MISSISSIPPI STATE UNIVERSITY

Request for Proposals (RFP) 19-55
High Performance Computing System for Mississippi State University

ISSUE DATE: July 24, 2019

ISSUING AGENCY: Office of Procurement and Contracts
Mississippi State University
610 McArthur Hall
245 Barr Avenue
Mississippi State, MS 39762

Sealed Proposals, subject to the conditions made a part hereof, will be received **August 22, 2019 at 2:00 PM in the MSU Office of Procurement and Contracts, same address above**, for furnishing services and potentially, optional services as described herein.

IMPORTANT NOTE: Indicate firm name, and RFP number on the front of each sealed proposal envelope or package.

All inquiries concerning this RFP should be directed to:

Jennifer Mayfield
Office of Procurement and Contracts (Same address above)
jmayfield@procurement.msstate.edu
662-325-2550

Any addendum associated with this RFP will be posted at http://www.procurement.msstate.edu/procurement/bids/index.php located under RFP 19-55.

Note 2: It is the respondent's responsibility to assure that all addenda have been reviewed and if applicable, signed and returned.

1) UNIVERSITY OVERVIEW

a) Mississippi State University (MSU) is a comprehensive land grant university with extensive research activities associated with high performance computing. MSU has a total enrollment of over 22,000 students. The main campus is located adjacent to the community of Starkville in northeast Mississippi.

b) The MSU High Performance Computing Collaboratory (HPC2), located in the Thad Cochran Research, Technology and Economic Development Park adjacent to the university campus, is a coalition of eight affiliated research centers and institutes sharing the common characteristic a of multi-disciplinary team-oriented effort that is

strategically involved in the application and advancement of computation science and engineering through the utilization of high performance computing. Additionally the HPC2 manages the university's Computational Engineering graduate program, offering both Master of Science and Doctor of Philosophy degrees.

c) Additional information about MSU can be found at our website www.msstate.edu.

2) INVITATION TO SUBMIT PROPOSAL ON RFP

Mississippi State University (MSU) seeks a high performance computing cluster based on x86-64 processors, interconnected with a high-bandwidth low-latency network, maximizing performance and minimizing power consumption. The proposed system should be a fully integrated system include all compute nodes, support nodes (management, login, data transfer), networking systems, storage systems, and rack-level power distribution units. The proposed system design should be one that is scalable to support future growth of the system. The University desires to utilize the proposed solution in support of research, educational, and support activities at the High Performance Computing Collaboratory. The total cost of the fully integrated system, including all items specified in this document, must not exceed **$3,150,000**. In their response, Suppliers must describe the system architecture of their proposed solutions (vendors may submit up to 2 responses to this solicitation).

3) SCOPE OF SERVICES REQUIRED

a) General Requirements

i) All proposed hardware, software (released commercially or as open source), and infrastructure must be supported by the Supplier at the time of system acceptance and throughout the subsequent 60 months of production system use.

ii) The proposed system must be a balanced, commercially-available, production-grade HPC system that contains an appropriate combination of processor, memory, interconnect, disk input/output (I/O), and operating system (OS) capabilities in order to execute complex, tightly-coupled, large-scale, scientific calculations; more specifically, the system must be able to successfully execute a variety of workloads, including jobs which stress all subsystems and which require the simultaneous, tightly-coupled use of the full number of compute nodes within the system.

iii) All equipment must be new; no refurbished or used equipment is allowed.

iv) All nodes and operating systems that are provided must include any required fixes for Spectre/Meltdown vulnerabilities and its variants.

b) Technical Requirements

i) **Compute Nodes**

The system must contain three distinct (i.e., mutually exclusive) sets of compute nodes: standard, large-memory, and GPU

(1) Standard Compute Node

(a) Must contain two processors

(i) The processor must be an Intel Xeon Gold 6248 or an equivalent AMD EPYC Zen 2 (ROME) processor

(b) Must contain at least 384GB of RAM, with a minimum of 32GB of memory per channel for all available memory channels, utilizing one DIMM per channel of the highest available memory speed supported by the proposed processor, must be error-correcting code (ECC) memory, and must be a balanced memory configuration

(c) Must contain a mixed-use internal SSD with a minimum size of 240GB to be used for operating system/boot drive

(d) Must contain a mixed-use express flash internal NVMe drive with a minimum size of 1.6TB to be used for local data storage.

(e) Must support the latest stable release of RedHat Enterprise Linux (RHEL) and CentoOS (licenses for RHEL are not required)

(f) Must include connectivity to the High Speed Network (HSN)

(g) Must include connectivity to the Management Network (MN)

(h) Must support IPMI2.0 and/or Redfish

(2) Large-memory Compute Node

(a) The proposal must include at least eight (8) large-memory nodes.

(b) Must be the same exact configuration of the proposed Standard Compute Node, but with a minimum of 4x the random access memory capacity utilizing no more than 2 DIMMs per channel, and 4x the NVMe drive capacity.

(3) GPU Compute Node

(a) The proposal must include at least four (4) GPU nodes.

(b) Must be the same exact configuration of the proposed Standard Compute Node, but additionally with two (2) NVIDIA V100 32GB GPUs

ii) **Login Nodes**

(1) The proposal must include a minimum of two (2) login nodes, each of which:

(a) Must contain two processors, using the same processor as the Standard Compute Node

(b) Must contain at least 384GB of RAM, with a minimum of 32GB of memory per channel for all available memory channels, utilizing the highest available memory speed supported by the proposed processor, must be error-correcting code (ECC) memory, and must be a balanced memory configuration.

(c) Must contain two (2) internal SSD's for mirrored OS, each of at least 400GB; and one mixed-use express flash internal NVMe drive with a minimum size of 1.6TB to be used for local data storage.

(d) Must contain redundant power supplies

(e) Same OS as the Standard Compute Node

(f) Must include connectivity to the High Speed Network (HSN)

(g) Must include connectivity to the Management Network (MN)

(h) Must support IPMI2.0 and/or Redfish

iii) **Data Transfer Nodes**

(1) The proposal must include a minimum of two (2) data transfer nodes, each of which:

(a) Must contain two processors, using the same processor as the Standard Compute Node
(b) Must contain at least 192GB of RAM, with a minimum of 16GB of memory per channel for all available memory channels, utilizing the highest available memory speed supported by the proposed processor, must be error-correcting code (ECC) memory, and must be a balanced memory configuration
(c) Must contain two (2) internal SSD's for mirrored OS, each a minimum of 400GB
(d) Must contain redundant power supplies
(e) Same OS as the Standard Compute Node
(f) Must include connectivity to the High Speed Network (HSN)
(g) Must include connectivity to the Management Network (MN)
(h) Must include connectivity to the facility LAN (10GigE/40GigE)
(i) Must support IPMI2.0 and/or Redfish

iv) **System Management Nodes**

(1) The proposal must include a minimum of two (2) system management nodes, each of which:
(a) Must contain two processors, using the same processor as the Standard Compute Node
(b) Must contain at least 96GB of RAM, with a minimum of 8GB of memory per channel for all available memory channels, utilizing the highest available memory speed supported by the proposed processor, must be error-correcting code (ECC) memory, and must be a balanced memory configuration
(c) Must contain two (2) internal SSD's for mirrored OS
(d) Must contain redundant power supplies
(e) Same OS as the Standard Compute Node
(f) Must include connectivity to the High Speed Network (HSN)
(g) Must include connectivity to the Management Network (MN) at 10GigE or better)
(h) Must support IPMI2.0 and/or Redfish

v) **High Speed Network (HSN)**

(1) A high-throughput low-latency interconnect network, with a minimum of 100 Gb/s per node injection rate
(2) Fat-tree topology with a maximum of 2:1 bandwidth over-subscription using no more than two-tiers
(3) Redundant power supplies for any switch that would impact more than 24 nodes
(4) If a director class switch is proposed, this must come with a redundant management system
(5) The fabric manager must run on the System Management Nodes

vi) **Management Network (MN)**

(1) One GigE connection to all equipment, including but not limited to all nodes, storage system, switches, smart/switched in-rack PDU's, etc.
(2) A core switch will be provided that has a minimum of 10GigE connections to all edge switches and system management nodes

(3) Minimum of 10GigE connectivity to the facility LAN
(4) 10G SR optics should be provided by the vendor; facility will provide cables for connectivity to the facility LAN

vii) **High-Capacity Storage System (/work)**

(1) Must be simultaneously mounted on all compute nodes, login nodes, and data transfer nodes
(2) Must be a Lustre-based high-performance parallel file system
  (a) Support for Lustre 2.10 or newer
  (b) Must have redundant metadata servers (MDS) configured for failover
  (c) MDS nodes should have a minimum of 128 GB of memory to allow for maximized metadata caching, support Lustre Data-on-MDT at a capacity of at least 5% of the total Lustre usable capacity, and must utilize RAID10
    (i) MDS nodes should favor processor clock-speed over core-count
    (ii) The utilization of flash storage for MDT is preferred, but not required
  (d) OSS nodes should favor core-count over processor clock-speed
  (e) Drive enclosures must provide redundancy to ensure continued data access in the event of a single enclosure failure.
  (f) Object Storage Targets (OSTs) must be configured with declustered RAID for drive failure protection and to accelerate rebuilds with large capacity hard drives.
(3) All HDDs shall be self-encrypting drives
(4) The non-file system related drives (operating system drives) do not require self-encryption.
(5) Must have at least 2 Petabytes (PB) of usable capacity
(6) Must support active/active controllers
(7) Must support mirrored writeback cache per active controller
(8) The configuration must be capable of at least 20GB/s writes and 25GB/s reads, as assessed via IOR benchmarks
(9) Must include connectivity to the High Speed Network (HSN)
(10) Must include connectivity to the Management Network (MN) for management functions

viii) **Home Directory and Application Storage System (/home & /apps)**

(1) Must be simultaneously mounted on all compute nodes, login nodes, data transfer nodes, and system management nodes
(2) Must be NFS-based with a total usable capacity of at least 50 TB, to be sub-divided into 2 distinct file systems (/home & /apps), in a hardware-based RAID6 or equivalent drive failure protection configuration
(3) Must support NFSv3 and NFSv4
(4) All HDDs shall be self-encrypting drives
(5) Must contain redundant power supplies
(6) Must include connectivity to the High Speed Network (HSN)
(7) Must include connectivity to the Management Network (MN)

ix) **Other**

(1) The proposal must include one networked KVM with monitor.

c) Physical Infrastructure Requirements

i) **Racks**

(1) All equipment will be rack mounted in standard 42U, 600mm wide racks; all racks with compute nodes must be the same size. All racks with support nodes must be the same size.

(2) Each rack should include a sufficient number of internal PDUs to feed all equipment mounted within the rack. MSU will provide a maximum of two (2) 208v 60-amp 3-phase power feeds per rack via IEC309 female connectors.

(3) All rack-level PDU's must support per-outlet power monitoring. Switched PDU's are not required but are acceptable.

(4) The maximum power draw for any single rack must not exceed 25 KW.

(5) All power connections shall be bottom fed. Network interconnect cables for adjacent compute racks must be top fed.

ii) **In-row Cooling Unit**

(1) The proposal must include three (3) chilled-water based in-row cooling units, each capable of rejecting 35KW of heat at 35% relative humidity, utilizing an inlet water temperature of 45F

(2) Units must be bottom fed for both power and chilled water connections

(3) Each unit should utilize variable speed fans

(4) Each unit must support automated dew point control to eliminate condensate; the units will be directly connected to the facility chilled water system via the CDU/Manifold

(5) Each unit must support dual power inputs for redundancy; acceptable power input is 208V-1PH or 208V-3PH at no more 30 amps (per input)

(6) Must include insulated hose to connect each unit to the CDU/Manifold; the maximum hose length is 30 ft.

(7) Humidification and electric reheat capabilities are not required

iii) **Cooling Distribution Unit (CDU)/Manifold**

(1) The Cooling Distribution Unit/Manifold must support 12 cooling circuits, with independent valving for each circuit (both input and output).

(2) The unit may be an above-the-floor, free-standing cabinet (for example, the Schneider-Electric/APC ACFD12-B) or may be a below-the-floor exposed unit. If the proposed solution is an above-the-floor cabinet, it must be bottom fed for all connections; if the proposed solution is a below-the-floor unit, it must fit under a computer room 18" raised floor plenum.

d) R&D, Operational, and Outreach Partnerships

i) Long term, sustainable partnerships have always been an important part of MSU's strategy for advanced information technology and cyberinfrastructure. The outcome of this RFP will play a strong role in defining MSU's partnerships in cyberinfrastructure in the years to come.

ii) The awardee must help MSU personnel with the tuning and benchmarking efforts of the proposed system

iii) The awardee is encouraged to promote MSU interests associated with the proposed system.

iv) The awardee is encouraged to identify any ongoing partnership opportunities available in the form of collaborative research and development programs, internship programs, hardware grants relevant to R&D, education and outreach, or economic development.

4) SCOPE OF WORK

a) General

i) The awardee is responsible for installation and deployment of the fully integrated system at MSU, with appropriate help from MSU personnel.

b) Maintenance and Support

i) The purchase price of the proposed system and support/infrastructure components is to include 60 months of 8x5 hardware and software support with next business day parts and a comprehensive spare kit (e.g., parts locker) on site.

c) Acceptance Testing and Benchmarking

i) MSU personnel must have access to the system, both physical and remote, during the benchmark and acceptance phases of the installation.

ii) Fabric validation must be conducted

iii) The Supplier must specify the Rmax of the proposed system (compute nodes only). The proposed system must meet or exceed the specified Rmax utilizing the latest version of the HPL benchmark.

iv) Upon award, additional acceptance criteria may be negotiated with the Supplier to confirm that the proposed system meets the specified performance and system operability objectives.

5) INQUIRIES ABOUT RFP

a) Prospective respondents may make written inquiries concerning this request for proposal to obtain clarification of requirements. Responses to these inquiries may be made by addendum to the Request for Proposal (RFP). Please send your inquiries to Jennifer Mayfield via electronic mail at jmayfield@procurement.mstate.edu

b) All inquiries should be marked **"URGENT INQUIRY. MSU RFP 19-55"**

6) ADDENDUM OR SUPPLEMENT TO RFP

a) In the event it becomes necessary to revise any part of this RFP, an addendum to this RFP will be provided to each respondent who received the original RFP. Respondents shall not rely on any other interpretations, changes or corrections.

7) ADMINISTRATIVE INFORMATION

a) Issuing Office

i) This RFP is issued by the following office:

Office of Procurement and Contracts
Mississippi State University
245 Barr Avenue, 610 McArthur Hall
Mississippi State, MS 39762

b) Schedule of Critical Dates

i) The following dates are for planning purposes only unless otherwise stated in this RFP progress towards their completion is at the sole discretion of the university.

(1) RFP Posted	July 24, 2019
(2) Questions from Vendors Due	August 5, 2019
(3) MSU Q&A Response Due	August 12, 2019
(4) Proposal Submission Deadline – 2:00 p.m.	August 22, 2019
(5) Award Date (Estimated Target)	August 31, 2019

8) PROPOSAL CONTENTS

a) This is a two-step RFP process. The technical proposals and the cost proposals are to be submitted in separate sealed envelopes. Indicate firm name, RFP# and word "Technical Proposal" on the front of the sealed technical proposal envelope or package. Indicate the firm name, RFP# and the word "Cost Proposal" on the front of the sealed proposal envelope or package.

b) At a minimum, the following items should be included in the contents of the Technical Proposal:

i) Cover letter, indicating the scope of the proposal. The letter should include an overview of the services being offered. The letter should include a statement of exceptions to any of the terms and conditions outlined in this RFP. (Cover letter should be no more than 3 pages in length.)

ii) Corporate Structure and Credentials

(1) Number of years of experience in HPC

(2) Staffing levels and support proposed
(3) Examples of similar previous work.

iii) Operations and Ability To Perform

(1) Provide operation plan. This should include, but not be limited to, acknowledgement and agreement with all requirements as well as explanations, where applicable, of the intended plan to achieve the requirements.
(2) Timeline of planned events, to include delivery, installation, and the beginning acceptance testing

c) At a minimum, the Cost Proposal should include costs breakdowns for the major components of the proposal (e.g., computing equipment, network systems, storage systems, physical infrastructure, maintenance/support, installation, software, etc.)

9) DISCUSSIONS/EVALUATION CRITERIA/AWARD PROCESS

a) MSU reserves the right to conduct discussions with any or all respondents, or to make an award of a contract without such discussions based only on evaluation of the written proposals. MSU reserves the right to contact and interview anyone connected with any past or present projects with which the respondent has been associated. MSU likewise reserves the right to designate a review committee to evaluate the proposals according to the criteria set forth under this section. MSU may make a written determination showing the basis upon which the award was made and such determination shall be included in the procurement file.

b) MSU reserves the right to award this contract in whole or in part, depending on what is in the best interest of MSU with MSU being the sole judge thereof.

c) The evaluation factors set forth in this section are described as follows:

i) The Vendor's ability to deliver a solution meeting the overall objective and functions described in the RFP
ii) Competitive cost
iii) Availability and access to technical support
iv) Delivery schedule
v) Vendor's HPC experience in higher education institutions and federal government
vi) Compliance with applicable State and Federal laws and regulations

d) Failure to attend a requested interview presentation before the committee may result in a proposal not being considered.

e) Upon award of contract, the successful respondent may be asked to provide a deployment plan, milestone timelines, confirmation of acceptance testing criteria, and obtain MSU's input and concurrence before moving forward.

f) Proposals will be scored based on the following weights (100 points total):
   i) Corporate Structure/Years of Experience in HPC/References – 20 pts
   ii) Overall System Design/Technical Approach – 20 pts
   iii) System Performance (compute/networking/storage) –30 pts
   iv) Expandability and/or Scalability of Overall System – 10 pts
   v) Delivery Time/Time to Production – 10 pts
   vi) Added Value Provided to MSU/Partnership Value – 10 pts

10) PROPOSAL SUBMISSION

a) Proposals shall be submitted in two packages (envelopes or boxes) as set forth in Section 7a. **Please make sure that the RFP number is clearly visible on the outside of the package.**

b) Technical Proposal – One (1) original and one (1) electronic copy (of the complete technical proposal in one pdf file on a flash drive) of parts 7(b)(i) (Cover Letter), 7(b)(ii) (Corporate Structure and Credentials), and 7(b)(iii) (Operations and Ability to Perform) should be sealed in a package with **"**Technical Proposal**"** in the lower left hand corner. Each submitted package should be a complete copy. The original shall be marked on the first page "Original".

c) The proposal package must be received on or before **2:00 p.m. on August 22, 2019**. It is the responsibility of the respondent to ensure that the proposal package arrives in the Procurement and Contracts office on-time. The proposal package should be delivered or sent by mail to:

Office of Procurement and Contracts
Mississippi State University
610 McArthur Hall
245 Barr Avenue
Mississippi State, MS 39762

d) Your response must include the signature page included in this RFP (See Appendix A) and contain the signature of an authorized representative of the respondent's organization. The signature on the "Original" signature page should be in **blue** ink

e) MSU reserves the right to reject any and all proposals and to waive informalities and minor irregularities in proposals received and to accept any portion of a proposal or all items bid if deemed in the best interest of the University to do so.

f) Proposals received after the stated due date and time will be returned unopened. Submission via facsimile or other electronic means will not be accepted.

11) TWO-PHASE, BEST AND FINAL OFFER

a) If the initial proposals do not provide MSU with a clear and convincing solution, or if MSU feels it is appropriate to offer the potential providers an opportunity to submit revised proposals, MSU reserves the right to use a two-phase approach and/or invite Best and Final Offers (BAFO). Based on the information obtained through the proposal submittals (Phase-One), MSU may choose a specific business model, and potential providers may be asked to submit revised proposals based upon that specific model.

b) The evaluation committee may develop, for distribution to the top-ranked firms, refined written terms with specific information on what is being requested as a result of information obtained through initial RFP submittal process. Proposers may be asked to reduce cost or provide additional clarification to specific sections of the RFP. Selected proposers are not required to submit a BAFO and may submit a written response notifying the solicitation evaluation committee that their response remains as originally submitted.

12) ACCEPTANCE TIME

a) Proposal shall be valid for one-hundred and eighty (180) days following the proposal due date.

13) RFP CANCELLATION

a) This RFP in no manner obligates MSU to the eventual purchase of any services described, implied or which may be proposed until confirmed by a written contract. Progress towards this end is solely at the discretion of MSU and may be terminated without penalty or obligations at any time prior to the signing of a contract. MSU reserves the right to cancel this RFP at any time, for any reason, and to reject any or all proposals or any parts thereof.

14) INDEPENDENT CONTRACTOR CLAUSE

a) The contractor shall acknowledge that an independent contractor relationship is established and that the employees of the contractor are not, nor shall they be deemed employees of MSU and that employees of MSU are not, nor shall they be deemed employees of the contractor.

15) OTHER CONTRACT REQUIREMENTS

a) **Award Terms:** This contract shall be awarded at the discretion of the University based on the capabilities and overall reputation of the Supplier, as well as the cost. Acceptance shall be confirmed by the issuance of a contract from the University.

b) **<u>The Procurement Process</u>:** The following is a general description of the process by which a firm will be selected to fulfill this Request for Proposal.

i) Request for Proposals (RFP) is issued to prospective Suppliers.

ii) A deadline for written questions is set.

iii) Proposals will be received as set forth in Section 10.

iv) Unsigned proposals will not be considered.

v) All proposals must be received by MSU no later than the date and time specified on the cover sheet of this RFP.

vi) At that date and time the package containing the proposals from each responding firm will be opened publicly and the name of each respondent will be announced.

vii) Proposal evaluation: The University will review each proposal.

viii) At their option, the evaluators may request oral presentations or discussions for the purpose of clarification or to amplify the materials presented in the proposal

ix) Respondents are cautioned that this is a request for proposals, not a request to contract, and the MSU reserves the unqualified right to reject any and all proposals when such rejection is deemed to be in the best interest of the University.

x) The proposals will be evaluated according to the criteria set forth in Section 9c.

APPENDIX A: SIGNATURE PAGE

Provide information requested, affix signature and return this page with your proposal:

NAME OF FIRM: _____

COMPLETE ADDRESS: _____

_____

TELEPHONE NUMBER: _____

AREA CODE/NUMBER

FACSIMILE NUMBER: _____

AREA CODE/NUMBER

E-MAIL ADDRESS: _____

AUTHORIZED

SIGNATURE: _____

PRINTED NAME: _____

TITLE: _____