TERMS OF REFERENCE FOR THE SUPPLY, DELIVERY, INSTALLATION, TESTING, TRAINING, AND COMMISSIONING OF THE ADVANCE DIGITAL FORECASTING INFRASTRUCTURE (ADVANCED WEATHER ANALYSIS AND VISUALIZATION TOOLS USING AWIPS II) – PHASE 1

A. BACKGROUND

It is the policy of the State *"to utilize scientific and technical knowledge and information as an effective instrument to ensure the safety, well-being, and economic security of the people; to safeguard the environment; and to promote national progress and sustainable socioeconomic development through various applications of meteorology, geophysics, astronomy and allied sciences*."[1] As such, efforts are being undertaken by the state meteorological bureau Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) to improve its technological operational capacity to ensure the provision of adequate, up-to-date data, and timely weather information and services. One of the ways by which weather services can be improved to meet the ever-increasing demands of the public and other specialized sectors (*i.e.*, marine industry, tourism, agriculture, etc.) is to revolutionize the methodologies employed in analysis and forecast operations, which includes the introduction of tools and guidance to view and understand the past and present state of the atmosphere and provide the reliable weather forecast information.

PAGASA operates a network of meteorological observation facilities, both manned and unmanned, that performs a multitude of in-situ measurements and remote sensing of the atmosphere across space and time. Such facilities include manned surface weather observation stations, automatic weather stations / rain gauges, upper-air stations, weather surveillance radars, high-frequency coastal radars, and lightning detectors. This is in addition to a ground receiving facility that receives data from geostationary and polar-orbiting satellites covering the Philippine region. However, there remains a lack of open-source, highly customizable, and scalable software framework designed by and for operational meteorologists for ingesting, managing, and displaying meteorological data with a wide array of formats (e.g., grib2, netCDF). At the present time, PAGASA forecasters view these observation data from a variety of display systems or workstation software that are usually proprietary and non-customizable by the end user at any point during the forecast operations.

In terms of approach to preparing weather forecasts, PAGASA meteorologists employ a point-based forecasting approach in providing forecast information of sensible weather. For instance, the Weather Division provides a 5-day outlook of weather conditions and maximum/minimum temperatures for 16 key cities in the country. To accomplish this, a forecast manually looks and assesses meteograms, forecast charts and observation data at each point, normally represented by the synoptic station representing the key cities, to create the forecast. For the 5-day outlook, this process must be repeated 16 times, which is time-consuming and limits the areas where detailed forecasts of sensible weather can be provided. The same approach is used by meteorologists providing localized regional forecasts in PAGASA Regional Services Division. Such a method limits the number of areas PAGASA can provide detailed forecasts of sensible weather out to 5 to 7 days. In addition, the bulk of the forecasters' workload is dedicated to typing worded forecast, aside from the time needed to perform the labor-intensive point-based forecast approach. Less time is dedicated to

[1] Section 2. Declaration of Policy, Republic Act No. 10692 (PAGASA Modernization Act of 2015)

performing a more in-depth prognostication of the atmosphere and the objective verification of model and official forecasts. Lastly, the current approach to forecast preparation prevents the forecasters from fully harnessing the value of information provided by high-resolution numerical weather prediction models.

The National Weather Service (NWS) of the United States' National Oceanic and Atmospheric Administration (NOAA) faced the same dilemma in the 1980s and 1990s. To address these issues, the then-Program for Regional Observing and Forecasting Services was tasked to develop a forecasting workstation to support weather data handling, graphical display, and product demonstration. This led to the introduction of the Advanced Weather Interactive Processing System (AWIPS) in 1997. A second version of the system was successfully rolled out to NWS Weather Forecast Offices in 2015. The AWIPS technology now serves as the cornerstone of the operations of the NOAA/NWS and its 9 National Centers, 122 Weather Forecast Offices, and 13 River Forecast Centers. Using this system, forecasters in WFOs of the NWS can view, combine, and analyze large amounts of meteorological data (e.g., observation, model, etc.) from both domestic and foreign sources.

An important component of the AWIPS is the Interactive Forecast Preparation System (IFPS). This system allows forecasters to prepare forecast information by editing graphical depictions of forecast conditions (e.g., temperature, dew point temperature, wind speed and direction, sky cover, rainfall, etc.) from actual gridded NWP model forecasts using an actual interactive on-screen editor called the Graphical Forecast Editor. Forecast products in text, tables, graphics, and voice formats are then generated automatically from the resulting gridded official forecast (also known as digital forecast) using the IFPS. This will allow the generation of official forecast information (i.e., forecasts produced by operational meteorologists) at spatial and temporal resolutions never seen in the Philippine setting and in formats that can be disseminated to a much wider audience through contemporary and new media platforms.

The introduction of IFPS and digital forecast represents a major paradigm shift in the way forecast operations work. Despite this shift, many benefits are seen in introducing IFPS. All forecast products are now consistent because they are generated from a single digital forecast. Forecasters can now focus on better prognostication of weather systems and the resulting sensible weather, instead of allocating a significant portion of the shift on generating forecast products. With NWP model grids as direct source of the forecast first guess (i.e., forecasters editing the NWP output via the GFE), the value of these models, especially those with high resolution, will be fully harnessed in the preparation of the forecast. Lastly, future products can be introduced with minimal effort (i.e., new products will not add significant burden to the forecaster) because all that is needed is to extract the information needed by the new product from the digital forecast created using the IFPS.

With PAGASA facing the same challenges and user demands, the introduction of a forecaster workstation software suite following the technology and innovations of the AWIPS II will address these issues and ensure that the Agency continues to meet its obligations to the public and various sectors. With rising availability of digital forecasts from commercial sources that compete with the public sector in the provision of timely and reliable public weather service, it is the duty of PAGASA as the national meteorological service to ensure that the ever-growing demand of end users for location-specific and complex weather information on a day-to-day basis are satisfied.

As such, it is imperative for PAGASA, through the Weather Division to introduce and operationalize an Advanced Digital Forecasting Infrastructure suite that (1) is nominally based on the Advanced Weather Interactive Processing System II, (2) utilizes open-source technology that is customizable and scalable to the current and future needs of PAGASA forecast operations at the national and local levels, and (3) enables the introduction of digital

forecast for short-term weather forecast products in the Philippines through an integrated interactive forecast processing system (IFPS). Considering the complexity of the technology needed, the degree of paradigm shift needed to transition to the proposed operational forecasting platform, and the experiences of other operational meteorological centers (i.e., Taiwan Central Weather Bureau, US National Weather Service), it is imperative that the introduction, transition, and full operationalization of the advance shall be done in multi-year phases to ensure the quality introduction, transition, and roll-out of the new system.

The preliminary introduction of gridded digital forecasts for surface meteorological variables requires not only instrumental verification from existing fixed manned weather stations but also instrumental verification from deployable weather instruments in areas where PAGASA stations are far. In addition, digital forecasts generated during cases of high-impact weather require on-site subjective field validation. These circumstances require the acquisition of a service vehicle to facilitate such activities.

B. APPROVED BUDGET FOR THE CONTRACT (ABC)

The Approved Budget for the Contract is **Seventy One Million Ninety Three thousand Pesos** (Php**71,093,000.00**) inclusive of value-added tax (VAT), custom duties, and all other applicable government taxes.

C. QUALIFICATIONS OF WINNING BIDDER

For the qualifications of the prospective bidder, 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 must:

- Have at least five (5) years of experience of successful delivery of integrated hardware-software solutions in the field of meteorology, weather forecasting, or data and computational sciences.
- Have completed contract(s) that are similar in scope and nature of this Project within the period of five (5) years from the date of the scheduled opening of bids. A similar project involves the installation of integrated hardware-software solutions for operational weather forecasting.
- Be able to provide a team of qualified hardware and software programmers and technicians that can provide and sustain 24/7 support services to shorten downtime periods of the advanced digital forecasting infrastructure. The Prospective Bidder shall be required to submit as part of its bid proposal the comprehensive curriculum vitae of at least two (2) technical support personnel including among others, their corresponding training certificates.
- Be willing to sign an Implementing Agreement with PAGASA and NOAA prior to the start of the project, and collaboratively work with the Global Systems Laboratory (GSL) under the auspices of the NOAA Office of Oceanic and Atmospheric Research.

D. PLACE AND DATE OF DELIVERY

The winning bidder shall supply, deliver, install, test, and commission the Advanced Digital Forecasting Infrastructure – Phase 1 at the PAGASA Weather and Flood Forecasting Center (WFFC) Building, BIR Road, Barangay Central , Quezon City and conduct the requisite trainings and technical meetings thereto, within a period of **three hundred calendar days (300 c.d.)** commencing from the date of issuance of the Notice to Proceed (NTP).

E. BID PROPOSAL CONTENTS

In addition to the specific requirements detailed under the Checklist of Eligibility, Technical and Financial Requirements, prospective bidders shall also be required to include in their proposal, original descriptive literature and un-amended brochures of all materials and softwares to be supplied.

All prospective bidders shall submit their proposed Service Level Agreement (SLA).

These details will allow the PAGASA-Bids and Award Committee to fully evaluate and determine compliance from the prospective bidders.

F. TECHNICAL SPECIFICATIONS and REQUIREMENTS

Working alongside GSL, the Winning Bidder shall supply, deliver, install, test, and commission the Advanced Digital Forecasting Infrastructure – Phase 1 based on the Advanced Weather Interactive Processing System II (AWIPS II) at PAGASA, Quezon City and conduct the required trainings and technical meetings based on the following minimum specifications:

AWIPS II System Software

The Advanced Digital Forecasting Infrastructure – Phase 1 must be based on the Advanced Weather Interactive Processing System II (AWIPS II) used operationally at the National Weather Service of the US National Oceanic and Atmospheric Administration. The system is a weather forecasting data and display workstation that ingests and analyzes data, creates useful visualizations, and distributes time-sensitive weather information such as forecasts, watches, advisories, and warnings to users – all within an operational forecasting environment.

To achieve the objectives of the establishment of the Advanced Digital Forecasting Infrastructure, the following minimum features and capabilities must be found in the AWIPS II software:

- **Display 2-Dimensions (D2D)**

  D2D is the default perspective display in the AWIPS Common AWIPS Visualization Environment (CAVE). Its main purpose is to display observational and environmental datasets, satellite-derived products, and forecast model data suites. AWIPS is tailored to the forecaster in that displays are customizable and adaptable on a by-user basis enabling forecasters to dynamically visualize and manipulate numerous model and environmental datasets. Data types can be overlayed, time matched, and fully integrated for a complete atmospheric assessment. Data display features and applications native to D2D include:

- Plan View Displays
- Cross Sectional Displays
- Time-Height Displays
- dProg/dT Displays
- Radar Display
- Satellite Display
- Surface Observations Display
- Upper-Air Display
- NSHARP (National Center Sounding and Hodograph Analysis and Research Program) used to query forecast sounding and hodograph data
- Numerical Weather Prediction (NWP) model suite full volume data displays
- Issued Product Display
- Analysis Tools (e.g., Distance, Time, Motion)
- Ability to import custom maps and file types, including georeferenced formats (e.g., GIS data, geotiff)
- Graphic exportation for decision-support briefings to partners

- **Graphical Forecast Editor (GFE)**

  The GFE is a perspective within CAVE that serves as the graphical on-screen editor forecasters use to create detailed gridded depictions of the weather forecast, stored in a numerical database. The grid size and spacing is customizable and can range from sub 1KM to several KM in size. This allows for the generation of unique forecasts at each grid point throughout the entire domain. Grids can be created from Numerical Weather Prediction models or from simply editing the existing gridded forecast. The weather forecast is created by editing a variety of weather elements that comprise a forecast. Weather elements encompass meteorological phenomena such as temperature, dewpoint, visibility, and probability of precipitation (POP), among many others. Derived forecast products, such as public or marine text formatters, are made automatically from the gridded forecast created by the forecaster. In addition to text formatters, GFE has the capability to disseminate these gridded forecast files in grib2 format. This allows users to digitally interact with the gridded forecast data.

- **Environmental Data Exchange (EDEX)**

  EDEX represents the backend server for AWIPS. Supported for Linux Systems, EDEX typically spreads across multiple machines. AWIPS's service-oriented architecture allows meteorological data to be requested, processed, and served in real-time. Recent upgrades to satellite data, and higher resolution global forecast models, elucidates the need for data decoding and ingestion to be distributed across multiple machines. Incoming data are processed through the Local Data Manager (LDM) to stage the data for ingesting and decoding using EDEX, and eventual display in CAVE.

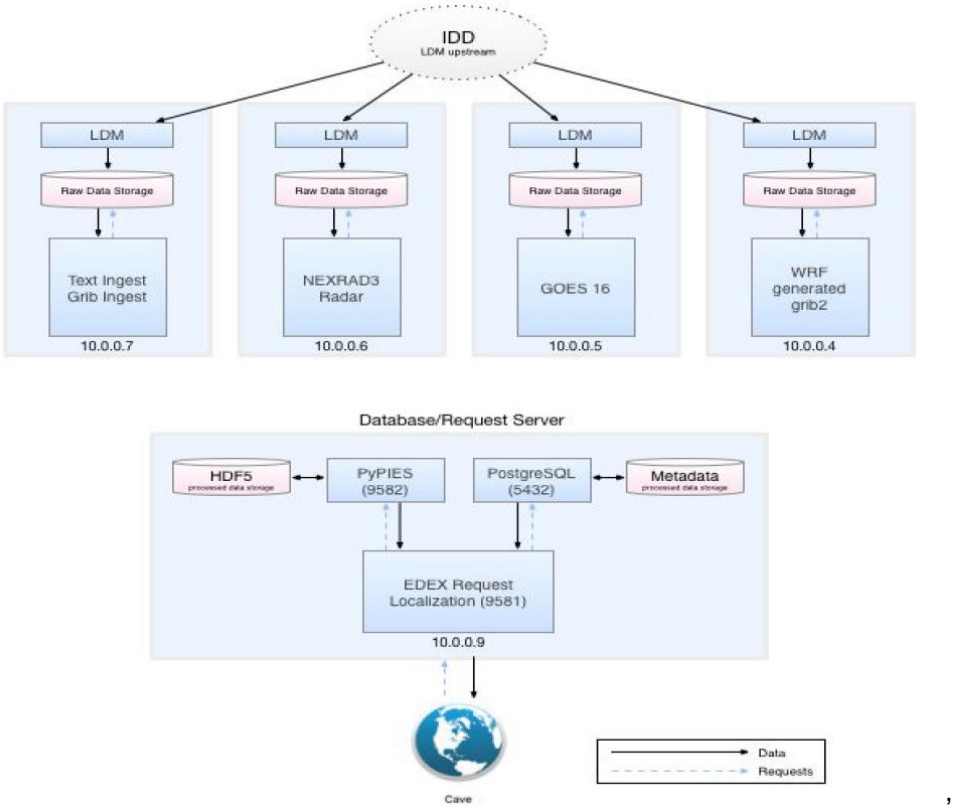

Fig. 1. A flow diagram depicting how meteorological data is processed through the LDM for ingesting and decoding using EDEX, and eventual display in CAVE.

Under the Phase 1 implementation of the Advanced Digital Forecasting Infrastructure, the following minimum milestones must be met for the implementation of the AWIPS II System Software:

- Prepare baseline software with AWIPS-ready data, configured for geography of PAGASA public weather, marine, and tropical cyclone forecast areas.
- Configure maps (D2D scales)
- Ingest and display Himawari-8/9 data
- Ingest and display surface (e.g., SYNOP, METAR, BUOY, SHIP), upper-air (TEMP, PILOT), and other point-based observational data using WMO formats
- Ingest and display in-house PAGASA NWP data (grib2, NetCDF)
- Ingest and display available global NWP data (grib2, NetCDF)
- Build menus for other datasets that work out-of-the-box (WMO-supported datasets).
- Install CAVE Annotation Tool (CAT)
- Install GFE for gridded forecast output production
- Set up data acquisition and ingest

AWIPS II System Hardware

The following diagram details hardware requirements and data flow for implementation specifically for PAGASA. These requirements differ from the National Weather Service implementation to give PAGASA more up-to-date hardware specifications in addition to providing PAGASA the capabilities to run 1km GFE and a larger nested GFE domain for marine and tropical cyclone forecast areas. This also considers updated demands due to enhanced satellite data (e.g., Himawari-8/9).

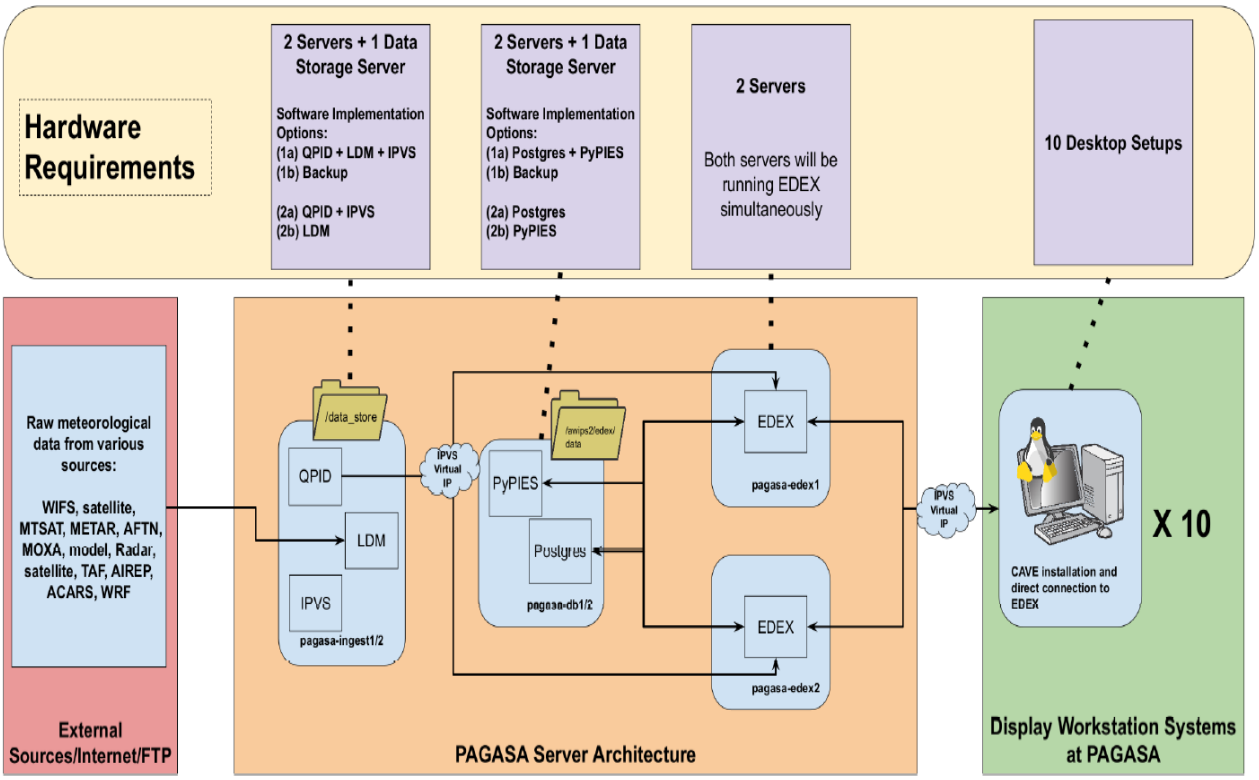

Fig. 2. General hardware requirements and data flow for the implementation of the Advanced Digital Forecasting Infrastructure – Phase 1.

Based on the above technical data flow recommendation, the following system hardware specifications are recommended to implement the AWIPS-II system for PAGASA:

These specifications set out the requirements to be met in the supply, delivery, installation, training, and commissioning of the Advanced Weather Analysis and Visualization Tools using AWIPS II for the Weather Division. All design, materials, manufacturing techniques & workmanship shall be in accordance with the highest accepted international standards for this type of system.

Hardware Minimum Specifications

The Winning Bidder shall supply the hardware needed for the Advanced Weather Analysis and Visualization Tools using AWIPS II for the Weather Division. The hardware shall meet or exceed the following minimum specifications:

- **Eight (8) sets of High-End Servers**

- Power Supplies 2x HPE 800W Flex Slot Platinum Hot Plug Low Halogen Power Supply
- Processors 2x HPE DL380 Gen10 Intel Xeon-Silver 4214 (2.2GHz/12-core/85W) Processor Kit
- Memory 8x HPE 8GB (1x8GB) Single Rank x8 DDR4-2933 CAS-21-21-21 Registered Smart Memory Kit
- Hard Drives 2x HPE 1.4TB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD,
- 2x HPE 960GB SAS 12G Read Intensive SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD,
- Storage Controllers HPE Smart Array P408i-p SR Gen10 (8 Internal Lanes/2GB Cache) 12G SAS PCIe Plug-in Controller
- Flexible LOM Adapters HP FlexFabric 10Gb 2-port 533FLR-T (RJ45) Adapter
- Security HPE Gen10 2U Bezel Kit
- Rail Kits HP 2U Small Form Factor Easy Install Rail Kit

- **One (1) set Network Attached Storage (NAS)**

- Highly scalable 2U rackmount NAS designed for large data storage
- Intel Xeon D-1541 8-core 2.1 GHz Processor
- Total of 16GB ECC RDIMM memory (expandable up to 128GB)
- 12 x 2TB Enterprise SAS HDD 7200 RPM
- With at least 2 x 10GbE ports RJ-45, and at least 4 x 1GbE ports RJ-45, all ports support Link Aggregation & Failover.
- Supports Btfrs & EXT4 file system for storage efficiency & data protection.
- Supports networking protocols of: SMB, AFP, NFS, FTP, WebDAV, CalDAV, iSCSI, Telnet, SSH, SNMP, VPN (PPTP, OpenVPN™, L2TP).
- Supports security such as Firewall, encryption shared folder, SMB encryption, FTP over SSL/TLS, SFTP, rsync over SSH, login auto block, Let's Encrypt support, HTTPS.
- Must include rack rail kit, management software, and other accessories.
- With 5-year warranty on hardware parts, Software updates, and support services.

- **Ten (10) Workstations**

- 128GB (4x32GB) DDR4 UDIMM ECC Memory
- Precision 3650 Tower CTO BASE
- Nvidia Quadro RTX 5000, 16GB, 4DP, DVI-D (Precision 3650T)
- Precision 3650 Tower with 1000W up to 90% efficient (80 Plus Gold) PSU, Advanced Front I/O, with SD card reader
- Intel Gigabit Ethernet 1GbE NIC PCIe Card
- 8x DVD+/-RW 9.5mm Optical Disk Drive
- Smart Card Keyboard (US)
- Optical Mouse - MS116 (Black)
- ProSupport Flex Client: 7x24 Technical Support, 5 Years
- ProSupport Flex: Next Business Day Onsite, 5 Years
- 256GB PCIe NVMe Class 40 M.2 SSD
- 11th Generation Intel Xeon W-1350P, 12 MB Cache, 6 Core, 4.0 GHz to 5.1 GHz, 125W TDP
- HEATSINK for 125W CPU
- C1: M.2 SSD Boot + Optional M.2 SSD (No SATA HDD)
- 92mm Front Cooling Fan, Precision 36x
- Y cable for certain GPUs, tied with 92mm Front Cooling Fan
- 10 Foot/3 Meter Displayport Cable
- Cable Labels - Brady (48 sheets)
- Internal Speaker for Precision 3650
- With 3 sets of Monitors 27 inch high resolution

- **Two (2) sets of 1Gbe Management Switch**

- With at least 48 x 1GbE ports and at least 2 x 10G SFP+ ports.
- With switching capacity of at least 128 Gbits/s.
- Layer 3 switches which have routing capabilities.
- Layer 3 supports IPv4 and IPv6 routing, Layer 3 LAG, RIPv2, DHCP Server, Layer 3 DHCP relay.
- Must include all needed SFP+ modules, cable patches, and accessories to interconnect the HC appliance, and integrate the system to the local network.
- With 3-year warranty on hardware parts, firmware updates, and technical support services.

- **TWO (2) SETS of 42U Enterprise Rack Cabinet**

- Must be industry standard, compatible with almost all server manufacturer's equipment with strong frame structure.
- Must have perforated, lockable front and rear doors with detachable side panels. All doors must have a secure lock and handle.
- Must have EIA standard 19″ rack rails, adjustable with square mounting holes.
- Must have space for rear cable management channels for mounting rack PDUs (power distribution units).
- Must include the rack PDUs power strips, vertically mounted side by side.
- Must have a KVM console for management of server & other equipment.
- With 3-year warranty on hardware parts, and technical support services.

- **TWO (2) SETS of UPS Uninterruptible Power Supply System**

- Must provide a minimum system backup time of at least 30 minutes.
- Must have at least 10kVA full load capacity or the kVA rated capacity must be within the total power requirement of the system offered.
- Must provide all needed electrical peripherals, wires, and accessories to connect from the power source identified by the site's technical personnel.
- With 3-year warranty on hardware parts, firmware & software updates, and technical support services.

- **One (1) Network Printer**

- Networked color-capable single function laser printer;
- 22.1" x 20.0" x 17.0" (560mm x 506mm x 432 mm);
- Up to 47 ppm letter; 1200 x1200 dpi;
- Maximum Monthly Duty Cycle;
- Up to 110K pages per month;
- 150-sheet multipurpose tray 2900 sheets via addition of optional 1x 1100+2 x 550-sheet paper tray;
- Processor 800MHz; Memory 512 MB

- With 3-year warranty on hardware parts, firmware & software updates, and technical support services.

- **One (1) Precision Aircon Unit**

Cooling
Total Cooling duty 18.0 or higher
Sensible Cooling Duty 16.9 or higher
Sensible Heat Ratio (SHR) 0.94 or higher
Compressors
Refrigerant (R-410A)
Type : Inverter Scroll
Number of Compressors: 1
Power Input : 4.2 kW
Energy Efficiency ratio (EER) : 4.3
Humidifier (Power Output 2.3 kW)
Heating (Electrical Heating 6kW)

Weight and Dimensions (H X W X D X W) 1940mm X 800mm X 600mm X 210kg

- Must provide all needed electrical peripherals, wires, and accessories to connect from the power source identified by the site's technical personnel.

- With 3-year warranty on hardware parts, and technical support services

Commercial Off-The-Shelf (COTS) Software Requirements

In addition to the aforementioned hardware specifications, the following commercially available software packages are needed to successfully implement the AWIPS-II system architecture:

Commercial Off-The-Shelf (COTS)	Description
Red Hat Enterprise Linux 7; 64-bit	Used on all official operational/testbed AWIPS Linux machines
Red Hat Satellite 7/8	Used to manage RedHat entitlements

G. DATA AND NETWORK SYSTEM

The Winning Bidder shall coordinate with the technical IT personnel of PAGASA, to be assisted by the Technical IT group of WD in WFFC, regarding the location of data cabinets to be installed, network cabling including IP configuration, and shall provide all necessary networking peripherals, accessories, & cables for the connectivity of the system facility to the existing local area network (LAN), private leased line, and public Internet of Data Center. The technical IT group of WD WFFC and PAGASA must attend the pre-installation or kick-off meeting and must be included in the end user's technical team for Site Acceptance Test (SAT) onsite. All expenses incurred for the integration of the system from the site's network system and data connectivity must be shouldered by the Winning Bidder.

H. ELECTRICAL SYSTEM

The Prospective Bidder shall coordinate with the Electrical group of Engineering and Technical Services Division (ETSD) Central Office technical personnel regarding the electrical layouts, electrical accessories, and other needs of tapping the system to the site's electrical source. The Prospective Bidder must submit as part of its bid all necessary documents and diagrams as required by the Electrical group.

The Winning bidder must include at least one personnel from the Electrical group of ETSD to attend the pre-installation or kick-off meeting and must be included in the end user's technical team for Site Acceptance Test (SAT) onsite. All expenses incurred for the integration of the system from the site's electrical system must be shouldered by the Winning Bidder.

I. ON-SITE VALIDATION AND TESTING

The Prospective Bidder shall include in its submissions a **detailed testing procedure or methodology**. The detailed testing procedure and methodology shall cover the full on-site validation and testing to be undertaken during the installation and testing process prior to Site Acceptance Testing.

J. SITE ACCEPTANCE TESTING

Site Acceptance Testing (SAT) shall be conducted on-site to verify the performance of the entire hardware-software infrastructure in accordance with specifications and functional requirements. Any defect or deviation discovered during the period of SAT shall be rectified by the Winning Bidder immediately or within a maximum period of 30 calendar days from the completion of the initial SAT. After such rectification, another test shall be made to verify the rectification.

The SAT shall be witnessed and accepted by at least four (4) PAGASA officials or personnel and shall be conducted for a period of ten (10) calendar days. The SAT may be conducted simultaneously with the on-site training activities.

K. SYSTEM COMMISSIONING

After the satisfactory conclusion of the Site Acceptance Test, the Winning Bidder shall demonstrate the capability of the Advanced Weather Interactive Processing System II (AWIPS II) to operate continuously for a period of seven (7) days under operational forecasting conditions. The successful demonstration thereof shall mean that the Advanced Weather Analysis and Visualization Tools using AWIPS II have been commissioned.

L. INSTALLATION, ON-SITE TRAINING AND TECHNICAL MEETING

In preparation for the installation, a kick-off meeting should be done with the winning bidder and PAGASA project proponent to ensure trouble-free project implementation. This will include the presentation of the schedule, or Gantt chart and the travel requirement/schedule of experts that will assist in the implementation of the project.

An in-depth set of training activities for **ten** (10) operational forecasters and **five** (5) technical support personnel of the Weather Division (including system administration training) shall be undertaken by the Winning Bidder and NOAA-Global Systems Laboratory (GSL). The core premise of the training activities shall include hands-on activities not only geared toward the operations and maintenance of the AWIPS II system software but also to ensuring that the new system is seamlessly integrated with Weather Division's forecast operations. These shall be done on-site, preferably face-to-face to promote effective and active learning for **two** (2) weeks. The training includes meals (lunch and snacks) during the entire training period.

Upon request by PAGASA or GSL, the Winning Bidder shall also facilitate the organizing of technical meetings to discuss matters involving the technical front-end and back-end aspects of AWIPS II and the operational usage of the newly-developed system. Such meetings shall also be utilized to facilitate a feedback mechanism between system end users and system developers during the course of the project.

All on-site training activities, technical meetings, and installation trips shall be conducted by the Winning Bidder alongside GSL. Furthermore, the Winning Bidder shall facilitate the travel to/from the Philippines and stay of **five** (5) or more experts dispatched by GSL for the purposes of the training activities, technical meetings, and/or installation trip.

M. WARRANTIES

All workmanship, system parts, accessories, other materials and equipment, and services shall be warranted by the Winning Bidder and have **3-year maintenance support** and services warranty on hardware, switches, rack cabinets, UPS, and firewalls.

Software and firmware updates, replacement parts, or units must be available immediately during the warranty subscription period. **Technical support services 24/7 via telephone**, t**ext, and email**, which include Remote Access Assistance thru Internet web or VPN access must also be readily available.

N. 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 specifically the hardware, switches, UPS, and firewalls to prevent disruption in the delivery of PAGASA operational services**. It shall include in its commitment a provision of reliable, swift, and efficient on-site 24/7 support, availability of ticketing and response system, and ensure a quick and readily available supply of spare and replacement parts.

O. SYSTEM DOCUMENTATION

The Winning Bidder shall provide installation, operations, and maintenance manuals to the end-user three copies. The manuals shall also include the system hardware and software configuration of the Advanced Weather Analysis and Visualization Tools using AWIPS II. It shall also contain, among others, the complete and detailed schematic diagrams, theory of operations, systems management, and maintenance procedures.

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.