IMPROVEMENT TO METEOROLOGICAL OBSERVATION IN NIGERIA

By

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***ABSTRACT***

*The Meteorological Service of Nigeria (NIMET) is making frantic efforts to ensure provision of timely and accurate Weather Information through acquisition of weather monitoring systems and training of technical and operational personnel on data capturing and data dissemination systems. In year 2006, we embarked on installation of Automated Weather Observing Systems at four international airports namely Abuja, Lagos, Kano and Port Harcourt respectively. As at then, only Abuja airport has Low Level Wind Shear Alert System(LLWAS), today, installation of the wind shear alert system at the three other airports are at different stages of completion.*

*Last year (2009), we installed additional Aviation Automated Weather Observing Systems(AWOS) at six other Airports such as Ilorin, Enugu, Owerri, Calabar, Katsina and Maiduguri. Furthermore, two of the six(6) new Doppler Weather Radars that we purchased from the Enterprise Electronics Corporation, USA are due to arrive in Nigeria and the installation of this equipment is expected to be completed by mid-next year. Also calibration equipment for Pressure, Precipitation, Humidity, Thermometer have been purchased and installed at the Agency’s operational Headquarters at Oshodi, Lagos*

*This work is aimed at disclosing the efforts being made by Nigeria towards provision of quality data for issuance of accurate weather information to the public.*

**1.0 INTRODUCTION**

Automatic Weather Station (AWOS) was first experimented in Nigeria in 1998 when four numbers were installed in some of our airports namely Lagos, Abuja, Port Harcourt and Maiduguri. As at that time, Meteorological Observers were familiar with the manually observed instruments whose derived values are computed with slide rule and electronic calculator. Then, we had certain challenges which ranges from low level of computer literacy among observers to the fear of loss of jobs since fewer personnel would be required if automatic weather system is allowed to stay. Hence, data output from the newly introduced automated weather stations were never used to prepare weather forecasts and in short, the system did not see the light of the day.

From the lesson learnt on the failure of the first set of Automatic weather stations, another set of AWOS was introduced in year 2000.This set of AWOS is solar powered and has a wireless telemetry whose console could be powered from two sources i.e. A.C. mains or battery. This type of AWOS is not dependent on the computer to retrieve data for the user because the data logger is right at the back of the receiving console. The only time a computer is needed is when data is to be downloaded from the logger to the computer for storage. This type of AWOS began to gain acceptance to the operators and we succeeded in installing about Forty Five numbers in our networks of stations. Since modernization of Meteorological Instrumentation has made it mandatory for both the operators and the maintenance personnel to have a good knowledge of end-user computing, the Nigerian Meteorological Agency organized computer appreciation training for its workforce and after this exercise, operators were no longer scare of computers and it became a useful tool that makes their jobs much easier. As of today, not less than thirty AWOS installed between year 2000 and 2005 are still functioning effectively.

**2.0 THE NEW INTEGRATED AUTOMATED WEATHER OBSERVING SYSTEM**

In year 2006, the Federal Government of Nigeria began a thorough overhauling of the Aviation sector and came up with the Safe Tower Project under which the four major international Airports were considered for the implementation of Aviation Integrated Weather Observing System. The system was successfully installed and commissioned in three of the four major airports, namely Lagos, Abuja and Port Harcourt. The installation at Kano Airport was delayed for the construction of the new control tower building to be completed. The parameters measured by this system are more than the conventional automatic weather station which provides Wind Speed, Wind Direction, Pressure, Temperature, Relative Humidity, Rainfall and Radiation values. The additional measurement from other sensors at the air side of the runway such as visibility, present weather and cloud base has made the system aviation AWOS.

Having used the system for more than a couple of years, the Nigerian Meteorological Agency in year 2009, awarded contract for the procurement and installation of Aviation Weather Observing and Display System(AWODS) for six(6) Airports, namely Enugu, Owerri, Ilorin, Calabar, Katsina and Maiduguri Airports. Apart from Enugu Airport, which have been closed because of construction work going on, the contractors handling this project are at different stages of completion. The Agency is implementing additional Eight Integrated Aviation AWOS in this year budget. The project had been advertised and the procurement process is on-going. The award will soon be given to the most qualified bidders. By the time another eight AWODS are are awarded and implemented, the total number of Aviation Weather Observing and Display System in Nigeria will be eighteen (18) and we would be looking at equipping the remaining four (4) airports with AWODS.

**3.0 LOW LEVEL WIND SHEAR ALERT SYSTEM**

Nigeria is located within the equatorial region of West Africa and is therefore regularly exposed to severe tropical thunderstorm activity with the associated danger of windshear or microburst activity, particularly dangerous to air transport around airports during landing and take-off.

The experience of three domestic air accidents in Nigeria forced the government to make every effort to prevent future air crash. Realizing the hazard of Wind shear and microburst to aircraft operations in the terminal area , the government observed that AWODS without Low Level Wind Shear Alert System (LLWAS) in any airport could pose serious danger to air safety, hence the resolve to install the system in all the airports in Nigeria.

The implementation of LLWAS started with Nnamdi Azikiwe International Airport, Abuja in 2008. Budgetary provision was made in 2009 to install the LLWAS in the other three major airports i.e. Lagos, Port Harcourt and Kano. The project was advertised and tenders were submitted and evaluated. The contract was eventually awarded to the successful bidder.

MTECH Systems have been contracted for provision of three (3) LLWAS systems for Kano, PortHarcourt and Lagos International Airports respectively. The MTECH Systems Opti-MET Low-Level Windshear Alert System (LLWAS) is designed to detect low-level wind shear in the terminal area (TMA). The ground based system provides both audio and visual alarms to ATC personnel in clearly represented numerical and graphical form. In locations where low level wind shear is known to be experienced, LLWAS systems significantly increase the operational

efficiency and safety of the airport.

The MTECH opti-MET Low Level Windshear Alert System is part of the MTECH systems opti-MET solution for total weather management that fulfils the safety requirements for weather prediction and analysis and airline flight operations.

A site survey of the three designated International Airports was carried out between 1st and 11th March 2010 by MTECH Systems personnel. This site survey report details the findings of the LLWAS site

The site survey was done and the result of the survey was submitted to the Agency. Before the final site survey was carried out by the manufacturer, a preliminary survey report of the three airports was sent to the Agency for observations and comments.

Factory Acceptance Test (FAT) was conducted by the representatives of Nigerian Meteorological Agency in Melbourne, Australia in May 2010. Shortly after FAT exercise, a team of engineers and the meteorologists were in Melbourne, Australia in June 2010 for Factory Training. The factory training was still on when the equipment meant for the project was dispatched to Nigeria.

The system being implemented is an Mtech Systems and has the following features:

* Range of communications options
* Ultrasonic Sensors
* Dual server redundancy
* Graphical Map displays
* Solar power option for sensor Sites
* Frangible, Fixed and Tilt Mast options
* Proven reliability in lightning prone areas

The MLLWAS system comprises the following elements:

* Wind Sensors and Masts
* Wind Data Telemetry Units with Data Communications device
* Central Data communications devices,
* Dual Servers with MTECH front end software
* Wind Data processing modules
* Display Systems

**The MTECH Wind Shear Algorithm**

The MTECH sensor stations report wind speed and direction at one second intervals.

The Surface Weather Server software [SWS Software ] implements ICAO SARPS which recommend computation of the following time averages:

* A 3 second average of wind samples for each sensor site. [ INSTANTANEOUS]
* A 2 minute average of wind samples for each sensor site [ MEAN ]
* A Gust reading determined from a ten minute array of wind samples. [PEAK]

**Wind Shear Alarms**

A range of alarm conditions can be detected by the SWS Software and the user can set the thresholds for the alarms. These alarms include comparisons between MEAN and PEAK wind speed and directions and between the MEAN and INSTANTANEOUS speed and directions.

This provides a limited indication of wind shear conditions. All alarms can be disabled below a user set level, this is normally set at 10 Knots. Below this winds are usually reported as Light and variable.

**Data Base Interaction**

Data is gathered into an SQL database for analysis by the MITAS Surface Weather Server, before this algorithm is called. The results are stored in the SQL database and MITAS Wind Shear Display software displays the Wind Shear alerts graphically on the airport map or text only display.

**Sensor Stations**

This is a network of ultrasonic sensors for high reliability. The sensor stations requires ICAO compliant obstruction lights and connection to mains power or solar arrays of adequate capacity to supply LED based obstruction lights.

**Displays**

The Text based alarms are shown on the touch screen graphics display, with black circular icons showing the Sensor Stations super-imposed on the airport map where detected by the algorithm. The text alarms are shown in the green panel on the lower right of the screen. This panel turns red and an alarm sounds if a wind shear is detected. An example map display is shown below.





**4.0 IMPLEMENTATION OF WEATHER RADAR SYSTEM**

In the 70’s, Nigeria had two C-band weather radars that were in operation. One was in Kano Airport and the other was in Lagos. From the mid 80’s to the present time, the Meteorological Service had no single radar system running because the two systems went bad and in 1999, an attempt was made to repair the one installed in Lagos, but this effort failed because of frequent components failure and lack of spare parts to replace defective components.

 At that juncture, it became clear that Nigeria required new set of weather radars. But a huge amount of money is needed to purchase radar equipment, so, in 2003, the Nigerian Meteorological Agency applied to the Federal Government to finance the project. The request was approved by the government and the procurement process commenced through an established tender procedure. The contract for the procurement and Installation of six (6) Doppler Weather Radars was granted to the Enterprise Electronic Corporation (EEC), USA in 2007. After signing the contract agreement, the EEC commenced the building of our Doppler Weather Radar System. As at September, 2009, when the Factory Acceptance Test was conducted, the company has fully built two systems meant for Abuja and Port Harcourt Airports. In October, 2009, 24 Engineers and Meteorologists were in Alabama, USA for factory training and before the training ended towards the end of October, 2010, the six systems had been built in the EEC factory.

The six sites earmarked for the Doppler weather radar systems are Lagos, Abuja, Port Harcourt, Kano, Yola and Maiduguri. Installation of these six has effectively covered the entire country for weather coverage. EEC has conducted site survey on each site as well as soil test of the platforms to mount the masts.

At the moment, four of the six radar systems are already in Nigeria. The civil works for the mast base in Abuja and Port Harcourt are on-going and it is believed that the installation of all the six Doppler weather radar equipment would be completed by next year.

**5.0 CALIBRATION EQUIPMENT**

Most of the calibration equipment in the workshop are obsolete and need replacement. For accuracy of measurements, any instrument purchased should be calibrated so as to confirm its status before it is sent for field installation. In an effort to conform to the established standards of the World Meteorological Organization/ International Civil Aviation Organization (WMO/ICAO), Nigerian Meteorological agency has procured calibration equipment for Rain gauges, Thermometer, Temperature/Humidity Sensors while the supply of Pressure chamber, Temperature test Cabinet and wind Tunnel is to be made this year.

**6.0 CONCLUSION**

The Introduction of Aviation AWOS in our airports, a quantitative and a qualitative improvement of the measurement of meteorological parameters in the country is ensured. The implementation of doppler weather radar in Nigeria will improve forecasting accuracies and reduce costs on a long term because measurements are automated, data are more reliable, and they are available in real time.