement, floor-loading information, under-floor clearance requirements (if appropriate), and placement and type of required electrical outlets. Provide weight estimates and quantity for each type of rack in the system.

The estimated total amount of power in kilowatts (kW) required should be provided, including any subsystems (e.g., I/O cabinets, disks, cabling, and external networking), and the power required for each rack type and the number of those racks in the system. The plan should also include the estimated total amount of cooling in British Thermal Units (BTU) or Tons AC required for each of the systems proposed and the cooling required for each rack type and the number of those racks in the system. List any other facilities requirements.

2.6 APPENDIX A GLOSSARY (SECTION 14. SOW)

Section 14 of the SOW is the current glossary. The Offeror should amend the SOW Section 14 glossary elements to reflect terminology used in the Offeror's proposal. The changes should be highlighted. In addition, a list of definitions and acronyms used throughout the Offeror's CORAL-2 Build Technical Proposal should be placed in Volume 1, Section 14.

3. SUPPLIER ATTRIBUTES (VOLUME 2)

Provide the following background information on active or completed contracts during the past four (4) years that the Offeror considers the most comparable to the complexity of this RFP in terms of providing high-end computing systems and working with high-end customers and partners to advance the high-end computing state of the art: contract number; contract type; contract value; contract effective date and term; place of performance; client contacts (include the name and phone number of contractual contact and the name and phone number of technical contact); and similarities to CORAL-2 requirements. The Offeror is encouraged to include a self-assessment of its performance on these projects, including what went well and, more importantly, what did not. Every computer-related project has significant problems to resolve, so a credible response will not say "everything went fine." The Laboratories are very interested in how the Offeror's organization overcame difficulty and ultimately became successful in the face of adversity, not that they avoided obstacles in the first place. The Offeror may discuss these challenges in the context of a lessons learned scenario.

Discuss the manufacturing and testing facilities of the Offeror's company. Discuss the expertise and skill level of the company's key personnel who will work on this project as described in Section 13 of the SOW. Key personnel submittals must utilize the resume format in Appendix A.

The Offeror's financial information is considered a Supplier Attribute. However, the Offeror should submit financial information in Volume 6, Offeror Financial Information.

If a proposal is submitted by a consortium led by an integrating subcontractor (as opposed to the primary original equipment manufacturer), refer to Section 9.2(3)d above for consortium-related information.

The Offeror should provide information on the history of its company with, and the capabilities to engage in, an open source development partnership and meeting the goals set out in the SOW. This information should include the willingness of the Offeror to participate in the open source development, with other partners, of key missing High Performance Technical Computing (HPTC) cluster technology components.

The Offeror should describe any use of subcontracting or third parties for major software, hardware components, or services and associated areas of risk and risk mitigation. The Offeror must specifically identify all key lower-tier subcontractors, partners, third parties, etc., by name and not by an ambiguous TBD-type references. If working with open source software communities includes subcontracts for deliverables, these should be described. The Offeror should also include a description of how the Offeror's organization intends to integrate the subcontractor's product or services to achieve CORAL-2 goals. The Offeror should describe any previous experience with the proposed third-party subcontractors and the experience that the proposed third-party subcontractors had on projects for similar equipment or services as being provided under the anticipated CORAL-2 Build subcontract. The Offeror must include proof of demonstrated experience and past performance for all proposed subcontractors and a commitment from integrated subcontractors to participate in the work.

4. CORAL-2 NRE TECHNICAL PROPOSAL (VOLUME 3)

The Offeror will submit an NRE Technical Proposal in support of the CORAL-2 effort. The Offeror's CORAL-2 NRE Technical Proposal should indicate the areas where the Offeror's CORAL-2 Build Technical Proposal depends on the proposed CORAL-2 NRE activities.

4.1 SECTION 1. OVERVIEW

This section should provide the high-level context for the NRE (also known as Research and Development) proposed in the subsequent sections. The Offeror should identify the gaps between the Offeror's Plan of Record (POR) roadmap and those prerequisites to meet or exceed CORAL-2 target requirements. For the purposes of this NRE proposal, these gaps should be beyond the scope of, or accelerations of, the Offeror's existing product roadmap and NRE incorporated in the build/delivery activities of the CORAL-2 Build subcontract. However, the Offeror should assume in the CORAL-2 Build proposal that this NRE proposal is also selected and write an integrated CORAL-2 Build response that includes end results of both efforts funded under separate subcontracts (one or two CORAL-2 Build and one CORAL-2 NRE). In other words, the Offeror should assume the results of all proposed NRE activities in the Build proposal and should clearly identify the impact of not funding each proposed NRE activity. The Offeror should identify the specific details of the NRE activities that must be funded to ensure that this NRE proposal is successful. If one NRE activity depends on another NRE activity, the Offeror must state these dependencies. The Offeror should also make clear how this NRE proposal reduces the schedule or performance risk associated with the proposed CORAL-2 configuration, timescale, and budget; e.g. reduces performance or schedule risks. As such, this proposal should integrate into the Offeror's overall CORAL-2 Build risk plan in the response to the SOW Section 13.

4.2 SECTION 2. SPECIFIC NRE OBJECTIVES AND ACTIVITIES

This section should list the specific proposed NRE objectives and activities in support of the CORAL-2 design, productization, test, and scaling. NRE milestones should be identified and a milestone schedule

defined that allows for a phased delivery. Milestones should be of sufficient granularity to facilitate down selecting among proposed activities in case annual appropriated funding levels require reductions. These activities should be split into four major categories, if applicable:

- Hardware;
- Software;
- System testing and scaling; and
- Center of Excellence to support DOE application porting and performance

The Offeror must include in the NRE proposal a Center of Excellence (COE) task that consists of multiple milestones to support the Laboratories in porting key DOE applications to the CORAL-2 system and improving the performance of DOE applications on the CORAL-2 system. The COE activity is a MR. Offeror remains responsible for all work regardless of offeror's use of lower-tier subcontractors. Support will be required from the successful Offeror (i.e., the prime subcontractor) and all of its key advanced technology providers (e.g., processor vendors). Activities will require the support of experts in the areas of application porting and performance optimization. These experts will work with laboratory personnel on porting and tuning of key applications, which may include some of the CORAL-2 benchmarks or full applications—to be determined during contract negotiation—for the target architecture. COE is a key activity that will help ensure that the DOE applications are able to run on the CORAL-2 system once acceptance has occurred.

The COE task will be run as its own project, with a coordinator/project manager overseeing and coordinating issues with the specific laboratory. Co-location of staff at the Laboratories' sites is desirable but not necessary. Base support is required from the date of subcontract execution through two (2) years after final acceptance. Laboratories may negotiate an extended period of performance or options for such an extension. This activity must reflect all terms and conditions of NRE activities including cost sharing.

This section must be a detailed Offeror-prepared SOW that describes the activities in sufficient detail to the price proposed. This section should identify proposed deliverable items. The Laboratories do not anticipate delivery of hardware or software resulting from NRE activities. However, the Offeror should propose monthly and quarterly reviews and the delivery of specific architectural and/or software functionality and API descriptions or other reports that document the work performed and results achieved. The delivery of this functionality may be phased and should be captured in proposed milestones, which must provide measurable criteria by which the progress and successful completion of the NRE activities can be assessed. Prototype hardware for testing at the Offeror's site that supports the Build Go/No-Go decision is strongly desired. The Laboratories anticipate an assessment of such hardware will support the conversion of target requirements in the CORAL-2 Build subcontract to performance requirements following a successful Go/No-Go decision. For more information on the CORAL-2 decision process, see article IV of the Sample CORAL-2 Build PO for ORNL or article 13 of B626589 Sample Build Subcontract for LLNL.

4.3 SECTION 3. IMPACT OF NRE ON CORAL-2 SYSTEMS

This section should indicate the direct impact of the proposed NRE activities and milestones on the CORAL-2 systems. This impact may include schedule improvements, productization, improving system qualities such as the system interconnect, RAS or MTABF, and performance of DOE applications. If the major impact is risk reduction, then Offeror should explain what risks are addressed and how the risks are reduced.

4.4 SECTION 4. PROJECT MANAGEMENT

This section should describe how the NRE project will be managed and how the results will be integrated into the deliverables of the CORAL-2 Build subcontracts. If managed separately from the CORAL-2 Build subcontracts, the Offeror should describe the NRE proposed project management structure and team.

The Offeror should describe the major phases of the project and any proposed reviews and decision dates. The Offeror should include a table in four parts (corresponding to the four major categories in Section 2) with each line in the table providing a deliverable title with dates and paragraph description but not payments.

After reading Sections 1, 2, and 4 of the NRE proposal, the Laboratories should be able to understand exactly what is proposed and the corresponding delivery/completion schedule. After reading Section 3, the Laboratories should be able to understand the full impact of this NRE proposal on the CORAL-2 systems and risk plan.

4.5 SECTION 5. SUBCONTRACTING

This section should describe any use of subcontracting or third parties for major software, hardware components, or services and associated areas of risk and risk mitigation. The Offeror must specifically identify all key lower-tier subcontractors, partners, third parties, etc., by name and not by an ambiguous TBD-type references. If working with open source software communities includes subcontracts for deliverables, these should be described. The Offeror should also include a description of how the Offeror's organization intends to integrate the subcontractor's product or services to achieve CORAL-2 goals. The Offeror should describe any previous experience with the proposed third-party subcontractors and the experience that the proposed third-party subcontractors had on projects for similar equipment or services as being provided under the anticipated CORAL-2 Build subcontract. The Offeror must include proof of demonstrated experience and past performance for all proposed subcontractors and a commitment from integrated subcontractors to participate in the work.

4.6 SECTION 6. OTHER RESEARCH & DEVELOPMENT

Offeror must describe any Government-funded research & development (R&D) being performed that relates to, or could have an impact or effect on, the proposed NRE. At a minimum, this section must describe the relationship to the proposed NRE of any DOE programs such as FastForward 1 and 2, DesignForward 1 and 2, and PathForward R&D that the Offeror has performed or is performing. The Offeror must describe the dependencies and risks between its current Government-funded R&D and the proposed NRE. The discussion of dependencies and risks must include technology, schedule, and funding.

5. CORAL-2 BUILD AND NRE PRICE PROPOSAL (VOLUME 4)

5.1 SECTION 1. NRE FIXED PRICE

Offeror must identify the proposed total firm fixed price corresponding with its CORAL-2 NRE Technical Proposal. Offeror must provide a firm fixed price for each proposed NRE milestone and the total firm fixed price must be the sum of the firm fixed prices of the proposed NRE milestones. The Offeror must include a basis of estimate (BOE) for its proposed total firm fixed price. The BOE should include, at a minimum, an estimate of materials, labor categories, labor hours by category, fully burdened hourly labor rates by category to perform each proposed NRE activity, and milestone commensurate with

the value to be received. The BOE should also identify proposed material, travel, or other expenses to perform each proposed NRE activity/task. The Offeror should include a projected funding expenditure profile by Government fiscal year (October–September) for each proposed NRE activity/task.

If the Offeror chooses to take advantage of the expected class advance patent waiver from DOE, the BOE must include a 40% cost-share. The cost-share value must be identified per milestone and as a total across all milestones.

The Laboratories do not anticipate a need for Certified Cost or Pricing Data (as defined at FAR Part 15); however, the Laboratories reserve the right to request submission of Certified Cost or Pricing Data from the selected Offeror(s).

5.2 SECTION 2. BUILD – CORAL-2 SYSTEM FIXED PRICES

The Offeror must provide a firm fixed price for each system offered. The Offeror must fully complete the price schedules contained in the Base System tab of the CORAL-2_Price_Schedule spreadsheet, as described herein, and include the completed price schedules in Section 2 of the CORAL-2 NRE and Build Price Proposal. Modifications to the spreadsheet may be made as necessary and should be highlighted.

An entry must be made for each line item. If the price of a line item is being offered at “No Charge” to the Laboratories, insert “NC” for that entry. If a line item cannot be separately priced, insert "NSP" for that entry. In the Note column, the Offeror must also insert an entry that identifies which line item includes that price.

All notes must also be included in a separate narrative that clearly indicates the tab and row of the CORAL-2_Price_Schedule to which the note corresponds. If any note entry exceeds a single sentence in length, then the Offeror may make the note entry a reference to this notes narrative.

For each node type, the Offeror must duplicate and complete the Base <TYPE OF RACK> tab in the CORAL-2_Price_Schedule spreadsheet. The Offeror should duplicate and complete the <TYPE OF NODE> row for each node type included in the summary matrix for that rack type. The Offeror should duplicate and complete the <TYPE OF INTERCONNECT> row for each interconnect type included in the summary matrix for that rack type. All other costs of this rack type, such as costs of power distribution units (PDUs) and the actual rack, should be included in the Other Rack Costs row. The Offeror should include a note for this row that explains the components included in those costs.

For each node type, the Offeror should complete a <TYPE OF RACK> Rack row in the Base System tab of the CORAL-2_Price_Schedule tab. For each node type, the Unit Price entry should be set to a link to the entry in column D of the Total Price row of the corresponding Base <TYPE OF RACK> tab. For each interconnect type, the Offeror should provide sufficient details to form a firm fixed price. These details should be provided in a <TYPE OF INTERCONNECT> row, possibly modified to incorporate additional details of the interconnect type. The price of any adapters for this interconnect type should be included in the node price as discussed above.

The total price proposed for each system must include all software and software license costs, unless explicitly noted. The Offeror must include a note that describes all software included in the Miscellaneous Software price row.

Software Maintenance pricing must be based on the model described in Section 11.2 of the SOW, starting with system acceptance and extending for 5.0 years. Hardware Maintenance prices should be based on models with on-site parts cache and “overlap” RMA process for all systems proposed starting with system

acceptance and extending for 5.0 years. The Offeror should link to the Total Price cell (\$D\$8) of the HW maintenance tab of the option that the Offeror suggests including in the Base System price. Hardware maintenance options should include at least the 9x5 and 12x7 models, although the Offeror may propose additional models as options as discussed in Section 11.1.1 of the SOW.

The Base System should include Base Options that form a complete system. The Unit Price entry of the Preferred Parallel Debugger row of the Base System tab should be set to a link to the Total Price cell (\$D\$4) of the debugger tab (DDT or TotalView) of the option that the Offeror suggests including in the Base System price.

The firm fixed price should also include all delivery and installation costs. The Offeror must provide separate pricing for each facility if installation costs vary due to facility differences, as detailed in Section 13 of the SOW.

The Laboratories do not anticipate a need for Certified Cost or Pricing Data (as defined at FAR Part 15); however, the Laboratories reserve the right to request submission of Certified Cost or Pricing Data from the selected Offeror(s).

5.3 SECTION 3. BUILD – MANDATORY OPTION AND TECHNICAL OPTION FIXED PRICES

Offeror must fully complete the Optional Pricing tabs contained in the CORAL-2_Price_Schedule spreadsheet for the MOs and TOs. **An entry must be made for each line item.** The Offeror may include additional options that it thinks would be of interest to the Laboratories. Offeror-defined options must include relevant technical, business, and price information in the appropriate proposal volume.

5.3.1 Scale the System Size

Offeror must provide an entry in the Note column that indicates viable quantities for each row of the Base System tab of the CORAL-2_Price_Schedule spreadsheet. If any options to scale the size of the system require changes to the Base System price beyond changing quantities in the Base System tab, the Offeror must duplicate and complete the Base System tab and any necessary auxiliary tabs to provide a total firm fixed price for those options.

5.3.2 Memory Scaling

Offeror must provide all details necessary to determine the cost implications of memory scaling options that are described in Volume 1, Section 3.7.2. The Offeror should duplicate and complete row 3 of the Memory Scaling tab of the CORAL-2_Price_Schedule spreadsheet for each memory scaling option. The completed row should include a note that describes how to compute a total firm fixed price for a system that uses that option. The note must clearly indicate which row should be replaced in which copy of the Base <TYPE OF RACK> tab to compute a firm fixed price of that option. The note must also clearly indicate in the CORAL-2_Summary_Matrices spreadsheet which Socket or Node is being modified and how it is being modified.

5.3.3 Interconnect Scaling

The Offeror must provide all details necessary to determine the cost implications of interconnect scaling options that are described in Volume 1, Section 3.7.3. The Offeror should duplicate and complete row 3 of the Interconnect Scaling tab of the CORAL-2_Price_Schedule spreadsheet for each interconnect scaling option. The completed row must include a note that describes how to compute a total firm fixed

price for a system that uses that option. The note should clearly indicate which row should be replaced in which copy of the Base <TYPE OF RACK> tab to compute a firm fixed price of that option. If any interconnect scaling option requires changes to the interconnect adapter pricing, the Offeror should duplicate and complete row 4 of the Interconnect Scaling tab of the CORAL-2_Price_Schedule spreadsheet for that interconnect scaling option. The completed row should include a note that clearly indicates which row should be replaced in which copy of the Base <TYPE OF RACK> tab to compute a firm fixed price of that option.

5.3.4 Scale the I/O Subsystem

The Offeror must provide notes in the rows of the Base System tab of the CORAL-2_Price_Schedule that clearly indicate how to compute the firm fixed price of any options for scaling the I/O subsystem that are described in Volume 1, Section 3.7.4. If necessary, the Offeror must complete additional worksheets that provide any additional pricing details to calculate the firm fixed price of those I/O subsystem scaling options.

5.3.5 Scale the Integrated Telemetry Database

The Offeror must provide notes in the rows of the Base System tab of the CORAL-2_Price_Schedule that clearly indicate how to compute the firm fixed price of any options for scaling the ITD that are described in Volume 1, Section 3.7.5. If necessary, the Offeror must complete additional worksheets that provide any additional pricing details to calculate the firm fixed price of those ITD scaling options.

5.3.6 CORAL-2-SU

The Offeror must provide note entries in the Base System tab of the CORAL-2_Price_Schedule that clearly indicate how to compute the firm fixed price of the CORAL-2-SU system that is described in Volume 1, Section 3.7.6. If necessary, the Offeror must copy and complete the Base System tab to provide a firm fixed price for the CORAL-2-SU system.

5.3.7 Mid-Life Upgrades

The Offeror must provide sufficient details to compute the firm fixed price of any mid-life upgrade options described in Volume 1, Section 3.7.7.

5.3.8 Additional Licenses

Offeror must provide option pricing additional I/O client software licenses for 2,500 nodes of x86, ARM, and Power architectures as described in Volume 1, Section 6.1.8.2.1 and for increments of 1,000 Pf additional I/O client software licenses as described in Volume, Section 6.2.8.3.

5.3.9 CORAL-2 Parallel Debugger Options

To cover the desired range of parallel debugger options, the Offeror will complete the DDT and TotalView tabs of the CORAL-2_Price_Schedule spreadsheet.

5.4 SECTION 4. LOWER-TIER SUBCONTRACTOR PRICE INFORMATION

If the Offeror is proposing to use lower-tier subcontractors, price information for each subcontractor should be furnished in the same format and level of detail as prescribed for the prime Offeror.

5.5 SECTION 5. MILESTONE PAYMENT SCHEDULE

The Offeror must provide a “proposed Milestone Payment Schedule according to the Government Fiscal Year (GFY) that matches the delivery milestones identified in the CORAL-2 Build Technical Proposal (Volume 1). The Offeror must provide a proposed Milestone Payment Schedule according to the GFY that matches the delivery milestones identified in the CORAL-2 NRE Technical Proposal (Volume 3).

- ORNL system: Payments for the ORNL system will be primarily through a lease-to-ownership agreement. Payments under a lease-to-own arrangement would occur after acceptance. Pre-acceptance, reimbursable milestone payments may be proposed. In the event acceptance does not occur the reimbursable milestone payments must be repaid to UT-Battelle.
- LLNL system: The Milestone Payment Schedule contained in any resulting subcontract(s) awarded by LLNS will be based on the system delivery schedule, on LLNS’s best estimate of anticipated fiscal year allocations for any subcontract(s) at the time of award, and on the value to be received by LLNS for each milestone.
- Argonne system: Payments for the Argonne system will be primarily through a lease-to-ownership agreement. Payments under a lease-to-own arrangement would occur after acceptance. Pre-acceptance, reimbursable milestone payments may be proposed. In the event acceptance does not occur the reimbursable milestone payments must be repaid to UChicago Argonne LLC.

6. OTHER DOCUMENTS (VOLUME 5)

6.1 SECTION 1: ROYALTY INFORMATION

If a proposal in response to this solicitation contains costs or charges for royalties or license fees totaling more than \$250, the following information should be included in the response relating to each separate item of royalty or license fee: name and address of licensor; date of license agreement; patent numbers, patent application serial numbers, or other basis on which the royalty is payable; brief description, including any part or model numbers of each item or component on which the royalty is payable; percentage or dollar rate of royalty per unit; unit price of item; number of units; and total dollar amount of royalties.

In addition, if specifically requested by the UT-Battelle Procurement Officer before award, the Offeror should furnish a copy of the current license agreement and an identification of applicable claims of specific patents or other basis upon which the royalty may be payable.

6.2 SECTION 2: SMALL BUSINESS SUBCONTRACTING PLAN

This applies to the NRE awards, and not to the machine build awards. Unless the Offeror is a small business, or the total value of the offer is less than \$700,000, the successful Offeror must provide a Small Business Subcontracting Plan, which includes the anticipated total subcontracting amount and the percentage goals and amounts for all the various small business categories. Refer to the RFP’s *SMALL BUSINESS SUBCONTRACTING PLAN* clause referenced in the Model Small Business Subcontracting Plan for additional information. The approved plan will be made a part of any resulting subcontract(s). Failure to agree on an acceptable subcontracting plan will likely render the Offeror ineligible for award of a subcontract.

6.3 SECTION 3: SOFTWARE BRANDING AND LICENSING

The Offeror should submit licensing policies for *all* categories of software (compilers, libraries, application development tools, etc.) that will be provided under any resulting subcontract. Identify all third-party software. Include policies for cluster-wide right-to-use licenses for an unlimited number of users for all software that will be delivered under any resulting subcontract. Include any required software license or maintenance agreement as well as any licensing requirements for source code. The following conditions must be incorporated in any resulting license agreement or maintenance agreement:

- For awards issued by LLNL, the governing laws of the state of California will apply.
- For awards issued by ANL, the governing laws of the state of Illinois will apply.
- For awards issued by ORNL, the governing laws of the state of Tennessee will apply.
- The right of assignment and any associated license agreement is a requirement for ANL, LLNL, and ORNL.
 - Right of assignment of any agreement to DOE for assignment to any succeeding prime contractor to LLNS, UT-Battelle, and UChicago Argonne LLC

An Offeror's proposal may be eliminated from consideration for award in the event the Offeror and the Laboratories cannot mutually agree to the terms and conditions contained in any software license or maintenance agreement.

6.4 SECTION 4: SYSTEM WARRANTY INFORMATION

The Offeror must provide warranty information for all Offeror-provided items as well as any third-party subcontracted items.

6.5 SECTION 5: REPRESENTATIONS AND CERTIFICATIONS

The Offeror must complete, sign, and submit separate Representations and Certifications Forms for the NRE and build subcontract from ANL, LLNL, and ORNL.

6.6 SECTION 6: EEO PRE-AWARD CLEARANCE REQUEST FORM

The Offeror will complete and include ORNL's EEO Pre-Award Clearance Request Form, which only applies to awards issued by ORNL.

6.7 SECTION 7: FACILITY CLEARANCE AND FOREIGN OWNERSHIP, CONTROL, OR INFLUENCE (FOCI) DETERMINATION

Applicable to LLNL subcontracts. LLNL subcontracts may involve access to classified information and/or special nuclear material or unescorted access to "Limited" or "Exclusion" security areas which will require access authorization. Therefore, the successful Offeror must possess a DOE or Department of Defense (DOD) Facility Clearance, which is based on a favorable FOCI determination, and personnel must possess a DOE Access Authorization (clearance) appropriate for the access level.

The successful Offeror will not be granted access authorization until a signed Contract Security Classification Specification (CSCS) Form (DOE F 470.1) is received by LLNS. Therefore, LLNS expects the Offeror to have or be able to obtain a DOE or DOD Facility Clearance that is based on a positive FOCI determination. The Offeror's proposal must indicate whether it currently has a Facility Clearance. If the Offeror does not have or is unable to obtain a Facility Clearance, the Offeror, at the discretion of LLNS, may be deemed ineligible for an award or will be required to perform on a restricted basis until a

Facility Clearance is granted. If required to perform on a restricted basis, the Offeror would not be permitted access to classified information or special nuclear material or unescorted access to certain security areas of LLNL.

To apply for and obtain a FOCI Determination and a Facility Clearance, the Offeror must complete and submit certain electronic FOCI forms and related information available on the DOE FOCI Electronic Submission Site Home at <https://foci.anl.gov/>,

6.8 SECTION 8: WORKPLACE SUBSTANCE ABUSE PROGRAM PLAN

The Workplace Substance Abuse Program Plan (WSAPP) requirement(s) apply only to awards issued by LLNS. The resulting LLNS subcontracts will include DEAR clause 970.5223-4, Workplace Substance Abuse Programs at DOE Sites, requiring the Subcontractor to (1) develop, implement, and maintain a workplace substance abuse program consistent with Part 707 of Title 10 of the *Code of Federal Regulations* (10 CFR 707) and (2) flowdown the requirements of this clause in applicable lower-tier subcontracts.

Before the work can begin, the Offeror selected for award must submit a written Workplace Substance Abuse Program Plan (WSAPP) or WSAPP Certification consistent with 10 CFR 707 for LLNS approval. Any lower-tier subcontractor's WSAPP must be approved before the lower-tier subcontractor is allowed to perform the work.

The LLNS subcontracts involve employees working in testing designated positions (TDPs), and such employees will be subject to applicant, random, reasonable suspicion, and occurrence drug testing.

6.9 SECTION 9: SAFETY-RELATED REQUIREMENTS

Environmental, safety, and health requirements are specific to each of the Laboratories. The associated requirements are incorporated into the draft subcontract(s), terms and conditions, provisions, or attachments.

7. OFFEROR FINANCIAL INFORMATION (VOLUME 6)

To assist the Laboratories in assessing the financial capability of the Offeror, the Offeror must demonstrate that their financial condition is suitable for an award. The Offeror may submit any or all of the following.

- Audited and certified balance sheets and profit and loss statements for the Offeror's company for the last six completed financial quarters, including interim statements for the current quarter.
- Copies of Form 10-K filed with the Securities and Exchange Commission for the past 2 fiscal years, plus any 10-Q Forms filed since the last Form 10-K.
- Affirmative assurance, such as endorsements from financial institutions, that the company has sufficient funds necessary to perform the work.
- The percentage of the performing organization's estimated total revenue during the period of performance the proposed subcontracts will represent.

- The distribution of the last complete fiscal year's sales volume among commercial business, US Government prime contracts, and subcontracts under US Government prime contracts.
- Any other relevant and useful information about the financial health of the company that will assist the Laboratories in assessing the financial capability of the Offeror.

8. PERFORMANCE OF THE SYSTEM (VOLUME 7)

The benchmark programs described below will be executed by the Offeror to measure the execution characteristics and compiler capabilities of the proposed CORAL-2 system and to project the performance of a CORAL-2 class platform. The benchmarks are divided into three categories with a TR-1 designation for all categories to give the Offeror a notion of the various workloads and relative priority of effort to their execution. The first three categories deal with application areas and include Scalable Science, Throughput, and Data Science & Deep Learning Benchmarks. The fourth category is the cross-cutting Skeleton Benchmarks that include various system functionality and performance tests. The Skeleton Benchmarks also serve as a challenge for compilers, for threading and the exploitation of Vector or SIMD hardware, and for floating point, integer, and branch prediction performance.

The CORAL-2 Benchmarks and details for running each of the benchmarks can be found at <https://asc.llnl.gov/coral-2-benchmarks/>.

CORAL-2 Benchmarks questions, and only benchmarks-related questions, may be submitted via electronic mail to coral2-benchmarks@llnl.gov. The Contract Administrators from each laboratory receive copies of emails from this email address. Offeror neutral (i.e., nonproprietary) questions and their answers, without identification of the submitter, will be posted on the CORAL-2 Benchmarks website. Offeror-specific or proprietary questions and their answers will be held in confidence and not posted on the CORAL-2 Benchmarks website. The Laboratories, at their sole discretion, will determine the appropriateness of posting Offeror-specific questions and answers with potentially edited content (to protect the anonymity of the source).

The tests may be run on a configuration as described on the CORAL-2 Benchmarks website according to the testing procedures described in the SOW Section 4. **In addition to running each benchmark, the Offeror must report any benchmark reference system characteristics and the benchmark results in the CORAL-2_Benchmark_Results spreadsheet as indicated in SOW Section 4.**

Changes to accommodate unique hardware and software characteristics of a system will be allowed except where specifically prohibited in the constraints for each benchmark. Code modifications will be documented in the form of initial and final source files, with mandatory accompanying text that describes the changes. An audit trail will be supplied to the Laboratories for any changes made to the benchmark codes. The audit trail will be sufficient for the Laboratories to determine that changes made violate neither the spirit of the benchmark nor the specific restrictions on the various benchmark codes. The source code and compile scripts downloaded from the CORAL-2 Benchmarks website may be modified as necessary to get the benchmarks to compile and to run on the Offeror's system. Other allowable changes include optimizations obtained from standard compiler flags and other compiler flag hints that do not require modifications of the source code. Likewise, changes in the system software such as expected improvements to compilers, threading runtimes, and MPI implementations can be considered. Once this is accomplished, a full set of benchmark runs must be reported with this "as is" source code.

Beyond this, the benchmarks can be optimized as desired by the Offeror. Performance improvements from pragma-style guidance in C, C++, and Fortran source files are preferred. Wholesale algorithm

changes or manual rewriting of loops that become strongly architecture specific are of less value. Modifications must be documented and provided back to CORAL.

In partnership with the Laboratories, the Offeror will continue its efforts to improve the efficiency and scalability of the benchmarks between award of the contract and delivery of the system. The Offeror's goal in these improvement efforts is to emphasize higher level optimizations as well as compiler optimization technology improvements while maintaining readable and maintainable code and avoiding vendor-specific or proprietary methodologies.

Results should be reported in the same CORAL-2_Benchmark_Results spreadsheet used for the required "as is" runs. This is done by creating a new entry on the source change configuration (SCC) worksheet in the CORAL-2_Benchmark_Results spreadsheet. Then, on the worksheet for the affected benchmark, rows must be duplicated, new results entered, and the SCC field should be made to reference the newly created source code configuration.

The individual benchmark codes can be downloaded from the above CORAL-2 Benchmarks website as tar files. Each benchmark is documented with a summary file with general information about that benchmark including a description of the code, how to build and to run it, and any specific information about timing or storage issues. The benchmark source code and makefiles are in the tar file. Larger problem sets are available for download on the CORAL-2 Benchmarks website.

The Scalable Science, Throughput, and Data Science & Deep Learning Benchmark codes will have specific performance levels that may be met and target optimizations for reasonable effort improvements.

The following is a checklist of the above requirements for each benchmark in the CORAL-2 suite. In general, for each benchmark the Offeror may do the following.

1. Report reference system characteristic in the CORAL-2_Benchmark_Results spreadsheet (Volume 7, Section 2).
2. Run benchmarks, "as-is", on a reference system and include all benchmark output files in Volume 7, Section 1.
3. Project benchmark results to the CORAL-2 system for all TR-1 benchmarks. These projections may be summarized in the CORAL-2_Benchmark_Results spreadsheet (Volume 7, Section 2).
4. Describe how benchmark results from the reference system were projected to CORAL-2 systems in Volume 7, Section 3. This report should include any additional information the Offeror used in the estimation process from simulation results to back-of-the-envelope estimations.
5. Repeat steps 2–5 for any source code modifications to the benchmark suite allowed by SOW Section 4 and by the benchmark summary files.
6. Document and describe all code modifications in the SCC worksheet in the CORAL-2_Benchmark_Results spreadsheet and provide all modified source code.

It is extremely important for the Offeror to provide the Laboratories as much benchmark data as possible in the Offeror's Proposal, Volume 7, in the form of the CORAL-2_Benchmark_Results spreadsheet, benchmark output files, and description of any code modifications. Furnishing full results is rewarded

more than incremental performance differences between vendors. If the Offeror cannot run a particular code or problem for whatever reason, Offeror should justify why the runs were not completed in the benchmark response. All benchmark omissions will be fully described by the Offeror and will be reviewed and evaluated by the Laboratories; supporting documentation may be provided.

8.1 SECTION 1: BENCHMARKS, MAKEFILES, SCRIPTS, AND OUTPUT FILES

The Offeror may return all benchmark source files, makefiles, modifications, scripts written to run the benchmarks, and actual output files. The output of each code build, each run reported, and all run scripts used must be provided in electronic form, organized in a manner that reflects a one-to-one correspondence with the benchmark results spreadsheet.

Correct execution and measurements will be certified by the Offeror.

Reported information in this section should be sufficient to convince the Laboratories' Technical Evaluation Team that the Offeror did actually run the benchmarks on the reference system and obtained the reported results. In addition, the Laboratories will evaluate the modifications to ensure consistency with reported modifications and allowed modifications requirements of SOW Section 4.

8.2 SECTION 2: CORAL-2_BENCHMARK_RESULTS SPREADSHEET

The Excel spreadsheet "CORAL-2_Benchmark_Results" (as found on the CORAL-2 Benchmarks website) may be used by the Offeror to report the official figures of merit (FOM), problem input parameters, and all configuration parameters used for each run.

The data from the sustained Scalable Science, Throughput, and Data Science & Deep Learning Benchmark workloads will be reported in the following way. All FOM for each benchmark type will be reported so that the average and standard deviation of the runs for each benchmark code can be calculated. The final aggregate FOM is defined as the geometric average FOM for each workload as stated in SOW Section 4.

8.3 SECTION 3: SCALING BENCHMARK RESULTS TO CORAL-2 REPORT

The Offeror may submit a report that justifies the scaling between the RFP benchmark runs and the Offeror's projected performance for the CORAL-2 system and otherwise highlights noteworthy aspects of the Offeror's performance on the RFP benchmark suite. This report may include a description of the reference system and how it met or did not meet the reference system requirement in SOW Section 4.

The Laboratories will be the sole judge of the validity of any scaled results.

8.4 SECTION 4: CORAL-2_SUMMARY_MATRICES SPREADSHEET

As discussed in Section 2.1, the Offeror must fully complete the CORAL-2_Summary_Matrices spreadsheet. In addition to including all completed matrices into Volume 3, the completed spreadsheet must be submitted as a separate file as part of Volume 7.

9. PROPOSAL EVALUATION AND AWARD INFORMATION

9.1 EVALUATION FACTORS AND BASIS FOR SELECTION

The CORAL-2 evaluation will be performed by staff members of CORAL, a collaboration of Oak Ridge National Laboratory (ORNL), Argonne National Laboratory (ANL), and Lawrence Livermore National Laboratory (LLNL), hereafter referred to as the Laboratories. ANL is managed by UChicago Argonne LLC, under Prime Contract DE-AC02-06CH11357 with the U.S. Department of Energy (DOE). LLNL is managed by Lawrence Livermore National Security, LLC (LLNS), under Prime Contract DE-AC52-07NA27344 with the Department of Energy / National Nuclear Security Administration (DOE/NNSA). ORNL is managed by UT-Battelle, LLC, under Prime Contract DE-AC05-00OR22725 with DOE. Each laboratory operates under procurement policies and procedures consistent with its respective Prime Contract.

LLNL staff will seek assistance from Sandia National Laboratories (SNL) and Los Alamos National Laboratory (LANL) staff in the proposal evaluation process. Lawrence Berkeley National Laboratory (LBNL) staff will assist ANL and ORNL in the proposal evaluation process.

The Laboratories envision separate NRE and machine build awards.

The CORAL-2 Build SOW, Attachment 3 contains the collective technical requirements of the Laboratories for an exascale High Performance Computing (HPC) system, with delivery in 2021 to ORNL (accepted in 2022); a second exascale system delivered in 2022 to LLNL (accepted in 2023); and a potential exascale system delivered in 2022 to ANL (accepted in 2023). These systems are required to meet the mission needs of the Advanced Scientific Computing Research (ASCR) Program within DOE's Office of Science (DOE-SC) and the Advanced Simulation and Computing (ASC) Program within the NNSA.

The delivery and acceptance timing provided above represents the current outlook and alignment of programmatic requirements and funding. However, ORNL reserves the right to make an award based on the proposals for the LLNL/ANL system.

As many as three NRE awards are possible, one to each recipient of a build award. LLNL may choose the same build awardee as ANL or ORNL. In that case, LLNL may choose to team with ANL or ORNL and to award a single NRE award in support of those build awards. The NRE awards may be made by ANL, LLNL, or ORNL, individually or collectively.

The Laboratories reserve the right to (1) make selections on the basis of initial proposals; (2) choose any proposal for their respective individual awards; (3) negotiate with any or all Offerors for any reason; (4) award subcontracts to one or more Offerors; (5) award subcontracts based on all or part of an Offeror's proposal, including any options contained in the proposal; (6) reject any or all proposals and make no award; (7) waive any minor irregularities in any proposal; (8) allow one (or more) individual laboratory to not make an award; and (9) cancel this request for proposal (RFP) at any time prior to award without cost to the Laboratories or the Government.

9.2 BASIS OF AWARD – TRADE-OFF

- (a) An award resulting from this RFP will be made to the responsible Offeror(s) who submits a proposal that is determined to provide the best value to the Laboratories considering both technical merit and price and the trade-offs between price and technical merit (e.g., the value in selecting a higher priced proposal against the technical merit of the proposal).

Each Technical Criterion will be graded based on the following ratings:

- (1) Blue – Proposal exceeds the performance or capability requirements necessary for acceptable subcontract performance and provides little or no risk to the Laboratories.
- (2) Green – Proposal meets the performance or capability requirements necessary for acceptable subcontract performance and provides low-to-moderate risk to the Laboratories.
- (3) Yellow – Proposal marginally meets the performance or capability requirements necessary for acceptable subcontract performance or provides moderate-to-high risk to the Laboratories.
- (4) Red – Proposal fails to meet the performance or capability requirements necessary for acceptable subcontract performance or provides unacceptable risk to the Laboratories. Proposal is unawardable.

The Technical Criteria listed below are of equal importance and technical is more important than price.

In addition to the evaluation of Technical Criteria, price will also be evaluated. In determining the best value, the total price as defined in Section 1.5 Price will be considered along with the technical merits and the trade-offs between price and technical merit (e.g., the value in selecting a higher priced proposal against the technical merit of the proposal).

- (b) The technical evaluation process consists of the proposals being reviewed, evaluated, and rated using a qualitative graded system that assesses the degree of compliance with the Technical Criteria requirements and the level-of-performance risk.
- (c) Diversity – Applicable to systems proposed for ORNL and ANL

DOE SC's ASCR Program has a requirement that ORNL and ANL systems must always be diverse from one another. ANL has a system planned for acceptance in 2021 called "A21," which is outside this RFP. Consequently, the ORNL system must be diverse from the A21 system. The LLNL system can be the same as the ANL system, the same as the ORNL system, or a different system altogether.

Diversity will be evaluated by how much it promotes a competition of ideas and technologies; how much it reduces risk that may be caused by delays or failure of a particular technology or shifts in vendor business focus, staff, or financial health; and how much the diversity promotes a rich and healthy HPC ecosystem.

- (d) The Technical Criteria are:

(1) Performance Features

- a. Technical requirements: The Laboratories will validate that an Offeror's technical proposal satisfies the Mandatory Requirements and Mandatory Option Requirements. Failure to satisfy the Mandatory Requirements and Mandatory Option Requirements will result in no further evaluation of an Offeror's proposal. The Laboratories will assess how well an Offeror's technical proposal addresses the Mandatory Requirements and Mandatory Options. An Offeror is not solely limited to discussion of these features. An Offeror may propose other features or attributes if the Offeror believes they may be of value to the Laboratories. At the discretion of the

Laboratories, consideration may be given to proposed features and attributes in the evaluation process. In all cases, the Laboratories will assess the overall value of each proposal.

b. Performance

- How well the proposed solution meets the overall programmatic objectives expressed in the SOW.
- The degree to which the technical proposal meets or exceeds the Target Requirements and Technical Option Requirements.
- Functionality, performance, and scalability of the proposed systems.
- Quality and quantity of the CORAL-2 Benchmark results. Each benchmark result will be assessed. The TR-1 “Scalable Science Benchmarks” and “Throughput Benchmarks” projected results in the Offeror’s responses are of highest priority. The TR-1 “Data Science and Deep Learning Benchmarks” and “Skeleton Benchmarks” are also of high priority.
- Delivered performance and scalability, including the delivered bandwidth and latency to applications expressed as MPI only and hybrid MPI+X, with X being chosen from a set that may include OpenMP, pthreads, and, for ORNL, OpenACC. Of particular importance is the scalability of the MPI implementation in terms of delivered performance of collective operations and required memory buffering per MPI task.
- Reliability, availability, and serviceability of the system, such as, MTABF, MTTR, hardware and software failsafe features, effectiveness of diagnostics, and data protection mechanisms.
- Features, reliability, performance, and scalability of the proposed I/O subsystem and flexibility and robustness of the I/O interfaces to the CORAL-2 I/O subsystem.
- Minimization of physical plant requirements, such as, facilities modifications for installation, system footprint, overall floor space, power, and cooling.
- Credible roadmaps for hardware and software. The Laboratories are not interested in acquiring technology for which DOE is the sole market nor are they interested in acquiring end-of-life technology. The technology must have potential commercial viability.
- Realism and completeness of the project work breakdown structure.
- Support of official and de facto standards for hardware and software and open source development of software.
- The proposed hardware and software support models and how these models will provide at least 5 years of practical system maintenance. The feasibility of the support models for open source components must be realistically and persuasively addressed. Specifically, the Laboratories will assess how well the maintenance model will work in practice.

- The proposed open source software development projects, which address key technological areas for HPC systems that directly address CORAL-2 requirements with an open source solution.

c. NRE

- The proposed NRE activities leading up to the CORAL-2 systems for impact, risk reduction, effectiveness, and DOE application performance.
- The quality and depth of integration between the NRE proposal and the proposal for the delivered system as demonstrated through the Go/No-Go linkage.
- The degree of innovation in the proposed NRE activities.
- The extent to which the proposed NRE achieves substantial gains over current industry roadmaps and trends.
- The extent to which the proposed NRE will impact HPC and the broader commercial marketplace.
- Degree of likelihood that the proposed NRE will achieve the proposed results.

(2) Feasibility of Successful Performance and Schedule Realism

The successful performance of the system is critical to achieving the programmatic mission of the Laboratories. The Laboratories will also evaluate the realism of the proposed schedule.

- The Laboratories will assess the likelihood that the Offeror's machine(s) will work as proposed.
- The Laboratories will assess the risks to both the Offeror and the Laboratories associated with the proposed solution, as well as the Offeror's assessment of those risks.
- The Laboratories will evaluate how well the proposed technical approach and solutions align with the Offeror's corporate product roadmap, product strategy, and the level of corporate commitment to the project.
- The Laboratories will assess the proposed delivery schedule relative to the delivery requirements for the machine(s).
- The Laboratories will consider the realism of the proposed schedule including its relationship to the Offeror's development, manufacturing, testing facilities, support offering, and the quality and roll out of technology proposed in the project and management plans.
- The Laboratories will evaluate the proposed NRE and its effects on reducing risks to the schedule for the system.
- The Laboratories will evaluate the realism and completeness of the proposed project plan.

(3) Supplier Attributes

The Laboratories will evaluate the following supplier attributes.

a. Capability

- The Offeror's experience and past performance in providing high-end computing systems and its demonstrated commitment to high-end computing customers.
- The Offeror's demonstrated commitment to providing high-end computing systems over the long term.
- The Offeror's demonstrated ability to meet complex and far-reaching schedule and delivery obligations.
- The Offeror's demonstrated ability to work as a member of a successful large-system integration project.
- The Offeror's history of working with third parties to ensure third-party software or other components operate correctly on the system.
- The expertise and skill level of Offeror's key personnel.
- The contribution of the key personnel to the management plan for successful and timely completion of the work.
- The Offeror's ability to diagnose and to determine the root cause of hardware and software problems in a timely manner.
- The Offeror's manufacturing and testing facilities ability and availability to support successful and timely completion of the work.
- If other companies (i.e., lower-tier subcontractors) are significant parties to some proposals, the Laboratories will evaluate the prime contractor on its ability to ensure the responsiveness of its partners to the performance requirements for the duration of the subcontracts, particularly the clear identification of responsibility among the partners for the proposed work.
- The Laboratories may solicit information concerning the Offeror's record of performance from other sources and use it in the evaluation based on records provided in Volume 2.

b. Open Source Position

Solutions based on open source are highly desirable to the Laboratories.

- The alignment of this proposal with the Offeror's open source software strategy.
- The Offeror's experience and past performance in working with communities to provide solutions based on open source software including working with communities to integrate enhancements and bug fixes back upstream.

- The Offeror's development and support resources available to the partnership.

c. Financial Condition

An Offeror's and subcontractor's financial condition is of critical importance to the Laboratories. The successful Offeror must have significant, verifiable financial resources to perform the work, including the ability to satisfy the obligations under subcontracts proposed to conduct the work.

- The Offeror's financial condition (refer to Section 7 of this document).

d. Consortium

If a proposal is submitted by a consortium led by an integrating subcontractor (as opposed to the primary original equipment manufacturer), the Laboratories will assess the likelihood that the integrating subcontractor can ensure the responsiveness of its partners in the consortium to the performance requirements for the duration of the subcontracts. This assessment will be based on the proposed detailed consortium management plan that explains the corporate relationships and responsibilities between or among the parties to the consortium and any other information provided by the Offeror or otherwise available to the Laboratories. The Laboratories believe that only aggressive, top-level management relationships that clearly identify who is responsible for what among the members of the consortium can reduce the performance risk posed by the integrating subcontractor-led consortium approach. In particular, the Laboratories will assess how responsibility for component hardware and software development, hardware and software bug fixes, system testing, and problem root cause identification and resolution (*FOR ALL PROPOSED HARDWARE AND SOFTWARE*, not only those developed directly by the consortium) is assigned and committed to in the proposed management plan.

Preparation of Offers

(a) Offerors must

- (1) submit a cover letter manually or digitally signed by an agent or individual authorized to by the Offeror, and
- (2) ensure the person signing a proposal initials each erasure or change made to any form.

(b) If this RFP is amended, all terms and conditions that are not amended remain unchanged.

9.3 DESCRIPTION OF REQUIREMENT CATEGORIES

Mandatory Requirements (MRs) in the CORAL-2 Build SOW are performance features that are essential to the Laboratories' requirements, and an Offeror must satisfactorily propose all MRs to have its proposal considered responsive.

Mandatory Option Requirements (MOs) in the SOW are features, components, performance characteristics, or upgrades whose availability as options to the Laboratories are mandatory, and an Offeror must satisfactorily propose all MOs to have its proposal considered responsive. The Laboratories may or may not elect to include such options in the resulting subcontract(s). Therefore, each MO must appear as a separately identifiable item in the CORAL-2 Build Technical Proposal (Volume 1) and CORAL-2 NRE and Build Price Proposal (Volume 5).

Technical Option Requirements (designated TO-1, TO-2, or TO-3) in the SOW are features, components, performance characteristics, or upgrades that are important to the Laboratories but that will not result in a nonresponsive determination if omitted from a proposal. Technical Options add value to a proposal and are prioritized by a dash number. TO-1 is most desirable to the Laboratories, while TO-2 is more desirable than TO-3. TO responses will be considered as part of the proposal evaluation process; however, the Laboratories may or may not elect to include TOs in the resulting subcontract(s). Each proposed TO should appear as a separately identifiable item in the CORAL-2 Build Technical Proposal (Volume 1) and CORAL-2 NRE and Build Price Proposal (Volume 5). TOs may also affect the Laboratories' perspective of the ideal CORAL-2 system(s), depending on future budget considerations.

Target Requirements (designated TR-1, TR-2, or TR-3), identified throughout the SOW, are features, components, performance characteristics, or other properties that are important to the Laboratories but that will not result in a nonresponsive determination if omitted from a proposal. Target Requirements add value to a proposal and are prioritized by dash number. TR-1 is most desirable to the Laboratories, while TR-2 is more desirable than TR-3. MRs, MOs, TOs, TRs, and additional features proposed by the selected Offeror(s), and of value to the Laboratories, will be included in a final negotiated SOW(s) and incorporated within the resulting subcontract(s).

It should be noted that verb forms such as "will," "will provide," or "will include," are used generally throughout the SOW to list describe desired outcomes and not mandatory requirements.

9.4 PRICE

The Laboratories will evaluate the following price-related factors.

- Reasonableness of the total proposed price and the prices of proposed components and options in a competitive environment.
- Reasonableness, transparency, and workability of the Offeror's price risk-sharing model for commodities or technologies.
- Proposed price compared to the value.
- Total cost of ownership including siting, power, cooling, floor space costs, capital and license costs, maintenance costs, and operating costs among others.
- Price trade-offs and options embodied in the Offeror's proposal.
- Financial considerations, such as, cost-share and financial incentives included in the proposal.

9.5 ADDITIONAL CONSIDERATIONS

The Laboratories may, at their sole discretion, award any proposed MO(s) or TO(s) at the time of initial award. The Laboratories may also decide to include any proposed MO(s) or TO(s) in the CORAL-2 Build subcontracts subject to mutually acceptable option exercise date(s).

The Laboratories may include fixed-priced options to reduce the system after award if annual appropriated funding from Congress makes the reduction necessary. This option, if exercised prior to CORAL-2 Build, would reduce the total fixed price of the CORAL-2 Build subcontract(s).

The Laboratories intend to award the CORAL-2 Build subcontracts with the maximum DRAM and NVRAM sizes (Byte:FLOP/s) that are affordable within the CORAL budgets and to include language in the resulting CORAL-2 Build subcontracts that shares the DRAM and NVRAM price risk between the Laboratories and the selected Offeror. The anticipated risk-sharing approach will budget a fixed amount of funding for CORAL-2 memory. The Laboratories and the selected Offeror will mutually agree to the actual amount of memory (and associated price) prior to building the CORAL-2 systems.

The Offeror may propose other commodities as potential risk-sharing. An example of another potential commodity is disk drives.

The Laboratories may consider risk-sharing approaches proposed by the Offeror for other technological aspects of the proposed system. Such Offeror-proposed risk-sharing approaches may include novel mechanisms to reduce or to mitigate project risks and do not need to be confined to ones that are directly derived from those described in these instructions.

Any technology refresh options or alternate configurations proposed by the Offeror may be awarded by the Laboratories at their sole discretion.

APPENDIX A. RESUME FORMAT

Name:

Proposed Title/Assignment on Contract:

Experience Summary: (A succinct summary of overall experience and capabilities including the name and phone number of the client that may be used for reference checking):

Current Assignment (Include description and from/to dates):

Current Client/Customer (Include current address and telephone number):

Education:

Technical Qualifications:

Description(s) of Experience Relevant to Proposed Contract Assignment:

Provide Three Business-Related References:

References listed in the resumes may be contacted to verify relevant experience as part of the evaluation process.

List Awards/Honors/Publications:

RESUMES MUST NOT EXCEED TWO PAGES IN LENGTH

END OF PROPOSAL EVALUATION AND PROPOSAL PREPARATION INSTRUCTION

