Sequoia RFP Attachment 3

PROPOSAL EVALUATION
and
PROPOSAL PREPARATION INSTRUCTIONS

Version 1.5

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ADVANCED SIMULATION AND COMPUTING (ASC)

Sequoia

RFP B563020

LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL)
LIVERMORE, CALIFORNIA

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1 PROPOSAL EVALUATION & AWARD INFORMATION

1.1 Evaluation Factors & Basis for Selection

The Sequoia evaluation will be performed by members of the staff from Lawrence Livermore National Security, LLC (LLNS) with input from Los Alamos National Security, LLC (LANS) and Sandia National Laboratory (SNL) with input from NNSA/ASC program office; collectively known as Tri-Laboratories or Tri-Labs. Evaluation factors are performance features, supplier attributes, and price that Tri-Labs will use to evaluate proposals. Tri-Labs have identified the performance features and supplier attributes listed below, which should be discussed in the proposal. Offerors may identify and discuss other performance features and supplier attributes they believe may be of value to Tri-Labs. If Tri-Labs agree, consideration may be given to them in the evaluation process. Tri-Labs' assessment of each proposal's evaluation factors will form the basis for selection. LLNS intends to select the responsive and responsible Offeror whose proposal contains the combination of price, performance features, and supplier attributes offering the best overall value to the ASC Program. Tri-Labs will determine the best overall value by comparing differences in performance features and supplier attributes offered with differences in price, striking the most advantageous balance between expected performance and the overall price. Offerors must, therefore, be persuasive in describing the value of their proposed performance features and supplier attributes in enhancing the likelihood of successful performance or otherwise best achieving ASC Program objectives for Sequoia.

LLNS intends to select one Offeror for a Sequoia Research and Development / Development and Engineering (referred to as R&D and/or D&E hereafter) subcontract and a Sequoia Build subcontract. LLNS also intends to select the "first runner up", as determined by LLNS, for a Sequoia R&D subcontract.

LLNS reserves its right to: 1) make selections on the basis of initial proposals; 2) negotiate with any or all Offerors for any reason, including, but not limited to, a Sequoia baseline system with a peak performance of greater than, less than, or equal to 20.0 petaFLOP/s (20.0×10^{15} floating point operations retired per second); 3) award subcontracts to one or more Offerors; and 4) award subcontracts based on all or part of an Offeror's proposal.

1.2 Description of Requirement Categories

Mandatory Requirements (designated MR) in the Statement of Work (SOW) are performance features that are essential to LLNS requirements, and an Offeror must satisfactorily propose all Mandatory Requirements in order to have its proposal considered responsive.

Mandatory Option Requirements (designated MO) in the SOW are features, components, performance characteristics, or upgrades whose availability as options to LLNS are mandatory, and an Offeror must satisfactorily propose all Mandatory Option Requirements in order to have its proposal considered responsive. LLNS may or may not elect to include such options in the resulting subcontract(s). Therefore, each MO shall appear as a separately identifiable item in the

Sequoia Build Technical Proposal (Volume 1) and Sequoia D&E 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 LLNS, but which will not result in a nonresponsive determination if omitted from a proposal. Technical Options add value to a proposal. Technical Options are prioritized by dash number. TO-1 is most desirable to LLNS, while TO-2 is more desirable than TO-3. Technical Option responses will be considered as part of the proposal evaluation process; however, LLNS may or may not elect to include Technical Options in the resulting subcontract(s). Each proposed TO should appear as a separately identifiable item in the Sequoia Build Technical Proposal (Volume 1) and Sequoia D&E and Build Price Proposal (Volume 5).

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 Tri-Labs, but which will not result in a nonresponsive determination if omitted from a proposal. Target Requirements add value to a proposal. Target Requirements are prioritized by dash number. TR-1 is most desirable, while TR-2 is more desirable than TR-3. TR-1s and Mandatory Requirements are of equal value. The aggregate of MRs and TR-1s form a baseline system. TR-2s are goals that boost a baseline system, taken together as an aggregate of MRs, TR-1s and TR-2s, into the moderately useful system. TR-3s are stretch goals that boost a moderately useful system, taken together as an aggregate of MRs, TR-1s, TR-2s and TR-3s, into the highly useful system. Therefore, the ideal ASC Dawn and Sequoia systems will meet or exceed all MRs, TR-1s, TR-2s and TR-3s requirements. MOs are alternative sizes of the system that may be considered for technical and/or budgetary reasons. Technical Option Requirements may also affect LLNS perspective of the ideal ASC Dawn and Sequoia systems, depending on future ASC Program budget considerations. Target Requirement responses will be considered as part of the proposal evaluation process.

MRs, MOs, TOs, TRs, and additional features proposed by the selected Offeror(s), and of value to LLNS, will be included in a final negotiated SOW(s) and incorporated within the resulting subcontract(s).

1.3 Performance Features

Technical Proposal Excellence

Tri-Labs will validate that an Offeror's technical proposal satisfies the Mandatory Requirements and Mandatory Option Requirements. Tri-Labs will assess how well an Offeror's technical proposal addresses the Technical Option Requirements and Target Requirements. 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 Tri-Labs. If Tri-Labs agree, consideration may be given to them in the evaluation process. In all cases, Tri-Labs will assess the value of each proposal as submitted.

For example, although Open Source Light-Weight Kernel solutions may initially have greater congruence with Sequoia technical requirements, Tri-Labs realizes that well-conceived proposals

cogently addressing gaps between existing Open Source based Linux clustering solutions and Sequoia compute node operating system requirements could greatly benefit the entire HPC community. Therefore, Tri-Labs place sufficient strategic value on Open Source Linux development efforts pertinently addressing key missing technologies. These offerings are equally valuable when compared to existing proprietary petascale solutions.

Tri-Labs will evaluate the following performance features as proposed.

- How well the proposed solution meets the overall programmatic objectives expressed in the SOW.
- Projected performance of the benchmarks on the proposed systems.
- Functionality, performance, and scalability of the proposed systems.
- The degree to which the technical proposal meets or exceeds the Mandatory Option Requirements and Target Requirements.
- The proposed hardware and software support model and determine how this model will provide at least five years of practical system maintenance. The feasibility of the support model for open source components must be realistically and persuasively addressed for the proposed open source components. Specifically, Tri-Labs 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 petascale systems that directly address Sequoia requirements with an Open Source solution.
- How well the proposed system infrastructure implements required functionality, performance and scalability for LLNS provided software solutions for resource management, scalable petascale code development tools and Lustre enterprise-wide file system.
- The proposed Research and Development activities leading to the Dawn and Sequoia petascale systems for impact, risk reduction and effectiveness.
- Overall system sustained performance characteristics, such as processor/core performance; cache, memory bandwidth; and compute node interconnect latency and bandwidth, both component and aggregate.
- Delivered message-passing performance and scalability, including the delivered bandwidth and latency to petascale applications expressed as MPI only and mixed MPI with Unified Nested Concurrency extension of the Livermore Model (Pthreads, OpenMP and possibly innovative models such as SE/TM styles of single node parallelism within a single MPI task). Of particular interest is scalability of MPI implementation in terms of delivered performance of collective operations and required memory buffering per MPI task.
- Quality and quantity of the Sequoia Benchmark results. Each benchmark result will be assessed. The benchmark projections to the Sequoia, and Sequoia14, platforms will be the primary focus, with the Dawn platform results and projections of secondary importance. The Tier 1 or “Marquee Benchmarks” result Offeror responses should be considered TR-1 requirements and highest priority. The Tier 2 benchmarks should be considered TR-1 requirements of secondary importance. The Tier 3 benchmarks should be considered TR-3 and lowest priority. Within a benchmark tier all benchmarks are of equal importance.

- Features, reliability, performance and scalability of the proposed IO forwarding mechanism through the LLNS provided Lustre client to the proposed Storage Area Networking (SAN) interfaces and device drivers.
- Minimization of physical plant requirements, such as facilities modifications for instillation, system footprint, power, and cooling.
- Credible roadmaps for hardware and software.
- Realism and completeness of project work breakdown structure.
- Support of official and de facto standards for hardware and software and open source development of software.
- Reliability, availability, and serviceability of the system, such as MTABF, MTTR, hardware and software failsafe features, effectiveness of diagnostics and data protection mechanisms.

1.4 Feasibility of the Schedule of Deliverables

Schedule is of critical importance to Tri-Labs. Tri-Labs will assess the proposed delivery schedule relative to the delivery requirements for Dawn and Sequoia. Tri-Labs will consider the realism of the proposed delivery schedule given the Offeror's development, manufacturing, testing facilities, support offering and the quality and roll out of technology proposed in the project and management plans. Tri-Labs will evaluate the realism and completeness of the proposed project Gantt chart.

1.5 Feasibility of Successful Performance

Tri-Labs will assess the likelihood that the Offeror's systems will work as proposed. Tri-Labs will assess the likelihood that the delivery schedule leads from Dawn to Sequoia with an achievable development and deployment of technology. Tri-Labs will assess the risks, to both the Offeror and LLNS, associated with the proposed solution. Tri-Labs will evaluate how well the proposed technical approach and solutions align with the Offeror's corporate product roadmap and the level of corporate commitment to the project.

1.6 Supplier Attributes

Tri-Labs will evaluate the following supplier attributes.

Capability

- The Offeror's experience and past performance in providing high-end computing systems and its demonstrated commitment to high-end computing customers. See Section 4.1 for additional information.
- The Offeror's demonstrated ability to meet schedule and delivery promises.
- The alignment of this proposal with the Offeror's product strategy.
- The Offeror's demonstrated ability to successfully work as a member of a 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 key Offeror personnel.

- The contribution of the management plan and key personnel to successful and timely completion of the work.
- The Offeror's ability to diagnose and determine root cause of hardware and software problems in a timely manner.
- The Offeror's manufacturing and testing facilities.

Open Source Position

Solutions based on Open Source are of critical importance to the Tri-Labs.

- The credibility of the Offeror's Open Source based petascale systems strategy.
- The alignment of this proposal with the Offeror's Linux and 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.

Financial Condition

An Offeror's financial condition is of critical importance to Tri-Labs. The successful Offeror should have sufficient financial resources to perform the subcontracts.

- The Offeror's financial condition (refer to Section 10 of this document).

Consortium

If a proposal is submitted by a consortium led by an integrating subcontractor (as opposed to the primary original equipment manufacturer), Tri-Labs 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 Tri-Labs. LLNS believes 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, Tri-Labs will assess how component hardware and software development, hardware and software bug fix, system testing and problem root cause identification and resolution (*FOR ALL PROPOSED HARDWARE AND SOFTWARE*, not only those developed directly by the consortium) responsibility is assigned and committed to in the proposed management plan.

1.7 Price

Tri-Labs 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 Offeror's memory price risk sharing model.
- Proposed price compared to the perceived value.

- Life cycle costs including power, cooling and floor space as compared to those of the competition.
- Price trade offs and options embodied in the Offeror's proposal.
- Financial considerations, such as price versus value and financial incentives.

1.8 Alternate Proposals

Tri-Labs may evaluate alternate proposals for award consistent with the preceding information, or as otherwise deemed necessary by Tri-Labs.

1.9 Options

LLNS may, at its sole discretion, award any proposed Mandatory Option(s) or Technical Option(s) at the time of initial award. LLNS may also decide to include any proposed Mandatory Option(s) or Technical Option(s) in the Sequoia Build subcontract subject to mutually acceptable option exercise date(s).

LLNS intends to award the Sequoia Build subcontract for a baseline Sequoia system with a peak 20.0 petaFLOP/s, and to include a fixed price option to later reduce the system size to 14.0 petaFLOP/s if annual appropriated funding from Congress makes the reduction necessary. This option, if exercised prior to Sequoia build, would reduce the total fixed price of the Sequoia Build subcontract.

LLNS intends to award the Sequoia Build subcontract for a baseline Sequoia system with the maximum memory size (Byte:FLOP/s) that is affordable within the Sequoia budget and to include language in the resulting Sequoia Build subcontract that shares the memory price risk between LLNS and the selected Offeror. The anticipated risk sharing approach will budget a fixed amount of funding for Sequoia memory. LLNS and the selected Offeror will mutually agree to the actual amount of memory (and associated price) prior to building the Sequoia system.

Any technology refresh options or alternate configurations proposed by the Offeror may be awarded by LLNS at its sole discretion. In addition, any other proposed mandatory or technical options may be awarded by LLNS at its sole discretion.

2 GENERAL PROPOSAL INFORMATION

2.1 Proposal Format

Offerors must submit ONE electronic copy of their entire proposal to the LLNS Contract Administrator as indicated in the RFP letter. Hardcopy (i.e., printed) proposals are not required. Submission of your proposal by electronic media (i.e., FAT formatted ISO standard CD-ROM) shall be considered by LLNS to be Certification that the media is virus free. All proposals should be presented using 8 1/2 by 11-inch paper format. "Page limit" is defined as consecutively numbered pages. Page limits for each proposal volume are stated in Table 1 below. Electronic copies of the complete proposal should be in Microsoft Office 2003 or 2007 (Word, Excel,

PowerPoint, Project and Visio), PDF format, or Rich Text Format. Electronic media shall be virus free.

An Offeror's proposal submission should be structured in accordance with Table 1 below. Proposal volumes should NOT be consolidated. In other words, each volume should be a separate file. Electronic file titles should identify the corresponding volume number and description.

Table 1
Sequoia Proposal(s) Format

VOLUME—SECTION NUMBER
Volume 1 Sequoia Build Technical Proposal ***(350 page limit total)*** Section 1. System(s) Overview Section 2. Sequoia High-Level Hardware Requirements Section 3. Sequoia High-Level Software Requirements Section 4. Dawn High-Level Hardware Requirements Section 5. Dawn High-Level Software Requirements Section 6. Integrated System Requirements Section 7. Facilities Requirements Section 8. Project Management Section 9. Performance of the System Section 10. Mandatory Options and Technical Options Section 11. Glossary Section 12. Subcontracting
Volume 2 Business Proposal ***(40 page limit total)*** Section 1. Supplier Attributes Section 2. Open Source Linux Product Roadmap Section 3. Proposed Open Source Development Partnerships
Volume 3 Sequoia Alternate Technical Proposal ***(250 page limit total)*** Section 1. Overview of Alternative or Option Section 2.0 System or Option Description Section 2.1 Alternative System Hardware Section 2.2 Alternative System Software Section 2.3 Alternative Integrated System Requirements Section 2.4 Alternative System Facilities Requirements Section 2.5 Alternative or Option Milestones Section 3. Subcontracting

VOLUME—SECTION NUMBER
Volume 4 Sequoia D&E Technical Proposal ***(250 page limit total)*** Section 1. Overview Section 2. Specific R&D/D&E Activities and Objectives Section 3. Impacts of R&D/D&E on Dawn and Sequoia Systems Section 4. Project Management Section 5. Subcontracting
Volume 5 Sequoia Build and D&E Price Proposal (***no page limit***) Section 1. D&E Fixed Price Section 2. Build – Dawn and Sequoia System Fixed Prices Section 3. Build – Mandatory Option and Technical Option Fixed Prices Section 4. Lower-Tier Subcontractor Prices Section 5. Milestone Payment Schedule Section 6. Financial Incentives
Volume 6 Sequoia Alternate Price Proposal (***no page limit***) Section 1. Alternate Proposal Fixed Price(s) Section 2. Alternate Additional Option(s) Fixed Price(s)
Volume 7 Other Documents ***(no page limit)*** Section 1. Royalty Information Section 2. Small Business Subcontracting Plans Section 3. Software Branding and Licenses, if applicable Section 4. System Warranty Information Section 5. Representations and Certifications Section 6. EEO Pre-Award Compliance Certification Form Section 7. Workplace Substance Abuse Program Plan
Volume 8 Offeror Financial Information (*no page limit*)
Volume 9 Performance of the System (*no page limit*) Section 1. Benchmarks, makefiles, scripts and output results. Section 2. Sequoia_Benchmark_Results spreadsheet Section 3. Scaling benchmark results to Dawn and Sequoia Report

3 SEQUOIA BUILD TECHNICAL PROPOSAL (VOLUME 1)

For the purposes of preparing the Sequoia Build Technical Proposal, Offerors should assume that they will be selected for one Sequoia D&E subcontract award (see Section 6, below). This assumption allows Offerors to put forward the most advantageous proposal. The Offeror's Sequoia D&E Technical Proposal should indicate the areas where the Offeror's Sequoia Build Technical Proposal depends on the Sequoia D&E activities.

In the Sequoia Build Technical Proposal, the Offeror should describe the proposed Dawn and Sequoia systems. 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 SOW with the same numbering scheme as the SOW**. SOW text should be included, but may be formatted with a smaller font. Offeror's proposal should include text font no smaller than 10 point, and preferably 12 point. This narrative should include a description of each of the proposed systems and any proposed technology refresh steps. The Sequoia Build Technical Proposal should be divided into the following tabbed sections.

3.1 Section 1: System(s) Overview

Offeror's Sequoia Build Technical Proposal response (Volume 1, Section 1) 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, a fully completed system architecture summary matrix, a systems software overview, a fully completed systems requirements summary matrix, a systems detailed hardware overview, a systems detailed software overview, and a timeline of deliverables**.** Details on what information should be included for each of these items are listed in the following subsections. In addition, a list definitions and acronyms used throughout the Offeror's Sequoia Build Technical Proposal should be placed in Volume 1, Section 8.

3.1.1 System Architecture Summary Matrix

The matrix in Table 2 below should be completed in its entirety**.** All entries should be cross-referenced to the section and/or page number in the proposal that contains this information**.** The system architecture summary matrix should be completed for the proposed Dawn system, any proposed technology refresh steps, and the proposed final Sequoia system. The F in the B:F ratios below is FLOP/s (FLoating point OPerations per second).

Table 2
System Architecture Summary Matrix

Attribute	**Dawn System**		**Technology Refreshes (if applicable)**		**Sequoia System**	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
COMPUTE NODE						
Number of Compute Nodes						
Processor Type						
Frequency						
Number of Cores per Node						
Threads per Core						
Total Number of Cores						
FLIN per Core per Clock						
FLOP per Core per Clock						

Attribute	**Dawn System**		**Technology Refreshes (if applicable)**		**Sequoia System**	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
Thread count to achieve FLIN or FLOP rates						
Node Memory Size						
Memory Size B:F						
Memory Type (technology, memory part capacity and speed)						
Node Memory Count (memory capacity per memory FRU and number of memory FRUs)						
Latencies L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Bandwidths L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Sizes L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
CN Interconnect Link Speed and number of links						
CN Interconnect Bandwidth B:F						
CN Interconnect Millions of Messages/s						
Node MTBF						
IO NODE						
Number of IO Nodes						
Processor Type						
Frequency						

Attribute	**Dawn System**		**Technology Refreshes (if applicable)**		**Sequoia System**	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
Number of Cores per Node						
Threads per Core						
Total Number of Cores						
Max number of instructions issued per clock per thread/ per core						
SPECintRATE2003 per ION						
Node Memory Size						
Memory Size B:F						
Memory Type (technology, memory part capacity and speed)						
Node Memory Count (memory capacity per memory FRU and number of memory FRUs)						
Latencies L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Bandwidths L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Sizes L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
ION Interconnect Link Speed and number of links						
ION Interconnect Bandwidth B:F						

Attribute	Dawn System		Technology Refreshes (if applicable)		Sequoia System	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
ION Interconnect Millions of Messages/s						
Node MTBF						
Number and type of PCIe2						
Number, type and speed of external networking HCA						
Number, type and speed of SAN HCA						
LOGIN NODE						
Number of Login Nodes						
Processor Type						
Frequency						
Number of Cores per Node						
Threads per Core						
Total Number of Cores						
Max number of instructions issued per clock per thread/ per core						
SPECintRATE2003 per LN						
Node Memory Size						
Memory Size B:F						
Memory Type (technology, memory part capacity and speed)						
Node Memory Count (memory capacity per memory FRU and number of memory FRUs)						
Latencies L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Bandwidths L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						

Attribute	Dawn System		Technology Refreshes (if applicable)		Sequoia System	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
Sizes L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
LN Interconnect Link Speed and number of links						
LN Interconnect Bandwidth B:F						
LN Interconnect Millions of Messages/s						
Node MTBF						
Number and type of PCIe2						
Number, type and speed of external networking HCA						
Number, type and speed of SAN HCA						
Login Node Local Disk (type, size and number)						
SERVICE NODE						
Number of Service Nodes						
Processor Type						
Frequency						
Number of Cores per Node						
Number of Threads per Core						
Total Number of Cores						
Max number of instructions issued per clock per thread/ per core						
SPECintRATE2003 per SN						
Node Memory Size						
Memory Size B:F						
Memory Type (technology, memory part capacity and speed)						
Node Memory Count (memory capacity per memory FRU and number of memory FRUs)						

Attribute	Dawn System		Technology Refreshes (if applicable)		Sequoia System	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
Latencies L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Bandwidths L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
Sizes L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
SN Interconnect Link Speed and number of links						
SN Interconnect Bandwidth B:F						
SN Interconnect Millions of Messages/s						
Node MTBF						
Number and type of PCIe2						
Number, type and speed of external networking HCA						
Number, type and speed of SAN HCA						
Number, type and speed of Management Ethernet links						
Service Node Local Disk (type, size and number)						
CN INTERCONNECT						
CN Interconnect Topology						
Peak CN Interconnect Node Bandwidth B:F						

Attribute	Dawn System		Technology Refreshes (if applicable)		Sequoia System	
	Description	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*	*Description*	*Proposal Cross-Reference*
Peak CN Interconnect Minimum Bisection Bandwidth B:F						
MPI Latency (max, min)						
Delivered CN Interconnect Link Bandwidth (GB/s)						
Delivered CN Interconnect Minimum Bisection Bandwidth (TB/s)						
Barrier Latency (min, max)						
SYSTEM CHARACTERISTICS						
System Hardware MTBF						
System Software MTBF						
Total System Power (MW)						
Rack Size(s)						
Number of Racks						
Size of System (sq.ft.)						
Rack Power (KW)						
Rack Power Feeds (count, AMPs and type)						
Demonstration Date						
Delivery Date						
System LA Date						

3.1.2 Systems Detailed Hardware Overview

This section should present a detailed hardware technical description of the components of the proposed Dawn system, Sequoia system, and technology refreshes described above in the executive summary**.** The features and functionality of all major components of the systems and technology refreshes should be discussed in detail as well as the areas of risk and risk mitigation**.** These technical descriptions should be targeted to the specific proposed configurations, not general product roadmap marketing hype**.** The discussion should include, in the order stated, but not be limited to, the following.

- **Processor.** Three distinct descriptions should be provided. **First**, the Instruction Set Architecture or ISA should be described. Special attention should be paid to instructions moving, converting or operating on 64b floating-point data and any 64b floating point instructions that are Single Instruction Multiple Data (SIMD). **Second**, the macroarchitecture of the processor should be described in detail. This should indicate the number and types of cores in the processor. This should include any embedded DRAM or the cache hierarchy of software managed memory or hardware managed cache coherent caches shared between multiple cores in the processor die or in a multi-chip package shared with the processor die. Any special inter-core synchronization and or communication hardware mechanisms should be described. If the processor includes a memory controller, DMA engine, or any inter-socket data transfer mechanisms, then these units should be fully described. Any other "un-core" elements (processor

macroarchitectural components that are not part of the core) should be fully described. An architectural block diagram of the processor with sizes of components (e.g., size of cache, number of bits operated on or transferred per basic operation) and speeds and feeds between components should also be included. **Third**, the microarchitecture of the processor core should be described in detail. This description should include all of the core components, instruction size in bytes, numbers and types of registers, and in-order or out-of-order superscalar instruction dispatch characteristics as well as other processor features such as number and types of functional units, branch prediction algorithms, pipelining characteristics. Execution latencies and pipelining for frequently used 64b floating-point or integer instructions should be listed in a table. If the core supports hardware threads, then the hardware thread features should be fully described including any restrictions on accessing functional units and/or requirements for multiple threads in a process to be executing in order to obtain maximum application performance out of the core. Any special hardware thread features that may impact runtime libraries (e.g., low overhead thread creation, synchronization or scheduling) should be described. The thread/core execution pipeline and stall characteristics and how many outstanding loads and stores are tolerated before the onset of stall should be discussed. An architectural block diagram of the core with sizes of components (e.g., number of registers or size of on core cache, number of bits operated on or transferred per basic operation) and speeds and feeds between components should also be included.

- **Memory Hierarchy.** This description should be an "inside out" description, beginning with a description of the innermost level of cache, to the next cache level out, to main memory. For each level of the hierarchy, the cache line or word size should be noted, along with bandwidths and latencies in paths to and from the levels above and below. The associativity of the cache levels as well as the method of cache coherency and/or end-user programmability should be described. The characteristics of both instruction and data caches should be described if the caches are not shared. Describe the shared memory access patterns for the compute nodes (i.e., whether the memory is Uniform Access, Non-Uniform Access, Cache Only Access, etc.). Memory banking and error detection and correction mechanisms should be described. If the memory controller supports features that mask defects in memory parts (i.e., chip-kill), then these should be described as well as any information about hardware correctable or un-correctable error counts and interrupts that are exposed to software.
- **Compute Node/IO Node.** Describe the number of processors, amount of physical memory, and the internal processor interconnect, including bandwidths and latencies**.** Describe the external I/O interfaces for SAN and external network connections, as well as system interconnects to other nodes or to the switching fabric, including bandwidths and latencies**.** A block diagram of the nodes should be provided with peak and delivered speeds/feeds**.** Describe the topological aspects of the communication between the processors and associated memory**.** Describe any hardware support for partitioning or virtualization and how that affects the configuration and I/O subsystem for OS booting**.** Explain how the OS multi-boot capability is accomplished for each partition or virtual OS instance from a hardware point of view**.** Explain how partitioning or virtualization affects the memory hierarchy, the system interconnect interfaces or other IO interfaces and any other node hardware impacts.

- **Compute Node Homogeneity.** Confirm whether or not the compute nodes for the proposed systems are homogeneous in terms of processors and architecture. If they are not homogeneous, describe in what way they are not and the rationale for the decision.
- **System Interconnect.** Describe all system interconnect components, including switches and switch hierarchies, if present, as well as bandwidths and latencies, both per link and bi-section or aggregate. The number of system interconnect links per CN should be described as well as the number of hops a message must take to reach its destination. Describe the topology or topologies (if multiple system interconnects) of the system interconnection when viewed as a whole, as well as the protocol used at the link and network layers. Estimate hardware transmission error rates and describe how errors are detected and repaired automatically by the hardware, if available. Include any viewing aids, such as block diagrams, etc., you believe would be helpful.
- **LN & SN Disk Subsystem.** Provide a block diagram for the proposed shared LN & SN RAID disk subsystem. Label this diagram with the bandwidths and latencies of each component. Describe the number and types of HCA and physical connections from the ION, LN to the RAID disk subsystem. Provide the estimates for sustained bandwidth and IOPS for the RAID disk subsystem for small (4KiB), medium (1MiB) and large 10 (MiB) block transfer sizes from the LN and SN and describe how it was estimated.
- **Reliability, Availability, and Serviceability Subsystem (RAS).** Provide a description of the Offeror's hardware scalable petascale RAS strategy from a single CN, ION, LN and SN all the way through the entire system for each Dawn, Tech Refresh (if proposed), and Sequoia systems. This should include how this is implemented in the proposed hardware. The maintenance console, if separate, should be described, as should any hardware enhancements such as redundancy, disk mirroring, or separate hardware diagnostic networks. Provide the Mean Time Between Application Failures (MTBAF) calculation for the entire Final System. The predicted MTBAF is the mean time between application termination due to hardware failure. Any hardware failures that do not cause an application to terminate (e.g., single disk failure in a RAID group, single power supply in an N+1 power supply configuration), but may require the application to run at a reduced performance level or degraded mode do not count as an application termination due to hardware failure event. Like all scientific simulations, ASC applications are not written to be hardware fault tolerant and will terminate on a processor, memory component, node, or CN interconnect failure. This calculation should be performed using a recognized standard. Examples of such standards are Military Standard (Mil Std) 756, Reliability Modeling and Prediction, which can be found in Military Handbook 217F, and the Sum of Parts Method outlined in Bellcore Technical Reference manual 332. Include the actual calculations performed to derive the system MTBAF number. Describe hardware failure modes that do not cause applications to terminate. Describe the hardware preventative maintenance approach. Describe system level diagnostics.

3.1.3 Systems Software Overview

Provide an overview of the software to be delivered with the proposed Dawn system, technology refreshes (as appropriate) and Sequoia system. This description should be high level and include every major component of software. Provide the following information for each software product proposed.

- Product Open Source Status**.** Is the software proprietary, third party, or open source? What type of license is required for this software? What organization, group or company is responsible for development and support for this software?
- The degree to which the software conforms to standards, if applicable
- Whether it is an evolution of an existing product or a new product
- Availability schedule, including the availability of Beta or early-access versions
- Salient features and functions to be included in each version
- Relationship between the availability of this product and that of the other proposed software products**.** Does the availability of this product depend upon the availability of features and functions in other software to be delivered?
- Product features that you believe are particularly noteworthy and distinguish your product from others

3.1.4 Systems Detailed Software Overview

This section should present a detailed software technical description of the components of the proposed Dawn, technology refreshes (as appropriate) and Sequoia systems, described above in the executive summary**.** For each software component provided, the discussion should include how the software will scale across the entire system and the anticipated start-up time**.** The features and functionality of all major components of the system should be discussed in detail as well as the areas of risk and risk mitigation**.** Discuss the intellectual property status of the software components: vendor proprietary, third party, Open Source**.** These technical descriptions should be targeted to the specific proposed configurations, not general product roadmap marketing hype**.** It should also include, in the order stated, but not be limited to, the following.

- **Light-Weight Kernel.** Describe the general approach to high reliability and low noise scalable Light-Weight Kernel (LWK) for the CN. For instance, is this kernel built from scratch or a de-featured derivative of a heavy-weight kernel? Describe what key features are implemented in the LWK and also what features were left out (presumably on purpose) and why. Describe how this approach has been validated to the petascale. Describe how dynamically linked libraries (DLLs) and Python based applications are supported. Describe what parallel job models are supported via the LWK and compiler runtimes. Describe how access to special hardware features such as Vectorization and/or SIMD execution and/or Speculative Execution/Transactional memory is supported in the LWK. Describe how direct user access (without LWK intervention) to system interconnect is securely architected including support for multiple MPI tasks with multiple LWK OS threads. Describe how direct user access to hardware performance monitors is accomplished including support for multi-threaded applications. Describe the IO function shipping mechanisms and how the LWK and ION Linux OS (LUOS) collude to allow user applications to perform high-performance parallel IO to the SAN connected LLNS provided Lustre file system. Describe RAS features in the LWK. Describe how the CN are booted and rebooted without hardware power cycling and what impact CN reboot has on associated ION and vise-versa.
- **LN, ION and SN Linux Operating System.** Describe the overall strategy for Linux OS (LUOS) on the LN, ION and SN. Describe how the LUOS on the ION is extended to support the wide array of system wide features such as RAS; scalable job launch; parallel

petascale code development tools; function shipping IO for LWK from associated CN. Describe LUOS features for high-bandwidth communications to/from CN and supporting high-performance Lustre file system access. Describe how LWK and LUOS on ION are booted and rebooted without hardware power cycling. Describe core services (daemons) that are required to run on the ION in order to provide core system services. Provide MTBF statistics for the OS and core services.

- **LN/SN LUOS**. Describe the LUOS strategy for the LN and SN, if different. If different LUOS are proposed for these nodes, then describe the high-level differences in these OSes from the ION LUOS and the impacts of this for system administration and how they are integrated as a single functional entity ("single system image"). Describe any services, daemons, layered products required by these systems.
- **System Administration.** Describe key system administration features that allow the systems to be managed productively by a limited system administration staff. Describe such features as configuration management, change notification, and a description of the scalable tools for administering the entire system as a single system**.** Identify the amount of time required for shutting down and rebooting a node or set of nodes as well as the entire system**.** Describe the effect of rebooting a single node or set of nodes on the rest of the system**.** Describe any administration capability that allows administration operations to occur on multiple nodes simultaneously, in parallel**.** In particular, indicate any system status database functionality and how it performs under load (e.g., system shutdown/reboot and network storm events).
- **Petascale System Services**. RAS; reliable scalable petascale job launch (different LWK per job and different binary per node); debugging tools infrastructure; security and authentication; secure, scalable communications mechanisms between distributed infrastructure components.
- **Resource Management.** Provide an architectural diagram of the resource management system including all key components and communication mechanisms and protocols**.** Include descriptions of mechanisms for process and job discovery and control**.** Describe mechanisms that control interactive usage**.** Provide a systems administrators and users guide to the resource management system**.** Any enhancements to scheduling, such as fair-share, should be described, as well as standard queue mechanisms**.** Describe Offeror's strategy for achieving the required capability application reliability. This description should include a proposed strategy for LLNS to integrate MOAB/SLURM over the proposed resource management architecture, distributed hieratical services and APIs. The security model for the resource management subsystem should be described.
- **Reliability, Availability, and Serviceability Software.** Provide a description of the Offeror's software RAS strategy from single nodes to the entire system for Dawn, Technology Refresh (if applicable) and Sequoia and how this is implemented with the proposed software**.** Describe features such as system-wide checkpoint/restart, ability to reset and power up/down hardware through software, and online diagnostic capability. The security model for the RAS subsystem should be described.
- **Application Development Environment.** Describe the features and functionality of compilers, debuggers, linking features such as dynamic shared libraries, performance analysis and tuning tools**.** Indicate how well the compiler can optimize and parallelize code both with and without debugging support**.** Describe any compiler optimizations or directives for specialized hardware such as vectorization and/or SIMD and/or speculative

execution/transactional memory. Provide a full list of all known compiler features and limitations (not bugs) such as support for C++ standard extensions**.** Describe how the hardware performance monitors are available to users via an API and what provided code development tools utilize these features**.** Describe how the LN can be used for code development for applications targeted to CN. In particular, describe how features such as AUTOCONF can be configured and utilized to cross-compile user applications and support libraries on the LN for application execution the CN environment.

- **Message Passing System.** Include a description of OS bypass capability, if applicable, and message striping, if available**.** Describe the capability to select or reject a particular cluster interconnect interface card**.** Explain how the MPI library handles multiple network planes per node, if proposed**.** Explain how the MPI library will scale to the size of the system including pinned and non-pinned buffer allocations required and time estimates for MPI global operations (e.g., MPI_Allreduce, MPI_Barrier)**.** Describe any MPI library implementation choices that cause buffering within each MPI task to grow with the number of MPI tasks in the job (e.g., eager protocol buffers) and how these non-scalable buffering mechanisms can be controlled by the user. Explain how the MPI library takes advantage of the node or node shared memory and how this actually improves performance**.** Provide a full list of all known MPI limitations (not bugs) such as task limits, number of tasks per node, etc.

3.1.5 Timeline of Deliverables

Provide a single timeline that includes all the hardware and software being delivered**.** The timeline may identify the functions and features anticipated to be included in each delivery**.** Early access hardware and software, such as Alpha and Beta releases, are also of interest and, if offered, may be included in the timeline as well.

Due to the size of the Dawn and Sequoia systems, Offeror may propose the delivery and installation in stages**.** This is the build-deliver-demo scenario**.** However, if the Offeror can first stage the systems at the Offeror's facilities for debugging and stabilization and demonstration before delivery, that is preferred by LLNS**.** This scenario is the build-demo-deliver scenario**.** If a build-deliver-demo scenario is proposed, please provide a description of the items to be delivered at each stage and the beginning and end dates for each delivery and an estimate of the maximum number of nodes or racks that can be built and tested as a single integrated system at the Offeror's manufacturing and testing facility**.** The system components delivered in each of the stages should contain a proportionate amount of memory, interconnect, and SAN and External Networking so that the resulting partial systems are usable after each delivery stage and can be handed over to the ASC code developers as soon as it is stabilized.

3.2 Section 2. Sequoia High-Level Hardware Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 2) should contain a detailed point-by-point response to Section 2 of the SOW with the same numbering scheme as the SOW. This response should include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), 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 Offeror identified additional performance features included in the technical solution. **LLNS will assess the technical appropriateness or viability of the proposed technical response to each requirement. Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Compiles" 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.

3.3 Section 3. Sequoia High-Level Software Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 3) should contain a detailed point-by-point response to Section 3 of the SOW with the same numbering scheme as the SOW. This response should include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), 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 Offeror identified additional performance features included in the technical solution. **LLNS will assess the technical appropriateness or viability of the proposed technical response to each requirement. Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Compiles" 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.

3.4 Section 4. Dawn High-Level Hardware Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 4) should contain a detailed point-by-point response to Section 2 and as superseded by Section 4 (applied to the Dawn system) of the SOW with the same numbering scheme as the SOW**.** It should include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), proposed technical options (TO-1, TO-2 and TO-3) and proposed target requirements (TR-1, TR-2 and TR-3) will be met, as well as a discussion of Offeror identified additional performance features included in the technical solution. **LLNS will assess the technical appropriateness or viability of the proposed technical response to each requirement. Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Compiles" 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.

3.5 Section 5. Dawn High-Level Software Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 5) should contain a detailed point-by-point response to Section 3 and as superseded by Section 5 (applied to the Dawn system) of the SOW with the same numbering scheme as the SOW**.** It should include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), proposed technical options (TO-1, TO-2 and TO-3)and proposed target requirements (TR-1, TR-2 and TR-3) will be met, as well as a discussion of Offeror identified additional performance features included in the technical solution. **LLNS will assess the technical appropriateness or viability of the proposed technical response to each requirement. Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Compiles" 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.

3.6 Section 6. Integrated System Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 6) should contain a detailed point-by-point response to Section 6 of the SOW with the same numbering scheme as the SOW**.** It should include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), proposed technical options (TO-1, TO-2 and TO-3) and proposed target requirements (TR-1, TR-2 and TR-3) will be met. In addition, any Offeror identified additional performance features included in the technical solution should be described. **LLNS will assess the technical appropriateness or viability of the proposed technical response to each requirement. Offeror should not respond simply with "Offeror understands and accepts this requirement" or "Offeror Compiles" 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.

The "Reliability, Availability, Serviceability and Maintenance" subsection should contain a detailed description all facts relating to the reliability, availability and serviceability of the Dawn and Sequoia systems and technology refreshes, as appropriate**.** In particular, Offeror should provide the Mean Time Between **Application** Failures (MTBAF) calculation for each. MTBAF is based on raw hardware MTBF except only those hardware failures (transient or permanent) that actually cause an application to count against this statistic. This calculation should be performed using a recognized standard**.** Examples of such standards are Military Standard (Mil Std) 756, Reliability Modeling and Prediction, which can be found in Military Handbook 217F, and the Sum of Parts Method outlined in Bellcore Technical Reference Manual 332**.** In the absence of relevant technical information in the proposal, Tri-Labs are forced to make pessimistic reliability, availability and serviceability assumptions in evaluating the proposal.

This section should describe in detail the proposed hardware and software maintenance strategy throughout the life of the Sequoia Build subcontract**.** Include the level of service Offeor intends to provide at various points during the Sequoia Build subcontract period (i.e., system build, system installation, acceptance testing, capability period and general availability period)**.** Specific roles and responsibilities for LLNS, 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 your company's job description of that job category**.** LLNS will provide office space for on-site support personnel, storage space for spare parts, and Q-clearance allocations**.** Specific elements of the spare parts cache and on-site hot spares should be itemized**.** Failed hardware return mechanism and parts cache refresh policy should be discussed.

Software maintenance procedures should be delineated**.** For instance, describe how (who does what) the following problems previously observed on ASC scale systems would be reported,

analyzed to root cause, fixed, tested and hardware replacements or software patches provided to LLNL and how are they will be tested at LLNL.

- The OS block device buffer cache mechanism fails to release memory and the OS tends to accumulate memory over time which causes nodes to have differing amount of memory available to user applications**.** The symptom seen by LLNS is that ASC application launch fails periodically and some jobs hang when they start paging.
- There is a race condition on the interconnect adapter firmware that allows message data payloads to be randomly overwritten on an infrequent basis**.** The symptom seen by LLNS is that ASC applications experience random bad answers and this is tracked down by them to MPI messages that seem to become randomly corrupted.
- There is a bug in node firmware that misdiagnoses power levels when floating point and memory bandwidth intensive applications run**.** The symptom seen by LLNS is that running a particular application causes random nodes to power off.
- There is a bug in the resource management software, caused by a race condition, that hangs the resource management system when multiple nodes are added or removed from the CN interconnect**.** The symptom seen by LLNS is that rebooting the system always fails when the resource management system hangs and can not be killed or restarted**.** The only recourse is to reboot the system, which of course repeats the symptom**.** The system is not usable.
- There is a bug in the resource management software that does not cleanly clean up jobs upon termination of the job via system administrator action. The symptom seen by LLNS is that some of the MPI tasks in the job remain active and all of the CN the job was using remain unavailable for scheduling other jobs. The only recourse is to manually reboot all of the CN and ION associated with the job. Major portions of the system are unavailable until this condition is diagnosed and the set of nodes rebooted.

3.7 Section 7. Facilities Requirements

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 7) should contain a detailed point-by-point response to Section 7 of the SOW with the same numbering scheme as the SOW**.** Include detailed information about projected **actual** 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.

Floor Plans**.** Provide a separate floor plan for each of the systems proposed, including any subsystems (e.g., I/O cabinets, disks, cabling, external networking, etc.)**.** The floor plan will include a diagram of asset placement, as well as floor-loading information, and under-floor clearance requirements and placement and type of required electrical outlets. Please provide weight estimates for each type of and the number of those racks in the system.

Provide the estimated total amount of power in kW (kilowatts) required for each of the systems proposed, including any subsystems (e.g., I/O cabinets, disks, cabling, external networking, etc.). Please provide 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 BTU (British Thermal

Units) or Tons AC required for each of the systems proposed. List any other facilities requirements. Please provide cooling required for each rack type and the number of those racks in the system.

3.8 Section 8. Project Management

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 8) should contain a detailed point-by-point response to Section 8 of the SOW with the same numbering scheme as the SOW**.** In particular, Offeror should provide the following detailed information.

3.8.1 Section 8.2.1. Draft Full Term Management Plan

In this section of the Sequoia Build Technical Proposal. Offeror should provide a first draft full term management plan as outlined in SOW Section 8.2.1**.** This draft plan should contain the proposed management teams and structure, proposed organization of core team, rough draft full term project plan and schedule that contains a work breakdown structure (WBS) including the proposed milestones to at least five (5.0) levels of detail (in Microsoft Project 2003 or 2007 format) and risk management plan that includes at least five (5.0) identified risk with HIGH impact to the program with at least MEDIUM or HIGH probabilities of occurrence for each of the hardware and software development activates (a total of ten (10.0) risks)**.** The risks should be associated with development activities on the critical path of the WBS**.** Failure to identify these risks will severely negatively impact the evaluation of Offeror's qualifications and credibility of schedule**.** That is, it is much worse to withhold information or appear naive by being unable to identify the requested number of risks than to honestly identify risks**.** For identified risks, Offeror should propose fall-back strategies that would become operative should the system implementation not proceed as rapidly as scheduled and decision dates**.** Offeror should name key personnel that will be part of the project management**.** Provide the resume of these individuals and a description of the roles and responsibilities in the format shown in Appendix A**.** Also indicate the level of authority this individual will carry within the corporation for the management of this activity.

In addition, include an Open Source Collaboration Plan that describes how the Open Source software objectives of the Sequoia procurement will be accomplished. The Open Source community management model should be described. Any open source software components like Lustre, MOAB/SLURM resource management and open source code development tools that LLNS is responsible for should be explicitly discussed. In addition, the general methods for open source community development, testing and system support should be discussed. Any pathways for open source software developed to meet the Sequoia procurement objectives and requirements should be described.

3.8.2 Section 8.2.2. Draft Full-Term Hardware Development Plan

In this section of the Sequoia Build Technical Proposal, the Offeror should provide a first draft full-term hardware development plan as outlined in SOW Section 8.2.2**.** This draft plan should contain the high level development, testing and build strategies for the components outlined in Section 8.2.2**.** Tie this development plan into the deliveries to LLNS with specific Dawn, technology refresh (if appropriate) and Sequoia deliveries identified in the milestone section.

3.8.3 Section 8.2.3. Draft Full-Term Software Development Plan

In this section of the Sequoia Build Technical Proposal, the Offeror should provide a first draft full-term software development as outlined in SOW Section 8.2.3**.** This draft plan should contain the high level development, testing and build strategies for the components outlined in Section 8.2.3**.** Tie this development plan into the deliveries to LLNS with specific Dawn, technology refresh (if appropriate) and Sequoia deliveries identified in the milestone section. Specific mention of the plans for each Open Source community contributions should be listed and described.

3.8.4 Section 8.2.4. Draft Detailed Year Plan

In this section of the Sequoia Build Technical Proposal, the Offeror should provide a first year draft project plan for the build and testing, demonstration and deployment of the Dawn system as described in SOW Section 8.2.4.

3.8.5 Section 8.3. Proposed Project Milestones

Offeror should propose a series of project milestones along the lines of those suggested in the SOW Section 8.3**. Offeror is not restricted to use the example milestones in the SOW Section 8.3.** Offeror should identify specific deliverables at each milestone (including SOW section numbers), acceptance criteria and corresponding milestone delivery/completion dates**.** An associated Milestone Payment Schedule should be **provided separately** and included in the Offeror's Sequoia D&E and Build Price Proposal (Volume 5).

3.9 Section 9. Performance of the System

Offeror's Sequoia Build Technical Proposal (Volume 1, Section 9) should contain a detailed point-by-point response to Section 9 of the SOW with the same numbering scheme as the SOW. **Most benchmarking results will be reported (without page limits) in Volume 9. See Section 11, below, for proposal preparation instructions on what should be reported in Volume 9 of Offeror's proposal.**

For Volume 1, Section 9, Offeror should provide the following detailed information. For each benchmark (i.e., individual subsections of Sections 9.1, 9.2 and 9.3), Offeror may 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 9.4.1.

For SOW Section 9.2, Offeror may describe the benchmark reference system configuration and how this configuration is below, meets or exceeds these requirements. Also Offeror, should argue how this reference system is reasonable as a basis for estimation of performance for Dawn and Sequoia systems.

For SOW Section 9.3, please describe how Offeror will implement the "Sequoia Marquee Benchmark Test Procedures" for the Sequoia system and what problems are proposed to be run. Of particular interest is Offeror's strategy for obtaining 24x performance improvement over

Purple for the "Marquee Benchmarks" including using more cores and threads than one per MPI task.

SOW Section 9.4 is informational and no response is required. For SOW Section 9.4.1, Offeror's code modifications may be consistent with this requirement and reported elsewhere. For SOW Section 9.4.2 and 9.4.2.1 Offeror may indicate what RAW figures of merit are projected for Sequoia and Sequoia14, respectively.

3.10 Section 10. Mandatory Options and Technical Options

The definitions of Mandatory Option Requirements and Technical Option Requirements are stated in Section 1.2 of this Proposal Evaluation & Proposal Preparation Instructions. Offeror shall propose the Mandatory Options of this RFP. Offeror may propose the Technical Options of this RFP.

Each option should appear as a separately identifiable item in the Offeror's Sequoia Build Technical Proposal (Volume 1, Section 10) and Sequoia Build Price Proposal (Volume 5). Offeror's technical proposal description should include all technical information for full evaluation of each proposed option as well as delivery date or schedule. The Offeror's price proposal should identify a firm fixed price for each proposed option. **A price proposal that does not offer separately priced Mandatory Options will be deemed nonresponsive**.

Offerors are reminded that technical information should be included in the technical proposals, while price information should only be included in the price proposal(s). Price information should not be included in a technical proposal.

Table 3 below identifies the inclusive set of Mandatory Options Requirements. Table 4 below identifies the inclusive set of Technical Option Requirements.

Table 3
LLNS Mandatory Options

SOW Section	Option	Description
2.12.3	Sequoia14 System Performance	A Sequoia system point design with a scaled down peak of 14 petaFLOP/s instead of the Section 2.1 mandatory 20.0 petaFLOP/s. All system components should scale as specified in Section 2.3.

Table 4
LLNS Technical Options

SOW Section	Option	Description
2.12.1	Sequoia Enhanced IO Subsystem (TO-1)	Enhanced IO subsystem for Sequoia that allows jobs running on half of the system (50% of the CN) to achieve 100% of the IO delivered full system bandwidth and allows jobs running on a quarter of the system (25% of the CN) to achieve 50% of the IO delivered full system bandwidth.
2.12.2	Sequoia Half Memory (TO-1)	A Sequoia system with only the CN configured with half as much memory as in the baseline system. The ION/LN have the baseline memory.
2.12.4	Sequoia14 Enhanced IO Subsystem (TO-1)	An enhanced IO subsystem for the Sequoia14 configuration with similar scalability attributes of 2.12.1.
2.12.5	Sequoia14 Half Memory (TO-1)	Similar to 2.12.2, but for the Sequoia14 system.
4.12.1	Dawn Enhanced IO Subsystem (TO-1)	An enhanced IO subsystem for the Dawn configuration with similar scalability attributes of 2.12.1.
4.12.2	Dawn Double Memory (TO-2)	A Dawn system with only the CN configured with twice as much memory as in the baseline system. The ION/LN have the baseline memory.
4.12.3	Dawn Double ION/LN Memory (TO-1)	A Dawn system with only the ION/LN configured with twice as much memory as in the baseline system. The CN have the baseline memory.

3.11 Section 11. Glossary

Offeror should revise SOW Section 10 glossary elements to reflect terminology used in the Offeror's proposal.

3.12 Section 12. 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. If working with Open Source Software communities includes subcontracts for deliverables, these should be described. It should also include a description of how Offeror's organization intends to integrate the Subcontractor's product or services to achieve the ASC Program goals. Describe your previous experience with the proposed third-party subcontractors and the experience that the proposed third-party subcontractors have had on projects for similar equipment or services as being provided under the anticipated Sequoia Build subcontract.

4 BUSINESS PROPOSALS (VOLUME 2)

4.1 Section 1. Supplier Attributes

Provide the following background information on those contracts during the past two years that the Offeror considers the most comparable to the requirements 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 LLNS requirements. 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 major problems, so a credible response will not say "everything went fine." LLNS is 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. Offeror may discuss these challenges in the context of a lessons learned scenario.

Discuss your company's manufacturing and testing facilities. Discuss the expertise and skill level of your company's key personnel who will work on this project.

Offeror financial information is considered a Supplier Attribute. However, Offerors should submit financial information in Volume 8, 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 1.6 above for consortium related information.

4.2 Section 2. Open Source Linux Product Roadmap

Describe the Offeor's corporate Open Source Linux OS product roadmap for the next four years. Include hardware and software offerings. Provide information that will give an indication of the depth and scope of the product roadmap as well as the products targeted specifically at high-performance Linux clustering. Indicate the open source partnerships the corporation is involved in and how the results of these efforts factor into future products.

4.3 Section 3. Proposed Open Source Development Partnerships

The Offeror should provide information on the capabilities of its corporation to engage in an open source development partnership and meet the goals set out in the SOW. This information should include the Offeror's qualifications as a high-end HPC provider; the Offeror's qualifications as an open source development organization; cluster product roadmap and comparison to the overall strategy; 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 such as scalable parallel file systems and cluster resource scheduling. If the Offeror has technology, such as a scalable parallel file system or cluster management tools or cluster resource scheduling, that could be contributed to the overall software effort, please indicate that as well.

5 SEQUOIA ALTERNATE TECHNICAL PROPOSAL (VOLUME 3)

An "alternate proposal" is defined as an additional proposal presenting a different approach to meeting the general Sequoia programmatic objectives with other innovative architectures. Offerors are encouraged to provide alternate proposals if your organization thinks more than one technical solution is viable, as well as any third party or value added solutions that would be in the best interest of their company and LLNS. Any risk-reduction suggestions Offeror has that would increase the company's ability to successfully meet LLNS requirements should also be included in this section.

5.1 Alternate Proposal Format

Offerors may submit a separate Alternate Technical Proposal (Volume 3) and separate Alternate Price Proposal (Volume 6) for different approaches to meeting the general Sequoia programmatic objectives. Technical information should be included in the Alternate Technical Proposal, while pricing information should be included in the Alternate Price Proposal. Cover page or section titles should clearly correlate an Alternate Technical Proposal and its respective fixed price proposal. The same format indicated in Table 1 should be followed for Alternate Technical Proposals. If a majority of the Alternate Technical Proposal is the same as the main proposal, duplicate information does not need to be reiterated. In such case, identify the differences between the two. If, however, a significant portion of the Alternate Technical Proposal is different from the main proposal, the Alternate Technical Proposal should stand alone. That is, it should follow the same format identified in Table 1 and have sufficient information to allow LLNS to evaluate it as a stand-alone proposal. An Alternate Technical Proposal may include pointers to the main proposal.

5.2 Alternate Additional Option(s) Format

Offeror is also encouraged to include alternate options they think may be of interest to LLNS. These alternate options should be addressed in the Alternate Technical Proposal (Volume 3) and priced separately in the Alternate Price Proposal (Volume 6). For the purposes of this solicitation, an "alternate option" is defined as additional equipment or services offered by the Offeror for which LLNS has the unilateral right to purchase. Technical information should be included in the Alternate Technical Proposal, while pricing information should be included in the Alternate Price Proposal. Cover page or section titles should clearly correlate an alternate option and its respective fixed price.

6 SEQUOIA D&E TECHNICAL PROPOSAL (VOLUME 4)

The Offeror should submit one or more research and development / development and engineering (R&D or D&E) Technical Proposal(s) in support of the Sequoia effort. The Offeror's Sequoia D&E Technical Proposal(s) should indicate the areas where the Offeror's Sequoia Build Technical Proposal depends on the Sequoia D&E activities.

LLNS' current intention is to select at least two D&E proposals for award: one for the selected best value Offeror for Sequoia Build and one for the "first runner up", as determined by LLNS, for a Sequoia D&E subcontract. As such, these proposals may facilitate the development of Offeror's technology or acceleration of that development for petascale systems and to form the basis for bids to the next ASC Program platform procurement for systems beyond Sequoia. The D&E proposal may also reduce the risk associated with the Sequoia build activity.

6.1 Section 1. Overview

This section should provide the high level context for the research and development / development and engineering (D&E) proposed in the subsequent sections. The Offeror should identify the gaps between the Offeror's D&E activities and those prerequisite to meet or exceed Sequoia target requirements. For the purposes of this D&E proposal, these gaps should be beyond the scope of, or accelerations of, the Offeror's existing product roadmap and D&E incorporated in the build/delivery activities of the Sequoia Build subcontract. However, Offeror may assume in the Sequoia Build proposal that this D&E proposal is also selected and write an integrated Sequoia Build response that includes end-results of both efforts funded under separate subcontracts (one Sequoia Build and one Sequoia D&E). Offeror can then identify the specific D&E activities to be funded by this accompanying D&E proposal. Offeror should also make clear how this D&E proposal reduces the schedule or performance risk associated with the proposed Sequoia configuration, timescale and budget. As such, this proposal should integrate into the Offeror's overall Sequoia Build risk plan in the response to Sequoia SOW section 8.2.

6.2 Section 2. Specific D&E Objectives and Activities

This section should list the specific proposed D&E objectives and activities in support of the Sequoia design, productization, test and scaling. These activities should be split into three major categories, if applicable: hardware, software and systems testing and scaling. This section should be a detailed in an Offeror prepared SOW describing the activities in sufficient detail to be appropriate for the level of payment received. This section should identify proposed deliverable items. LLNS does not anticipate delivery to LLNS of hardware or software resulting from D&E activities. However, Offeror should propose monthly and quarterly reviews and the delivery of specific architectural and/or software functionality and API descriptions or other reports documenting the work performed and results achieved.

6.3 Section 3. Impacts of D&E on Dawn and Sequoia Systems

This section should indicate the direct impacts of the proposed D&E activities on the Dawn and Sequoia systems. This impact may include schedule improvements, productization, improving

system qualities such as the system interconnect, RAS or MTABF, etc. If the major impacts are risk reduction, then explain what risks are addressed and how the risks are reduced.

6.4 Section 4. Project Management

This section should describe how the D&E project will be managed and results integrated into the Sequoia Build subcontract deliverables. If managed separately from the Sequoia Build subcontract, Offeror should describe the D&E proposed project management structure and team.

Offeror should describe the major phases of the project and any proposed reviews and decision dates. Offeror should include a table in three parts (corresponding to the three 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 D&E proposal, LLNS should be able to clearly understand exactly what is proposed and the corresponding delivery / completion schedule. After reading Section 3, LLNS should be able to clearly understand the full impact of this D&E proposal on the Dawn and Sequoia systems and risk plan.

6.5 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. If working with Open Source Software communities includes subcontracts for deliverables, these should be described. It should also include a description of how Offeror's organization intends to integrate the subcontractor's product or services to achieve LLNS goals. Describe your previous experience with the proposed third-party subcontractors and the experience that the proposed third-party subcontractors have had on projects for similar equipment or services as being provided under this subcontract.

7 SEQUOIA BUILD AND D&E PRICE PROPOSAL (VOLUME 5)

7.1 Section 1. D&E Fixed Price

Offeror should identify the proposed total firm fixed price corresponding with its Sequoia D&E Technical Proposal. Offer should include a basis of estimate (BOE) for its proposed total firm fixed price. The BOE should include, at a minimum, an estimate of labor categories, labor hours by category, and fully burdened hourly labor rates by category to perform each proposed D&E activity / task. The BOE should also identify proposed material, travel, or other expenses to perform each proposed D&E activity / task. Offer should include a projected funding expenditure profile by Government Fiscal Year (October – September) for each proposed D&E activity / task. LLNS does not anticipate a need for Certified Cost or Pricing Data (as defined at FAR Part 15); however, LLNS reserves its right to request submission of Certified Cost or Pricing Data from the selected Offeror(s).

7.2 Section 2. Build – Dawn and Sequoia System Fixed Prices

Offeror shall fully complete the price schedules contained in Attachment 4 "Sequoia_Price_Schedule" spreadsheet, as described herein, and include its completed price schedules in Section 2 of the Sequoia D&E and Build Price Proposal. Modifications to the spreadsheets may be made as necessary.

Offeror shall provide a firm fixed price for each system offered. The total price proposed for each system should include all software and software license costs, unless explicitly noted. The firm fixed-price should also include all delivery and installation costs. Hardware Maintenance prices should be based on "Self Hardware Maintenance" with on-site parts cache and "overlap" RMA process for all systems proposed starting with system acceptance and extending for five (5.0) years. Software Maintenance pricing should be based on 7x12 (0800-2000 Pacific Time Zone) with one hour response time for all systems proposed starting with system acceptance and extending for five (5.0) years.

An entry must be made for each line item. If the price of a line item is being offered at "No Charge" to LLNS insert "NC" for that entry. If a line item cannot be separately priced, insert "NSP" for that entry. In the description column, the Offeror must also insert the entry "Note __" directing LLNS to the "Note" that provides a narrative explanation for all "NSP" entries, identifying which line item includes that price. All accompanying notes must be included at the end of the price schedule.

7.3 Section 3. Build – Mandatory Option and Technical Option Fixed Prices

Offeror shall fully complete the Optional Equipment Pricing tabs contained in Attachment 4 "Sequoia_Price_Schedule" spreadsheet for the Mandatory Option and Technical Options. Pricing should be for a single additional node rack. An entry must be made for each line item. Offeror may include additional options that they think would be of interest to LLNS. Offeror-defined options must include relevant technical, business, and price information in the appropriate proposal volume.

7.4 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.

7.5 Section 5. Milestone Payment Schedule

Provide a "draft" Milestone Payment Schedule according to the Government Fiscal Year (GFY) that matches the delivery milestones identified in the Sequoia Build Technical Proposal (Volume 1) Provide a "draft" Milestone Payment Schedule according to the Government Fiscal Year (GFY) that matches the delivery milestones identified in the Sequoia D&E Technical Proposal (Volume 4) The actual Milestone Payment Schedule contained in any resulting subcontract will

be based on the system delivery schedule as well as on LLNS' best estimate of anticipated fiscal year allocations for any subcontract at the time of award.

It is LLNS' intent to more heavily price milestones that: 1) demonstrate that the ASC applications can run successfully across the entire system; and 2) reflect greater value received by LLNS. Milestones that reflect only the hardware installation without the accompanying software scalability will be considered of less value for milestone payment purposes.

7.6 Section 6. Financial Incentives

Just as creativity will be required to meet LLNS' technical requirements, it is also anticipated that creative financial arrangements will be needed to meet LLNS' budget constraints. Therefore, Offeror is encouraged to propose alternative, creative financial incentives such as lease-to-ownership (LTO) arrangements, purchase with trade-in option, cost share, etc. Any LTO arrangements would have to be part of the resultant LLNS subcontract. LLNS will not enter into a LLNS issued third party LTO. However, LLNS would consider a financial arrangement whereby the Awardee assigned the LTO to a third party if the rates were consistent with prevailing and competitive rates. LLNS would also be willing to provide interested companies with the names of third party financial institutions that have done business with LLNS and understand our environment. In general, an operating lease is not usually considered an attractive financial incentive unless the lease costs offer a significant savings over the direct purchase or LTO financing methods. Offeror is encouraged to look for ways in which LLNS can obtain title to the equipment at the end of the subcontract period.

8 SEQUOIA ALTERNATE PRICE PROPOSAL (VOLUME 6)

In the event that Offeror submits a Sequoia Alternate Technical Proposal, Offeror should submit a corresponding Sequoia Alternate Price Proposal.

8.1 Section 1: Alternate Proposal Fixed Price(s)

Offeror shall provide a firm fixed price for each alternate system offered, as described in Offeror's Sequoia Alternate Technical Proposal (Volume 3). The total price proposed for each system should include all software and software license costs, unless explicitly noted. The firm fixed-price should also include all delivery and installation costs. Hardware Maintenance prices should be based on "Self Hardware Maintenance" with on-site parts cache and "overlap" RMA process for all systems proposed starting with system acceptance and extending for five (5.0) years. Software Maintenance pricing should be based on 7x12 (0800-2000 Pacific Time Zone) with one hour response time for all systems proposed starting with system acceptance and extending for five (5.0) years.

Offeror shall complete substantially similar price schedules, as contained in Attachment 4 "Sequoia_Price_Schedule" spreadsheet of this Proposal Evaluation and Proposal Preparation Instructions, for any alternate system offered.

An entry must be made for each line item. If the price of a line item is being offered at "No Charge" to LLNS insert "NC" for that entry. If a line item cannot be separately priced, insert "NSP" for that entry. In the description column, the Offeror must also insert the entry "Note __" directing LLNS to the "Note" that provides a narrative explanation for all "NSP" entries, identifying which line item includes that price. All accompanying notes must be included at the end of the price schedule.

8.2 Section 2: Alternate Additional Option(s) Fixed Price(s)

Offeror shall provide a firm fixed price for each alternate additional option offered, as described in Offeror's Sequoia Alternate Technical Proposal (Volume 3). The total price proposed for each alternate additional option should include all software and software license costs, unless explicitly noted. The firm fixed-price should also include all delivery and installation costs. Hardware Maintenance prices should be based on "Self Hardware Maintenance" with on-site parts cache and "overlap" RMA process for all systems proposed starting with system acceptance and extending for five (5.0) years. Software Maintenance pricing should be based on 7x12 (0800-2000 Pacific Time Zone) with one hour response time for all systems proposed starting with system acceptance and extending for five (5.0) years.

9 OTHER DOCUMENTS (VOLUME 7)

9.1 Section 1: Royalty Information

In addition, if specifically requested by the LLNS Contract Administrator 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.

9.2 Section 2: Small Business Subcontracting Plans

The successful Offeror(s) must provide Small Business Subcontracting Plans, which include anticipated total subcontracting amount and the percentage goals and amounts for all of the various small business categories. Refer to the *Small Business Subcontracting Plan* clause referenced in the GENERAL PROVISIONS and the attached Model Small Business Subcontracting Plan for additional information. LLNS anticipates that an individual subcontracting plan will be necessary for a D&E subcontract, and that a commercial subcontracting plan will be sufficient for the Sequoia Build subcontract. The approved subcontracting plans will be made a part of any resulting subcontract. Failure to submit acceptable subcontracting plans shall make the Offeror ineligible for award.

9.3 Section 3: Software Branding and Licensing

Submit all branding or certification of software standards adherence required in RFP Attachment 2, SOW, Section 2.2.

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:

- The governing laws of the State of California will apply.
- The right of assignment of any agreement to the Department of Energy/National Nuclear Security Administration (DOE/NNSA) for assignment to any succeeding prime contractor to LLNS.

An Offeror's proposal may be eliminated from consideration for award in the event the Offeror and LLNS cannot mutually agree to terms and conditions contained in any Software License or Maintenance Agreement.

9.4 Section 4: System Warranty Information

Provide warranty information for all Offeror-provided items as well as any third-party subcontracted items.

9.5 Section 5: Representations and Certifications

Offeror shall complete, sign, and submit the Representations and Certifications Form.

9.6 Section 6: EEO Pre-Award Compliance Certification Form

Offeror shall complete, sign, and submit the EEO Pre-Award Compliance Certification Form, unless otherwise exempt from this requirement. Additional information is included in the RFP letter.

9.7 Section 7: Workplace Substance Abuse Program Plan

The Sequoia Build Subcontract will include Department of Energy Acquisition Regulation (DEAR) clause 970.5223-4, *Workplace Substance Abuse Programs at DOE Sites*, requiring the Subcontractor to 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). The selected offeror will be required to include the requirements of 10 CFR 707 in any lower tier subcontract with a value of $25,000 or more that is determined to involve access to or handling of classified information or special nuclear materials; high risk of danger to life, the environment, public health and safety, or national security; or transportation of hazardous materials to or from a DOE/NNSA site.

Before the work can begin, the Offeror selected for award must submit a written Workplace Substance Abuse Program Plan (WSAPP) consistent with 10 CFR 707 for LLNS approval. Upon execution of the Sequoia Build Subcontract and submittal and approval of the Subcontractor's WSAPP LLNS will issue a written notice to proceed with the on-site work. Any lower-tier subcontractor's WSAPP must be approved before the lower tier subcontractor is allowed to perform on-site work.

If the Sequoia Build Subcontract involves employees working in TDPs, such employees will be subject to applicant, random and reasonable suspicion drug testing. TDPs include:

- Positions determined to require a "Q" or "L" access authorization.
- Positions determined to be covered by the DOE/NNSA Human Reliability Program (HRP) (10 CFR Part 712)
- Positions identified by the Subcontractor which entail duties where failure of an employee adequately to discharge his or her position could significantly harm the environment, public health or safety, or national security, such as:
- Pilots
- Firefighters
- Protective force personnel, exclusive of those covered by the HRP, in positions involving use of firearms where the duties also require potential contact with, or proximity to, the public at large
- Personnel directly engaged in construction, maintenance, or operation of nuclear reactors
- Personnel directly engaged in production, use, storage, transportation, or disposal of hazardous materials sufficient to cause significant harm to the environment or public health and safety
- Other positions determined by LLNS or DOE/NNSA, after consultation with the Subcontractor, to have the potential to significantly affect the environment, public health and safety, or national security

After the WSAPP is approved by LLNS, its implementation will be subject to LLNS monitoring for compliance and effective implementation.

10 OFFEROR FINANCIAL INFORMATION (VOLUME 8)

To assist LLNS in assessing the financial capability of the Offeror, provide any or all of the following.

- Provide audited and certified balance sheets and profit and loss statements for the Offeror's company for the last six (6) completed financial quarters, including interim statements for the current quarter.
- Provide copies of your Form 10-K filed with the Securities and Exchange Commission for the past two (2) fiscal years, plus any 10-Q Forms filed since the last Form 10-K.
- Furnish affirmative assurance, such as endorsements from financial institutions, that your company has sufficient funds necessary to perform the work.
- State what percentage of your performing organization's estimated total revenue during the period of performance the proposed subcontracts will represent.
- State the distribution of your last complete fiscal year's sales volume among commercial business, Government prime contracts, and subcontracts under Government prime contracts.
- Provide any other relevant and useful information about the financial health of the corporation that will assist LLNS in assessing the financial capability of the Offeror.
- Provide tax returns for a minimum of the two most recent completed fiscal years.

11 PERFORMANCE OF THE SYSTEM (VOLUME 9)

The benchmark programs described below will be executed by the Offeror to measure the execution characteristics and compiler capabilities of the proposed reference system and to project the performance of a Sequoia class platform. The benchmarks are divided into three tiers to give the Offeror a notion of the relative priority of effort to their execution. The tier 1 benchmarks are the required Sequoia Marquee performance codes. The tier 2 codes provide functionality and performance tests for various system components including the platform memory subsystem, network, operating system, and runtime environment. Finally, the optional tier 3 codes are application "micro kernels" that are provided as a courtesy to Offerors who wish to report results from prototype node hardware or simulators of Sequoia class processor or node hardware that are not yet available. These "micro kernels" also serve as single CPU challenges for compilers, for threading and the exploitation of Vector or SIMD hardware, and for floating point, integer and branch prediction performance.

The Sequoia benchmarks and details for running each of the benchmarks can be found at http://asc.llnl.gov/sequoia/benchmarks/

ASC Sequoia Benchmark questions, and only benchmark related questions, may be submitted via electronic mail to "mailto:asc-bench@llnl.gov"**.** The LLNS Contract Administrator will be included on this mail list**.** Offeror neutral (i.e., non-proprietary) questions and their LLNS answers, without identification of the submitter, will be posted on the ASC Sequoia benchmark website. Offeror specific or proprietary questions and their LLNS answers will be held in confidence and not posted on the ASC Sequoia benchmark website. LLNS, in its sole discretion, will make the determination of the appropriateness of posting Offeror specific Q&A with potentially edited content (to protect anonymity of the source).

The tests may be run on a configuration as described in SOW Section 9.3 according to the testing procedures described in SOW Section 9.4. **In addition to running each benchmark, the Offeror must report the benchmark reference system characteristics and benchmark results in the "Sequoia Benchmark Results" spreadsheet as indicated in SOW Section 9.5.**

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 describing the changes. An audit trail will be supplied to Tri-Labs for any changes made to the benchmark codes. The audit trail will be sufficient for Tri-Labs to determine that changes made violate neither the spirit of the benchmark nor the specific restrictions on the various benchmark codes. Tri-Labs requires that all benchmark codes first be run as provided, without any code modifications, in each required configuration and that these baseline results be included along with any results obtained from modified code. Results should be reported in the same Excel spreadsheet used for the required "as is" runs. This is done by creating a new entry on the source change configuration (SCC) worksheet. 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 ASC Sequoia Benchmarks web site as tar files. Each benchmark is documented a PDF file with general information about that benchmark including a description of the code, how to build and run it, and any specific information about timing or storage issues. The benchmark source code, makefiles and problem sets are in the tar file. Each benchmark also has a text file that is a change log file and/or micro-kernel change file which details any changes to the benchmark over time. Some benchmarks also contain a file that describes a Sequoia specific problem set.

The benchmark suite consists of five "marquee benchmarks" UMT, AMG, IRS, SPhot, and LAMMPS. These application codes will have specific performance levels that may be met and target optimizations for reasonable effort improvements. In addition to the marquee benchmarks, several functionality and performance test run are required. These include the Pynamic, CLOMP, FTQ, Phloem MPI, and memory subsystem benchmarks. There will also be five optional application micro-kernel benchmarks.

The following is a check list of the above requirements for each benchmark in the Sequoia suite. In general for each benchmark the Offeror may:

1. Report reference system characteristic in Volume 9, Section 2, "Sequoia Benchmark Results" spreadsheet.
2. Run benchmarks, "as-is", on a reference system and include all benchmark output files in Volume 9, Section 1.
3. Project results to full scale Dawn system or Dawn node for FTQ and Tier -3 benchmarks. These projections may be summarized in Volume 9, Section 2, "Sequoia Benchmark Results" spreadsheet.
4. Project results to Sequoia baseline system (20.0 PF/s peak) or Sequoia node for FTQ and Tier -3 benchmarks. These projections may be summarized in Volume 9, Section 2, "Sequoia Benchmark Results" spreadsheet.
5. Project results to Sequoia14 (14.0 PF/s peak). These projections may be summarized in Volume 9, Section 2, "Sequoia Benchmark Results" spreadsheet.
6. Describe how benchmark results from reference system were projected to Dawn and Sequoia and Sequoia14 systems in Volume 9, Section 3. This report should include any additional information Offeror used in the estimation process from simulation results to back-of-the-envelope estimations.
7. Repeat steps 2-5 for any source code modifications to the benchmark suite allowed by SOW Section 9.4.1.
8. Document and describe all code modifications and provide all modified source code

It is extremely important for Offeror to provide Tri-Labs as much benchmark data as possible in Offeror's Proposal Volume 9, in the form of the Sequoia 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 Offeror cannot run a particular code or problem for whatever reason, Offeror should justify why they were unable to complete the runs in the benchmark response. All benchmark omissions will be fully described by the Offeror and will be reviewed and evaluated by Tri-Labs; supporting

documentation may be provided. Tri-Labs will be the sole judge of the validity of any scaled results.

11.1 Section 1: Benchmarks, makefiles, scripts and output files.

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 Offeror.

Reported information in this section should be sufficient to convince the Tri-Labs technical evaluation team that the Offeror did actually run the benchmarks on the reference system and obtained the reported results. In addition, Tri-Labs will evaluate the modifications to ensure consistency with reported modifications and allowed modifications requirements of SOW Section 9.5.1.

11.2 Section 2: Sequoia_Benchmark_Results spreadsheet

The Excel spreadsheet "Sequoia_Benchmark_Results" (as found on the Sequoia benchmarks web site) may be used by the Offeror to report the official FOM, problem input parameters, and all configuration parameters used for each run.

The data from the sustained IDC plus science benchmark workload will be reported in the following way. All figures of merit for each benchmark type will reported so that the average and standard deviation of the runs for each benchmark code can be calculated. The final aggregate figure of merit is defined to be the sum of six times the average figure of merit for each of the four IDC benchmark codes plus the average LAMMPS figure of merit.

11.3 Section 3: Scaling benchmark results to Dawn and Sequoia Report

Offeor may submit a report that justifies the scaling between the RFP benchmark runs and Offeror's projected sustained performance for the Dawn and Sequoia systems, and otherwise highlights noteworthy aspects of 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 9.2.

Tri-Labs will be the sole judge of the validity of any scaled results.

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:

List Awards/Honors/Publications:

RESUMES MUST NOT EXCEED FOUR (4) PAGES IN LENGTH
References listed in the resumes may be contacted to verify relevant experience as part of the evaluation process.

END OF PROPOSAL EVALUATION AND PROPOSAL PREPARATION INSTRUCTIONS.