

Tender Specification - High Performance Computing Cluster

Technology-neutral release - bidders may quote AMD or Intel, on DDR4 or DDR5

Instructions to Bidders

PRECEDENCE: where the column headed 'Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)' states a requirement, that column is binding and supersedes the 'Technical Specification' column to the extent of any inconsistency. Where that column reads 'As specified', the Technical Specification column applies unchanged.

I.Master Node

Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks
1	Processor	Dual processor, minimum 16 physical cores per processor (32 cores per node), 3.0 GHz, minimum 128 MB aggregate cache	Processor make and generation are not restricted. Bidders may offer AMD or Intel x86-64 server processors of any generation, on either a DDR4-class or a DDR5-class platform, provided the following minima are met: 2 processors per node, minimum 16 physical cores per processor (32 physical cores per node), base frequency 2.8 GHz or higher, minimum 128 MB aggregate L3 cache per node, PCIe Gen4 or higher, AVX2 instruction set support, and full support for the memory configuration specified in the Memory clause. The offered processor must satisfy the Product Life and OEM Support clause.		
2	Memory	Minimum 16 Memory DIMM Slots	Memory generation is not restricted. The offered memory shall be either DDR4-3200 or higher, OR DDR5-4800 or higher, ECC Registered (RDIMM),		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

		Total minimum 128 GB (4 x 32 GB or, 2 x 64 GB) ECC Registered memory, running at 3200 MHz or higher The supplied modules shall be populated across distinct memory channels in a balanced configuration.	matched to the offered processor platform. MINIMUM CONFIGURATION: 4 modules of 32 GB each, total 128 GB usable, supplied from day one. SLOT POPULATION: the 4 modules shall be distributed 2 per processor and shall occupy 4 DISTINCT memory channels, in the slot positions prescribed by the board OEM for a 2-DIMM-per-socket configuration. Populating two modules on the same memory channel while another channel of the same processor remains empty shall be rejected. All remaining DIMM slots shall be left vacant and available for future expansion. Higher capacities and additional populated channels are permitted and encouraged, and will be reflected in the memory bandwidth score under General Terms clause 7.		
3	DIMM Slot Provision	Sufficient DIMM slots shall be provided to allow future memory expansion without replacing the board.	The board shall provide a minimum of 16 DIMM slots in total, so that the 4 supplied modules occupy 4 distinct channels and at least 12 slots remain free for future expansion. Slot count per channel shall follow the offered platform (DDR4-class or DDR5-class).		
4	Storage	Each server should have 8 Hot-swap 2.5"/3.5" SAS SATA drive bays for future upgradation At least 2 x 960GB SATA SSD should be installed from day one configured in Hardware RAID - 1 4 x 8TB Ent SATA HDD should be installed for Data and a Hardware Raid Controller with 1GB Cache should be available in the Server System.	<i>As specified.</i>		
5	Network	At least 2 x 10G RJ45 networking ports along with 1 x dedicated RJ45 port should be available	<i>As specified.</i>		
6	PCI expansion	The server shall have at least 3 nos. of PCIe Gen4 x16 and 2 nos. of x8 expansion slots.	At least 3 nos. PCIe Gen4-or-higher x16 and 2 nos. PCIe Gen4-or-higher x8 expansion slots. PCIe Gen5 is acceptable and preferred where the offered platform supports it. A PCIe Gen5 accelerator installed in a Gen4 slot is acceptable.		
7	External Ports	Following minimum number of external ports should be available in the system 1 x VGA port 2 x USB 3.0 ports 1 x dedicated 1GbE RJ45 port for IPMI	<i>As specified.</i>		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

8	Chassis	Appropriate Chassis (Maximum 2U) with rail-kit. Chassis should be populated with a maximum number of redundant cooling fans that can be accommodated in the chassis and the cumulative air flow should be sufficient to take away the heat generated at peak load with fully populated hardware.	<i>As specified.</i>		
9	Server Management	Dedicated IPMI 2.0 compliant management 1 Gbps ethernet port having support for 1. Real-time health logging and telemetry streaming 2. Browser-based and command-line interface for managing and monitoring the server hardware 3. Out of band web management with real-time power meter, graphing, thresholds, alerts and capping with historical power counters 4. Redfish API and DMTF Systems Management Architecture for Server Hardware Command Line Protocol (SMASH CLP) 5. Agentless management using the out-of-band remote management port 6. Remote management of server over LAN and WAN with SSL encryption through gigabit management port 7. Advanced Encryption Standard (AES), SNMP v3, TLS 1.3 or above, Active Directory v1.0 8. HTML5 based virtual console, remote firmware update (BIOS/BMC) 9. All required licenses (if any) to use IPMI features	<i>As specified.</i>		
10	Power Supplies	80+ Platinum Certified Redundant Power Supply with minimum Power Rating of 1200W Power supply has to be configured in N+1 redundancy The system should sustain in the occasion of failure of one power supply. Power Management Bus (PMBus) support should be provided and status information must be available via IPMI	<i>As specified.</i>		
11	Power Cord and other cables	Power cable should have IEC 320 (male-female) connectors matching the peak-load rating of the power supplies.	<i>As specified.</i>		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

		All the network cables required are to be supplied in appropriate numbers and of appropriate specification.			
12	OS Support	The system should support the following minimum operating systems without any deviations: Windows Server 2022 Windows Server 2025 RHEL 9.4 - 9.x Ubuntu 22.04 LTS VMware ESXi 8.0 U3, ESXi 9.0, ESXi 9.1	<i>As specified.</i>		
13	Warranty	5 years comprehensive on-site advance replacement warranty on Server. Warranty includes 5-Year Parts, 5-Year Labour, 5-Year Onsite support.	5 years comprehensive on-site advance replacement warranty on the complete server, including all supplied components. The warranty shall be trackable online on the OEM website through the system serial number, providing a detailed system hardware configuration report.		
14	Environment compliance	RoHS compliance	<i>As specified.</i>		
15	MII (Make in India)	It is mandatory to submit declaration of breakup of MII (Make in India) content with proof, either at component or overall system level.	<i>As specified.</i>		
16	Job Scheduler	Open source job scheduler, SLURM must be installed and demonstrated to be working with job submission scripts. i. Jobs can be submitted only from the master/login node. ii. Jobs must be scheduled based on a fair-share calculation, historical usage etc. iii. Dynamic resource management and load balancing must be enabled. iv. Module support for maintaining multiple versions of the same software. v. Job status monitoring must be possible. Runaway processes must be checked for before allocating new jobs. vi. User login directly to compute nodes must be prevented/restricted.	<i>As specified.</i>		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

17	MAF & BOM	The Vendor must provide Manufacturer Authorization Form (MAF) and technical Bill Of Material (BOM) with the quote	<i>As specified.</i>		
18	Software / OS Installation	The Bidder / OEM shall install the Operating System, MPI and job schedulers, and shall reinstall or update the same as and when required throughout the warranty period.	<i>As specified.</i>		
19	Product Life & OEM Support	The quoted product should not be End-of-Life (EOL) or End-of-Service (EOS) for a minimum of 5 years, and OEM support including all spare parts must be available for a minimum of 5 years from the date of installation and acceptance. An OEM undertaking to this effect must be submitted.	The quoted product shall not be End-of-Life (EOL) or End-of-Sale/End-of-Service (EOS) for a minimum of 5 years from the date of installation and acceptance, and OEM support including all spare parts shall be available for a minimum of 5 years from the date of installation and acceptance. An OEM undertaking to this effect must be submitted with the bid. This clause is platform-selecting and no relaxation will be granted on grounds of processor make, processor generation or memory platform: a bidder unable to certify an older platform for 5 years should quote a newer one.		
20	Spare Parts	The OEM shall maintain and supply all the necessary spare parts for a minimum of 5 years to ensure faster response and resolution.	The OEM shall maintain and supply all necessary spare parts for a minimum of 5 years from the date of installation and acceptance, to ensure faster response and resolution.		

II. Compute Node

Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks
1	Processor	Dual processor, minimum 64 physical cores per processor (128 cores per node), minimum 256 MB aggregate cache, 2.45 GHz	Processor make and generation are not restricted. Bidders may offer AMD or Intel x86-64 server processors of any generation, on either a DDR4-class or a DDR5-class platform, provided the following minima are met: 2 processors per node, minimum 64 physical cores per processor (128 physical cores per node), base frequency 2.25 GHz or higher, minimum 256 MB aggregate L3 cache per node, PCIe Gen4 or higher, AVX2 instruction set support, and full support for the memory configuration specified in the Memory clause. The offered processor must satisfy the Product Life and OEM Support clause.		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

2	Memory	Minimum 16 Memory DIMM Slots Total minimum 256 GB (8 x 32 GB or, 4 x 64 GB) ECC Registered memory, running at 3200 MHz or higher The supplied modules shall be populated across distinct memory channels in a balanced configuration.	Memory generation is not restricted. The offered memory shall be either DDR4-3200 or higher, OR DDR5-4800 or higher, ECC Registered (RDIMM), matched to the offered processor platform. MINIMUM CONFIGURATION: 8 modules of 32 GB each, total 256 GB usable, supplied from day one. SLOT POPULATION: the 8 modules shall be distributed 4 per processor and shall occupy 8 DISTINCT memory channels, in the slot positions prescribed by the board OEM for a 4-DIMM-per-socket configuration. Populating two modules on the same memory channel while another channel of the same processor remains empty shall be rejected. All remaining DIMM slots shall be left vacant and available for future expansion. Higher capacities and additional populated channels are permitted and encouraged, and will be reflected in the memory bandwidth score under General Terms clause 7.		
3	DIMM Slot Provision	Sufficient DIMM slots shall be provided to allow future memory expansion without replacing the board.	The board shall provide a minimum of 16 DIMM slots in total, so that the 8 supplied modules occupy 8 distinct channels and at least 8 slots remain free for future expansion. Slot count per channel shall follow the offered platform (DDR4-class or DDR5-class).		
4	Storage	Each server should have 4 x 2.5"/3.5" SAS SATA drive bays for future upgradation 1 x 960 GB SATA SSD should be installed from day one and there should be provision to install three more in future.	<i>As specified.</i>		
5	Network	At least 2 x 10G RJ45 networking ports along with 1 x dedicated RJ45 port should be available	<i>As specified.</i>		
6	PCI expansion	The server shall have at least 3 nos. of PCIe Gen4 x16 and 2 nos. of x8 expansion slots.	At least 3 nos. PCIe Gen4-or-higher x16 and 2 nos. PCIe Gen4-or-higher x8 expansion slots. PCIe Gen5 is acceptable and preferred where the offered platform supports it. A PCIe Gen5 accelerator installed in a Gen4 slot is acceptable.		
7	Co-Processor / Accelerator	Each server has to be populated with 1 number of accelerator and each accelerator should have: 1. 48GB or more GDDR7 with ECC	RELAXED / EQUIVALENCE CLAUSE - this clause supersedes the numbered list opposite. The accelerator make and model are not restricted. Any PCIe accelerator meeting or exceeding ALL of the		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

		2. 1344GB/second or higher memory bandwidth 3. 2064 AI TOPS 4. 14080 accelerator cores or more 5. Single-precision performance 65TFLOPS with RT Core performance of 196TFLOPS 6. Max power consumption of 300 W 7. Active cooling support 8. Display connectors 4 x DisplayPort 2.1b	following minima is acceptable: (i) minimum 48 GB of GDDR7 or newer, or HBM-class, memory with ECC; (ii) minimum 1000 GB/s memory bandwidth; (iii) minimum 10000 accelerator (CUDA or equivalent) cores; (iv) minimum 50 TFLOPS peak FP32 (single-precision); (v) maximum board power 350 W, which must be supported by the supplied chassis and power supplies; (vi) active or passive cooling, provided the supplied chassis delivers the airflow required by the accelerator OEM; (vii) PCIe Gen4 x16 or higher host interface; (viii) minimum 4 display outputs of DisplayPort 2.1 or later. AI TOPS and RT-core throughput shall be declared for information but are NOT qualifying criteria, as the target workload is double-precision scientific computing. The NVIDIA RTX PRO 5000 Blackwell 48 GB is cited as the reference model against which these minima were framed; any accelerator of equal or higher specification is equally acceptable. FP64: the bidder shall declare the native FP64 (double-precision) throughput of the offered accelerator in TFLOPS, supported by the manufacturer datasheet, architecture whitepaper, OR a written OEM statement. Where the manufacturer publishes the FP64 rate only as a ratio of the FP32 rate, the bidder shall state the ratio and the derived FP64 figure, and this shall be accepted as evidence. Minimum acceptable native FP64 is 0.8 TFLOPS. Bidders are advised that the target application codes are double-precision dominated and that workstation and visualization-class accelerators provide FP64 at a small fraction of their FP32 rate. The purchaser reserves the right, at the time of any future expansion, to require a data-centre-class accelerator with high native FP64. This clause is independent of the processor make and of the memory platform chosen.		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

8	External Ports	Following minimum number of external ports should be available in the system 1 x VGA port 2 x USB 3.0 ports 1 x dedicated 1GbE RJ45 port for IPMI	<i>As specified.</i>		
9	Chassis	Tower Convertible to Rackmount chassis with rail-kit.	<i>As specified.</i>		
10	Server Management	Dedicated IPMI 2.0 compliant management 1 Gbps ethernet port having support for 1. Real-time health logging and telemetry streaming 2. Browser-based and command-line interface for managing and monitoring the server hardware 3. Out of band web management with real-time power meter, graphing, thresholds, alerts and capping with historical power counters 4. Redfish API and DMTF Systems Management Architecture for Server Hardware Command Line Protocol (SMASH CLP) 5. Agentless management using the out-of-band remote management port 6. Remote management of server over LAN and WAN with SSL encryption through gigabit management port 7. Advanced Encryption Standard (AES), SNMP v3, TLS 1.3 or above, Active Directory v1.0 8. HTML5 based virtual console, remote firmware update (BIOS/BMC)	<i>As specified.</i>		
11	Power Supplies	80+ Platinum Certified Redundant Power Supply with minimum Power Rating of 1200W Power supplies should be only of the make/model approved for the motherboard. Power supply has to be configured in N+1 redundancy The system should sustain in the occasion of failure of one power supply. Power Management Bus (PMBus) support should be provided and status information must be available via IPMI	<i>As specified.</i>		
Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks

12	Power Cord and other cables	Power cable should have IEC 320 (male-female) connectors matching the peak-load rating of the power supplies. All the network cables required are to be supplied in appropriate numbers and of appropriate specification.	<i>As specified.</i>		
13	OS Support	The system should support the following minimum operating systems without any deviations: Windows Server 2022 Windows Server 2025 RHEL 9.4 - 9.x Ubuntu 22.04 LTS VMware ESXi 8.0 U3, ESXi 9.0, ESXi 9.1	<i>As specified.</i>		
14	Warranty	5 years comprehensive on-site advance replacement warranty on Server and on GPU. Warranty includes 5-Year Parts, 5-Year Labour, 5-Year Onsite support	5 years comprehensive on-site advance replacement warranty on the complete server INCLUDING the accelerator / GPU. The warranty shall be trackable online on the OEM website through the system serial number, providing a detailed system hardware configuration report.		
15	Environment compliance	RoHS compliance	<i>As specified.</i>		
16	MII (Make in India)	It is mandatory to submit declaration of breakup of MII (Make in India) content with proof, either at component or overall system level.	<i>As specified.</i>		
17	Job Scheduler	Open source job scheduler, SLURM must be installed and demonstrated to be working with job submission scripts.	<i>As specified.</i>		
18	MAF & BOM	The Vendor must provide Manufacturer Authorization Form (MAF) and technical Bill Of Material (BOM) with the quote	<i>As specified.</i>		
19	Software / OS Installation	The Bidder / OEM shall install the Operating System, MPI and job schedulers, and shall reinstall or update the same as and when required throughout the warranty period.	<i>As specified.</i>		
20	Product Life & OEM Support	The quoted product should not be End-of-Life (EOL) or End-of-Service (EOS) for a minimum of 5 years, and OEM support including all spare parts must be available for a minimum of 5 years from the date of installation and	The quoted product shall not be End-of-Life (EOL) or End-of-Sale/End-of-Service (EOS) for a minimum of 5 years from the date of installation and acceptance, and OEM support including all spare parts shall be		
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		acceptance. An OEM undertaking to this effect must be submitted.	available for a minimum of 5 years from the date of installation and acceptance. An OEM undertaking to this effect must be submitted with the bid. This clause is platform-selecting and no relaxation will be granted on grounds of processor make, processor generation or memory platform: a bidder unable to certify an older platform for 5 years should quote a newer one.		
21	Spare Parts	The OEM shall maintain and supply all the necessary spare parts for a minimum of 5 years to ensure faster response and resolution.	The OEM shall maintain and supply all necessary spare parts for a minimum of 5 years from the date of installation and acceptance, to ensure faster response and resolution.		

III.Additional Infrastructure

Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks
1	42U Rack	42U, 19 inch server rack with sufficient PDUs to house all the rack-mountable hardware.	<i>As specified.</i>		
2	UPS System	3 kVA UPS system with the required number of batteries to provide adequate battery backup at full load.	<i>As specified.</i>		
3	Console	1 x Monitor, 1 x Keyboard and 1 x Mouse.	<i>As specified.</i>		
4	Cluster Interconnect and Network Switch	Minimum acceptable: a non-blocking managed minimum 24-port 1G switch with all cabling. A separate or VLAN-segmented management / IPMI network shall also be provided.	<i>As specified.</i>		
5	Shared Filesystem (NFS minimum)	4 x 8 TB storage in the Master Node (configured in RAID-5) will be used as NFS share and mounted on the compute node. A shared filesystem shall be provisioned and exported to every node (NFS at minimum) for home directories, application binaries and job data, since Slurm and MPI require a common namespace across all nodes.	<i>As specified.</i>		

IV.Software Stack

Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks
1	Cluster Manager	A cluster management tool shall be supplied and fully supported for provisioning, monitoring and management of all the nodes.	<i>As specified.</i>		
2	Job Scheduler	Slurm Workload Manager shall be installed and configured on the cluster.	<i>As specified.</i>		
3	Cluster Monitoring	A solution must be provided for remote monitoring of cluster running status.	<i>As specified.</i>		
4	Scientific Libraries and Environment Modules	Parallel HDF5, FFTW, GSL and LAPACK/BLAS (Intel MKL acceptable) shall be installed, together with the GNU compilers (gcc and gfortran). Environment modules (Lmod or environment-modules) and HPC package management using SPACK must be installed.	<i>As specified.</i>		

V.General Terms and Eligibility

Sr. No	Parameter	Technical Specification	Platform-Neutral Requirement (AMD or Intel, DDR4 or DDR5)	Compliance (Yes/No)	Remarks
1	Blacklisting	The Bidder and OEM should not have been blacklisted, banned or debarred in the past 10 years by any Govt / PSU / GeM organization. An undertaking to this effect must be submitted. (Annexure – VII)	<i>As specified.</i>		
2	Local Office and Field Service Engineers (FSE)	The Bidder / OEM must have a local registered office in the Mumbai/Pune Region along with a dedicated team of Field Service Engineers (FSE). A Field Service Engineer is a technically qualified engineer deployed by the Bidder / OEM at the customer site to carry out installation, preventive maintenance, fault diagnosis, repair and replacement of hardware, and to provide timely on-site response to any support calls logged during the warranty period. Proof of the local office along with a list of qualified FSEs must be submitted.	<i>As specified.</i>		
3	Scope of Work (Racking and Commissioning)	The entire job shall be executed on a turnkey basis by a single vendor and shall include supply, racking, installation, configuration, commissioning, testing and integration of the complete solution. The supply, installation, configuration, commissioning, testing and maintenance support for both hardware and software during the warranty period should be	<i>As specified.</i>		

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		provided either by OEM engineer or by OEM authorized system integrators engineers.			
4	Training	The Bidder shall provide training on cluster usage to administrators as well as to research scientists.	<i>As specified.</i>		
5	Site Preparation	It is mandatory to submit the detailed power, cooling and rack-space requirements, including the schematic diagram and rack layout, along with the technical bid.	<i>As specified.</i>		
6	Benchmark and Acceptance Testing	Acceptance and final payment shall be contingent on a written benchmark and acceptance test executed at the customer site after commissioning, with thresholds agreed in the purchase order. The bidder shall demonstrate: (a) HPL (LINPACK) sustained performance across all compute nodes through the supplied interconnect; (b) OSU Micro-Benchmarks point-to-point and collective latency and bandwidth across nodes; (c) at least one representative double-precision application run from the target stack, each completing successfully and reproducing reference results.	As specified, and in addition the acceptance test shall include (d) measurement of the sustained STREAM Triad memory bandwidth per node, performed on the delivered machine in its as-supplied memory configuration with all cores active, to verify the figure declared under General Terms clause 7.		
7	Service Level Agreement (Response and Resolution Timescales)	The following service levels shall apply throughout the warranty period and shall be deemed part of the contract. All timescales are counted from the time a fault is logged by the purchaser with the Bidder's designated support contact, by email, telephone or web portal. (a) Call logging. The Bidder shall provide a single point of contact for fault reporting, available on all working days, together with an escalation matrix listing at least three levels of contact with names, designations, telephone numbers and email addresses. The escalation matrix shall be submitted at the time of installation and kept current throughout the warranty period. Every logged call shall be acknowledged with a unique ticket reference within 4 working hours. (b) On-site response. For any fault rendering a node, the storage, the network switch, the accelerator or the cluster software stack unusable or degraded, a qualified Field Service Engineer shall attend the site within 24 working hours of the call being logged. For faults not affecting			

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		availability, on-site response shall be within 48 working hours. (c) Resolution. The Bidder shall restore the affected equipment to full working condition within 5 working days of the call being logged for faults affecting availability, and within 7 working days for all other faults. Where a defective part must be replaced, the replacement shall be new and of equal or higher specification, and shall be supplied on an advance-replacement basis at no cost to the purchaser. In case of any replacement during the warranty period the same shall be made free of cost. All the duties / taxes relating to these replacements have to be borne by the supplier. (d) Standby / temporary replacement. If a fault affecting availability cannot be resolved within 5 working days, the Bidder shall provide functionally equivalent standby equipment at no additional cost, until the original equipment is restored, and shall bear all costs of installation and removal of such standby equipment. (e) Uptime. The Bidder shall ensure a minimum uptime of 98 percent for the complete cluster, calculated on a quarterly basis over working days, excluding downtime attributable to scheduled preventive maintenance agreed in advance with the purchaser, to failure of site power or air-conditioning, or to any cause solely attributable to the purchaser. (f) Penalty for non-compliance. For each working day, or part thereof, by which the resolution timescale in sub-clause (c) is exceeded, a penalty of 0.5 percent of the value of the affected equipment shall be levied, subject to a maximum of 5 percent of the value of that equipment per incident. Alternatively, and at the purchaser's discretion, the warranty period of the affected equipment shall be extended by twice the period of the delay. Penalties may be recovered from any outstanding payment, from the performance security, or by direct demand. (g) Preventive maintenance. The Bidder shall carry out preventive maintenance of the complete system using Predictive Failure Analysis (PFA). PFA alerts system across			

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		CPUs, DIMMs, adapter slots, fans, PSUs and storage should be implemented.			
8	Security feature	(a) Should have a cyber resilient architecture for a hardened server design for protection, detection & recovery from cyber attacks (b) Should protect against firmware which executes before the OS boots (c) Should provide system lockdown feature to prevent change in system firmware image(s) & prevent malicious modification of server firmware.			
9	Other mandatory feature	Predictive Failure Analysis: PFA alerts should be available for all major components, including CPUs, DIMMs, adapter slots, fans, PSUs, storage devices etc.			
10	Platform Choice, Memory Bandwidth Declaration and Evaluation	(a) Platform choice. Bidders may quote either a DDR4-based or a DDR5-based platform, and either AMD or Intel processors, whichever combination the bidder is able to offer at the lower price. No make, generation or memory platform is preferred and all are fully eligible, provided every mandatory clause of this specification is met, including the minimum memory configuration and the distinct-channel population rule in the Memory clauses. (b) Declaration. Each bidder shall declare, in the technical bid, the sustained STREAM Triad memory bandwidth in GB/s, separately for the master node and for the compute node. The figure shall be measured on the EXACT memory configuration quoted - the same number of modules, the same module capacity and the same slot positions as offered - with all physical cores active. Measurement shall use the standard (unmodified) STREAM benchmark of J. D. McCalpin, compiled with OpenMP, with each array at least four times the aggregate last-level cache of the node, threads bound to physical cores. The bidder shall state the compiler, compiler flags, array size, thread count, module count, module capacity and slot positions used. A bid that does not declare a figure shall be scored zero on this parameter but shall not be disqualified on that ground alone.	This clause is the mechanism that makes DDR4 and DDR5 bids, and AMD and Intel bids, directly comparable on a single scale. It shall be read together with the Memory clauses of the Master Node and Compute Node schedules.		

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		(c) No bandwidth threshold. No minimum memory bandwidth is imposed and no memory platform is excluded. The bandwidth parameter is a relative, weighted score only, so that DDR4 and DDR5 bids and AMD and Intel bids compete on the same scale, and a lower-priced bid on any platform can win on total score. (d) Indicative range. For the minimum memory configuration specified (8 modules across 8 distinct channels on the compute node), sustained STREAM Triad is expected to fall broadly in the range of about 160 to 185 GB/s on a DDR4-3200 platform and about 250 to 280 GB/s on a DDR5-4800 platform. These figures are indicative only, are not thresholds, and are stated solely to assist bidders in validating their measurement methodology. A declared figure materially above the theoretical peak of the quoted configuration will be treated as evidence of an invalid measurement. (e) Verification and remedy. The declared bandwidth shall be re-measured at site during acceptance testing under clause 6, on the delivered machine in its as-supplied configuration. If the measured sustained STREAM Triad bandwidth is more than 10 percent below the declared figure, the bidder shall remedy the configuration at no additional cost to the purchaser, failing which the purchaser may invoke the remedies set out in the purchase order.			