# *New Developments and Operational Experience With Surface Observation Technology*

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## 1-Introduction

The presence of *Automatic Weather Observing Systems (AWOS) was commissioned in EMA 25 years ago and since that time EMA installed many of AWOS in a lot of surface stations .So the new technology become reliable. Modifications have been made with the view of maintaining.

High availability of AWOS can be achieved either through high Mean Time To Failure (MTTF) or low Mean Time To Repair (MTTR) .System designers have focused on maximizing MTTF as a way of providing high availability. However recent work in recovery oriented computing systems has emphasized recovery from failures -rather than failure avoidance.

The Reliability, Availability, and Maintainability, through the operational experience with surface observations as a new development technology will be discussed in this paper. The results obtained were based on the experiments of maintenance of 25 AWOS during the period 1997 -2002.

## 2-Reliability

The reliability is the probability of a given system to perform its required function under specified condition for a specified period of time

Possible methods to increase reliability

1- Reduce system complexity
2- Parallel redundancy
3- Standby redundancy
4- Repair preventative maintenance
5- Increase reliability of system components
6- Quality control during manufacturing

A primary component of reliability analysis is referred to as failure rate , or the number of failures expected during a certain period of time . Calculation of equipment failure rate and its inverse –The Mean Time Between Failures (MTBF) is the basic of reliability predication

## 3-Mean Time Between Failures (MTBF)

MTBF is the basic measure of reliability for repairable items .It can be described as the number of hours that pass before a component , assembly , or system fails it is d commonly used variable in reliability and maintainability analysis .

MTBF can be calculated as the inverse of the failure rate for constant failure rate systems. For example if a component has a failure rate of 2 failure per 3 years (12720 hours), the MTBF would be the inverse of that failure rate

$$MTBF = 12720/2=6360 \text{ hours}$$

MTTF is the basic measure of reliability for non repairable systems .It is the mean time expected until the first failure of a piece of equipment .MTTF is a statistical value and is meant to be the mean over a long period of time and large number of units . For constant failure rate systems MTTF is the inverse of failure rate

Technically MTBF should be used only in the reference to repairable items While MTTF should be used for non repairable items .However MTBF is commonly used for both repairable and non repairable items.

### 3-1 MTBF calculation

Calculated MTBF values are used during the design phase of systems and sensors. However it has been found that statistical analysis from a statistically relevant sample shows that calculated values are too pessimistic. Therefore statistical values are used for realistic MTBF calculation purposes and evaluate the reliability and availability of the systems .

### 3-2 MTBF based on statistical values

The statistical MTBF calculations are the ratio of total normal operation time of all the systems to the number of failure so from our experience and documents which trace repairs to the installed base of sensors and systems in 5 major airports and 20 surface stations The systems are assumed to be regularly and correctly maintained. consumable items are not regarded as part of the statistical analysis for the MTBF.

The statistical MTBF is calculated as a function of:

- The number of installed systems
- The average time since installation of the sensors
- The number of repairs to systems.

Due to the number of AWOS and sensors involved as well as the close co operation with department of the instrument, who’s responsibility it is to maintain the systems, it is considered that the sample volume is statistically relevant for the purposes of MTBF calculation.

MTTR includes time for identification of failure, assembling of spares and tools and transportation to sensor/system position. This time may vary corresponding to local facilities. Pure repair time will normally not exceed 2h per sensor

| Device | QTY | #of failure | MTBF(hours) | MTTR(hours) | Availability |
|---|---|---|---|---|---|
| Visibility (forward scatter) | 10 | 32 | 13687.5 | 6 | 0.999561836 |
| Wind | 50 | 60 | 36500 | 5 | 0.999863032 |
| Temp | 25 | 53 | 20660.37736 | 3 | 0.999854816 |
| Humidity | 25 | 50 | 21900 | 3 | 0.999863032 |
| Pressure | 25 | 65 | 16846.15385 | 4 | 0.999762613 |
| DCP | 25 | 43 | 25465.11628 | 5 | 0.999803692 |
| Data bus | 25 | 15 | 73000 | 7 | 0.999904119 |

The resulting availability (Av) is calculated to be 0.999801877

**Central Processing Unit (CPU)**

If the Central Computers are fully independent duplicated units it is assumed that the MTBF is limited by that of the data lines or power supply or the probability that two Workstations are down at the same time. The probability of the secondary Central Processing Unit failing during the repair period of the primary is calculated to be less than 1:10 Million. It is assumed that spare parts are available either on site or within 24 hours of registration of failure.

| Device | MTBF (hours) | MTTR (hours) | Availability |
|---|---|---|---|
| CPU | 10900 | 3,00 | 0.9997 |

DPU MTBF> 15000 hours
Critical failure DPU > 35000 hours
Other Workstations and Display Units

It is assumed that a single workstation failure does not mean a critical system failure has occurred. It is assumed that spare parts are available either on site or within 24 hours of registration of failure. MTTR covers time to set up a new computer and loading of relevant software. Workstations and Display Units are assumed to be exchanged as complete unit.

**4- Maintenance Costs**

There will be no additional maintenance costs except consumables and spare parts. After the factory training course, our experts able to perform maintenance and replacement of defect components by themselves. Under normal conditions no external assistance from the supplier necessary.

## 5-Conclusion

1. If there are two units or more of one sensor or component are included in the system, these lead to lower MTBF values. Therefore spare parts are recommended which would not be necessary for the 2 years period if only one system would be installed.

For example:

A system has a MTBF of 24,000 h. If two units of the same system are installed, MTBF of the 2 systems will be 12,000 h and relevant spares have to be foreseen for the 2 years period, If 3 units are installed, even a doubled number of spares might be necessary.

2. A general periodic Maintenance four times a year, is recommended. All sensors should be cleaned and performance shall be evaluated. Bearings of wind sensors shall be checked for smooth rotation.

Cleaning of sensor optics may be necessary in between, depending on contamination caused by environmental phenomena. Cleaning requests will automatically be generated by the system and displayed on CPU Workstation.

3. There are averaged yearly costs that may occur after warranty period for maintenance and repair, assuming that parts are repaired in factory or by authorized and trained personnel but if there is a professionals persons these costs will be few $.and we well keep our system in high availability

4. The experience and documents for all the systems including failure diagnostic and fault isolation and how you fixed these fault all these items are very important to reduce the MTTR and increase availability of the systems

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