



**TERMS OF REFERENCE FOR THE SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING  
AND COMMISSIONING OF HIGH-PERFORMANCE COMPUTING MACHINE FOR PROVIDING  
HIGH RESOLUTION (5KM) CLIMATE CHANGE PROJECTIONS IN THE PHILIPPINES USING  
WEATHER RESEARCH AND FORECASTING (WRF) MODEL**

**A. OVERVIEW**

The Climatology and Agrometeorology Division (CAD) is responsible for the generation of Climate Projection in the Philippines. The enhanced and updated Climate Change Projection is one of the PAGASA's mandates to provide empirical evidences for the formulation of Science-based decisions and build-resilience to future climate-related risks.

To meet the growing demand for climate information, there is a need to improve the PAGASA's Climate Projection. At present, CAD only produces climate projection at 25-km resolution at provincial level and there were shared to local up-to national agencies such as NEDA, DA, DENR, and CCC. However, the small provinces (e.g. Batanes, Marinduque, Siquijor, Biliran, etc.) were not represented in the 25 km resolution, to be able to improve and resolve this issue, and to address one of the most pressing challenges in modeling research that demands the use of most advanced computer machines available, a designated High-Performance Computing (HPC) Machine for climate projection is extremely essential.

The HPC Machine for climate projection of the CAD, needs all necessary administration, application, training, uninterruptible power supply, visualization tools, compilers and libraries, system software, and extended warranties and support. Furthermore, this project should be compatible and ready to be deployed into the current PAGASA setting, and can be used immediately once installed and implemented.

Post processing and visualization of the Climate Model outputs with the deliverables will serve as a key, to further develop the climate information in the Philippines. It will help not only the Local Government Units (LGUs) but also stakeholders and decision makers (e.g. Impact assessment for various sector such as water, health, etc.), and It will also serve as a pool of

new research studies like Pseudo Global Warming, Urban Heat Island, and other climate related studies that will lead to better understanding of climate change.

## **B. APPROVED BUDGET FOR THE CONTRACT**

The Approved Budget for the Contract is **FIFTY-TWO MILLION PESOS (PhP 52,000,000.00)** inclusive of Value Added Tax (VAT), custom duties, and other government taxes.

## **C. BID VALIDITY**

The bid proposals shall remain valid for a period of one hundred twenty (120) calendar days from the date of submission of bids.

## **D. QUALIFICATIONS OF PROSPECTIVE BIDDERS**

Please refer to Section II, Instructions to Bidders, the Bid data Sheet and Checklist of Eligibility and Technical Requirements of the Bidding Documents.

In addition, the prospective Bidder(s) must have the following:

1. High Performance Computing Environment Experience – The manufacturer of the high-performance computing machine to be supplied, must have at least four years of experience of providing computing resources intended for scientific and technical problems on the premise of computer simulation.
2. Prospective Bidder's experience and capability
  - 2.1 The prospective bidder should submit certificates regarding their experience in installation, configurations, troubleshooting and other technical support services on various ICT equipment, for the last ten years of expertise.
  - 2.2 For purposes of achieving shortened down time of the HPC Machine, especially during the warranty period, prospective Bidders are expected to provide a team of qualified local technicians that can provide and sustain 24/7 support services. Prospective Bidders are required to submit curriculum vitae of a least two (2) numerical modelers and/or technicians including their corresponding training certificates.
  - 2.3 After Sales Support for a detailed Level of Support that the Winning Bidder shall provide during the warranty period.
3. Additional Requirements for Winning Bidders

- 3.1 It is required that the Winning Bidder or the manufacturer must collaborate with National Center for Atmospheric Research (NCAR) in Boulder, Colorado, through its scientists for the installation and implementation of Weather Research and Forecasting (WRF) for Climate Projection System of PAGASA, including technical training.

#### **E. PERIOD AND PLACE OF DELIVERY**

The Winning Bidder shall supply, deliver, install, test and commission the PAGASA Climate Forecast Computing facilities with installed WRF for Climate Projection System of PAGASA, at PAGASA Data Center, WFFC Compound, Agham Road, Diliman, Quezon City and the requisite training and technical meeting thereto, within one hundred calendar days (100 c.d.), commencing from the date of issuance of the Notice to Proceed. Moreover, technical training and meeting related to the implementation of the HPC Machine shall also be provided by the Winning Bidder, within one hundred calendar days (100 c.d.), commencing from the date of issuance of the Notice to Proceed.

#### **F. BID PROPOSAL CONTENTS**

1. The prospective bidder shall submit an **Engineering Plan and Block Diagram** (i.e., electrical, networking, mechanical, cooling system) of the whole HPC Machine, its power supply requirement, Uninterruptible Power Supply (UPS), the grounding system and other accessories with complete sets of brochures and manuals. The Engineering Plan and Block Diagram should be duly signed by Professional Electrical Engineer and shall be subject for approval by PAGASA Engineering and Technical Services Division.
2. The prospective bidder shall likewise clearly indicate in its bid offer the model number and specifications of the HPC Machine and all other equipment and accessories referred to in **Item G. Technical Specifications and Requirement (1-14)** to be supplied, if awarded the contract for the Project.
3. To aid the procuring entity in its procurement planning and to ensure a sustainable and continuous operation and maintenance of the computing machine, the prospective Bidder shall be required to include in its bid proposal a list of recommended spare parts, both serviceable and disposable, with their corresponding prices and guarantee their availability in the market within the next five years.
4. Product documentation on the HPC Machine management and software solution detailing use for HPC scenarios should be submitted together with this bid.

5. The prospective bidder or manufacturer should provide at least three (3) customer references on the proposed HPC Machine. The site references must currently be used for production by operational National Hydrological and Meteorological Services who are members of the World Meteorological Organization (WMO).

**G. TECHNICAL SPECIFICATIONS AND REQUIREMENT**

The Winning Bidder Shall **Supply, Deliver, Install, Test, Supervise, Train, finish all labor and perform operations necessary to complete the Commission for the PAGASA’s HPC Machine for Climate Projection at PAGASA, Quezon City** and conduct the required meetings/trainings based on the following minimum specifications:

**G.1 SOLUTION ARCHITECH**

<b>Specification</b>
<b>G.1.1</b> Provide High-Performance Computing Machine Infrastructure
<b>G.1.2</b> Include Weather Research and Forecasting (WRF), Regional Climate Model (RegCM), Conformal-Cubic Atmospheric model (CCAM), Providing Regional Climates for Impact Studies (PRECIS), and required libraries to run climate model applications
<b>G.1.3</b> Must Provide Software Applications for Analysis, Post-processing, and Visualization. See section G.3 (CDO, NCO, NCL, NCVIEW, XCONV, MATLab, and R)
<b>G.1.4</b> Provide On-site technical training on related hardware and software

**G.2.1 TECHNICAL SPECIFICATIONS:**

<b>Item No.</b>	<b>QUANTITY AND UNIT</b>	<b>DESCRIPTION</b>	<b>SPECIFICATIONS</b>
<b>1</b>	<b>1 Lot</b>	<b>High Performance Computing (HPC) Machine</b>	<p><b>The Proposed HPC Machine must:</b></p> <ul style="list-style-type: none"> <li>• <b>at least total of 1000 Physical Cores</b></li> <li>• <b>Supports at least 60 teraflops of performance</b></li> <li>• <b>Must have at least 945TB useable storage capacity</b></li> <li>• <b>Must have at least 4TB System RAM, 2666Mhz DDR4-2666</b></li> </ul>

2	2 Unit	HPC Login/Master Nodes	<ul style="list-style-type: none"> <li>• 2 x 20-core processors of Intel Gold Scalable processors clocking at 2.4GHz or better;</li> <li>• 384 GB DDR4 2666MHz RAM. Each memory DIMM module must be an ECC 16GB DDR4-2666 RDIMM or better;</li> <li>• 1 x 1Gb 4-port Base-T or higher;</li> <li>• 1 x Intel OPA 100 series or EDR Infiniband single-port PCIe network card;</li> <li>• 12Gb SAS or 8G FC HBA card;</li> <li>• 2 x 240 GB SSD or higher;</li> </ul>
3	1 Lot	Compute Node Servers	<ul style="list-style-type: none"> <li>• 2 x 20-core processors of Intel Gold Scalable processors clocking at 2.4GHz with 27 MB L3 Cache or better;</li> <li>• 192 GB DDR4 2666MHz RAM per node. Each memory DIMM module must be an ECC 16GB DDR4-2666 RDIMM or better;</li> <li>• 1 x 10Gb 4-port Base-T or higher;</li> <li>• 2 x 240 GB SSD or higher</li> <li>• RHEL 7.0, CentOS 7.0, SUSE Linux Operating System or better;</li> </ul>
4	1 lot	Shared storage for login nodes	<ul style="list-style-type: none"> <li>• two storage controllers or better;</li> <li>• 4 x 12Gb SAS or 8G FC ports per controller;</li> <li>• 12 x 1.2TB at 10k rpm –HDD or higher;</li> </ul>
5	1 lot	HPC Storage Subsystem	<ul style="list-style-type: none"> <li>• scalable parallel file system solution or better;</li> <li>• 945TB useable capacity in RAID6 or RAID 5 or using erasure coding configuration;</li> <li>• support and implementation of high-performance interconnect of Omni Path Architecture (OPA) or Infiniband;</li> <li>• support low latency RDMA communication for data transfer between compute node and fileserver;</li> <li>• support 2-fault/3-fault tolerance of disk failure to provide data integrity, reliability and flexibility;</li> </ul>

**TERMS OF REFERENCE**

			<ul style="list-style-type: none"> <li>no single point of failure in the overall architecture and the solution should be highly available so that there is no loss of access to data even in the event of a complete node or controller failure;</li> </ul>
6	1 Lot	100 Gbps Low Latency Switch	<ul style="list-style-type: none"> <li>unidirectional throughput of at least 100Gb/sec per port or better;</li> <li>configurable from one to eight virtual lanes plus one management virtual lane;</li> <li>interconnect includes two (2) spine switches and one (1) leaf switch;</li> <li>deliver minimum of 60 TFlops overall performance of HPC and can accommodate 42U of Racks;</li> </ul>
7	2 pcs	42U Server Racks	<ul style="list-style-type: none"> <li>include 2 power distribution unit per rack as required by the proposed system;</li> </ul>
8	1 unit	Management Network Switch	<ul style="list-style-type: none"> <li>48x 10/100/1000BASE-T RJ-45 ports and four 10 Gigabit Ethernet SFP+ ports to act as management switches or higher;</li> </ul>
9	1 lot	Management Software	<ul style="list-style-type: none"> <li>open source cluster management software stack, consolidating the management, monitoring and scheduling functions into a single platform;</li> <li>include workflow templates to provide an intuitive starting point for less experienced users;</li> <li>include management of private space on shared storage;</li> <li>monitoring of job progress and log access (Sun Grid Engine);</li> <li>include console access for advanced cluster users with command-line skills;</li> <li>include a cluster management portal consolidating monitoring, alarms, and reporting;</li> <li>compatible with popular shared file systems (Spectrum Scale, Network File System 'NFS', Lustre, Ceph) and other file systems;</li> </ul>

**TERMS OF REFERENCE**

10	1 pc	Operating System	<ul style="list-style-type: none"> <li>Linux environment, preferably Linux CentOS;</li> </ul>
11	1 lot	Uninterruptible Power Supply (UPS)	<ul style="list-style-type: none"> <li>Uninterruptible Power Supply (UPS) subsystem that provides minimum system backup time of 15mins, based on the proposed design for the total power requirement or better;</li> <li>UPS system should include auxiliary transformers and connection requirements;</li> </ul>
13	1 Lot	1U Rack mount KVM Console	<ul style="list-style-type: none"> <li>16 ports or better;</li> </ul>

### G.2.2. MOBILE WORKSTATION

Item No.	QUANTITY AND UNIT	DESCRIPTION	SPECIFICATIONS
14	3 Units	Mobile Workstation	<p>Each unit must have the following specification:</p> <ul style="list-style-type: none"> <li>4 cores Intel core i7 with hyper-threading with 8MB cache or better.</li> <li>16GB memory @ 2133Mhz or better</li> <li>Integrated Intel UHD 620 or discrete graphics.</li> <li>Storage capacity of 512GB Solid State Drive or better</li> <li>13.3 inches FHD display or better</li> <li>802.11 ac wireless networking plus Bluetooth, with Miracast capable or better</li> <li>Windows 10 64bit operating system</li> <li>Microsoft Office 2016 (Home and Business) Permanent License</li> </ul>

### G.2.3 SOFTWARE

Item No.	QUANTITY AND UNIT	DESCRIPTION	SPECIFICATIONS
1	One (1) Unit	*1 MATLAB Server license for HPC Machine; and	<ul style="list-style-type: none"> <li>• must be a multi-paradigm numerical computing environment and proprietary programming language</li> <li>• must Include the following toolbox:               <ol style="list-style-type: none"> <li>a. Symbolic Math Toolbox</li> <li>b. Partial Differential Equation Toolbox</li> <li>b. Statistics and Machine Learning</li> </ol> </li> </ul>
2	One (1) Unit	*1 MATLAB license for Mobile Workstation	<ul style="list-style-type: none"> <li>• must be a multi-paradigm numerical computing environment and proprietary programming language</li> <li>• must Include the following toolbox:               <ol style="list-style-type: none"> <li>a. Symbolic Math Toolbox</li> <li>b. Partial Differential Equation Toolbox</li> <li>c. Statistics and Machine Learning</li> </ol> </li> </ul>
3	1 Intel Fortran Compiler License	1 Intel Fortran Compiler License for the HPC Machine	<ul style="list-style-type: none"> <li>• Installation of Intel Fortran Compiler to the HPC Machine</li> </ul>
4	1 lot	Post-processing and visualization	-include the following software tools: <ol style="list-style-type: none"> <li>a. NetCDF Operators (NCO)</li> <li>b. Climate Data Operators (CDO)</li> <li>c. R Software / RStudio</li> <li>d. NetCDF viewer (ncview, xconv)</li> <li>e. Panoply</li> <li>f. Vapor</li> </ol>
5	1 unit	Required libraries for Climate models	<ul style="list-style-type: none"> <li>• all required libraries to run and implement the WRF for climate, RegCM, CCAM, and PRECIS.</li> </ul>

### H. NETWORKING AND DATA CABLING

The winning bidder shall supply necessary supporting peripherals required by the system design including connection with existing PAGASA Data Center local area network.



## **I. ELECTRICAL SYSTEM**

The winning bidder shall coordinate with PAGASA Engineering and Technical Services Division (ETSD) regarding the electrical system before and during the implementation of the project.

## **J. IMPERATIVE NUMERICAL MODELS**

The Winning Bidder shall install the latest stable version of the following numerical models for operational and research use of PAGASA:

- Weather Research and Forecasting Model (WRF - NCAR/UCAR USA) for Climate Projection System of PAGASA – including implementation of **RegCM, CCAM, and PRECIS**
- In addition to the above-mentioned model, the Winning Bidder shall assist the Scientist and Technical staff of PAGASA on the installation of PAGASA Regional Climate Model (WRF) System to the HPC Machine.

It is important that the Winning Bidder shall recommend the most optimized configuration of the WRF model in terms of the combination of physics and parameterizations. The optimized configuration shall be a product of sensitivity analysis on the different configurations tested by the Winning Bidder. Sensitivity analyses done for WRF for Climate Projection System of PAGASA shall be documented by the Winning Bidder with the assistance from PAGASA and the results of which shall be presented to the PAGASA Executive Staff and other concerned entity.

The configuration of WRF for Climate Projection System of PAGASA including the resolution, domains/nests and the number of grid points, shall be finalized together with PAGASA. All output parameters (temperature, pressure, rainfall, etc.) and formats (for images, station data, etc.) shall be discussed by the Winning Bidder with PAGASA operations and research staff during the technical training and/or technical meeting.

## **K. VISUALIZATION TOOLS**

A software or tool for displaying the model output (images, station data, etc.) from WRF Climate Projection System of PAGASA shall be deploy and installed by the Winning Bidder, please see section G.2.3 item no. 4.

## **L. TESTING PROCEDURE**

The Winning Bidder shall include in its submissions a **detailed testing procedure or methodology**. The detailed testing procedure and methodology shall include the full validation and testing on-site.

## **M. SITE ACCEPTANCE TEST (SAT) and On-Site Training**

Site Acceptance Test (SAT) shall be conducted on-site at WFFC Compound, Agham Road, Diliman, Quezon City, Metro Manila. The purpose of the test is to verify the performance of the Machine in accordance with the specifications and functional requirements. Any defect or deviation discovered during the site acceptance test shall be rectified by the Winning Bidder immediately or within a maximum period of one (1) month from the completion of the test. After such rectification, another testing shall be made to verify the rectification.

The SAT shall be witnessed and accepted by at least three (3) members of the PAGASA Executive Staff (Administrator and/or Deputy Administrators or Chief of CAD) and/or end-user and shall be conducted within a total of seven (7) calendar days.

A 5-day on-site training on the use of the HPC Machine shall be conducted. All expenses related to the on-site training on HPC shall be provided to a minimum of five (5) participants by the Winning Bidder.

## **N. HPC MACHINE COMMISSIONING**

After the satisfactory conclusion of the Site Acceptance Test, the Winning Bidder shall demonstrate the capability of the HPC Machine which will be operated continuously for a 5-day period. The successful demonstration thereof shall mean that the HPC Machine has been commissioned.

## **O. WARRANTIES**

1. Three (3) years warranty on all hardware and software.
2. Availability of technical support on 24/7 via email, phone, or SMS during the warranty period.
3. For severe or critical issues, a Service Level Agreement (SLA) of 4 hours response time should be available.
4. Proof of Product: Datasheets/Brochures with indications of certified Standards.

5. The winning bidder should not assign, transfer, pledge nor subcontract any part or interest therein.

#### **P. AFTER SALES SUPPORT**

The Winning Bidder shall include in its bid a commitment for at least five (5) years support to PAGASA for the repair and maintenance of the equipment to be supplied. It shall include in its commitment a provision of a reliable, swift and efficient on-site support, available 24/7 trouble and ticketing and response system (especially during critical events), and ensure a quick and readily available supply of spare and replacement parts.

#### **Q. HPC MACHINE DOCUMENTATIONS**

The Winning Bidder shall likewise provide PAGASA with the HPC's installation, operations and maintenance manuals. Said manuals shall contain among others the complete and detailed schematic diagrams, theory of operations, calibration and maintenance procedures. **This should also provide modifications on the original setup of the HPC.**

All other hardware and software requirements shall also be turned-over to PAGASA prior to the issuance of the Final Inspection and Acceptance report.

In addition, the Winning Bidder shall provide a complete list of deliverables and installation materials.