SIERRA LEONE CIVIL AVIATION AUTHORITY

ADVISORY CIRCULAR

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Availability and Reliability Standards for Communication Navigation and Surveillance Facilities

Director General

Sierra Leone Civil Aviation Authority

1. GENERAL

The Sierra Leone Civil Aviation Authority's Advisory Circulars contains information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated Regulations.

An AMC is not intended to be the only means of compliance with a Regulation, and consideration will be given to other methods of compliance that may be presented to the Authority

Information considered directive in nature is described in this AC in terms such as "shall" and "must", indicating the actions are mandatory. Guidance information is described in terms such as "should" and "may" indicating the actions are desirable or permissive, but not mandatory

1.1 Purpose

This AC provides guidance of the key requirements, principles and standards applying to CNS facilities.

The values for each of the basic parameters stated in this AC, as relevant to each service type, shall be checked and calculated for analysis and corrective action taken.

1.2 Applicability

This AC is applicable to Air Navigation Service Providers (ANSPs) providing Communication, Navigation and Surveillance services in Sierra Leone.

1.3 Description of Changes

This AC is the first to be issued on this subject

1.4 References

(a) SLCAR Part 10 (A, B, C, D & E)
(b) Equipment Technical Manuals.

1.5 Cancelled Documents

Not Applicable

1.6 Abbreviations

The following abbreviations used in this document:

AC - Advisory Circular
ATM - Air Traffic Management
ANS - Air Navigation Service
ANSP - Air Navigation Service Provider
CNS - Communication, Navigation and Surveillance
MTBF - Mean Time between Failures

2. BACKGROUND

The provisions in the Sierra Leone Civil Aviation Regulations (ANS) require Air Navigation Services Providers (ANSP) to ensure that their facilities meet the operational performance requirements.

The Aeronautical Telecommunication systems and facilities used by Air Navigation Service Providers thus, must satisfy operational requirements such as availability, reliability, integrity and Continuity. These are very important indications providing information to Airspace users that Aeronautical Telecommunication (i.e. CNS/ATM Facilities and Systems) services are available and reliable for their use efficiently.

3. PROCEDURES

To review the performance targets for each facility, every CNS provider shall be required to generate the following:

3.1 Availability

(a) All CNS facilities shall provide high level of operational availability. In many cases, achievement of the necessary availability levels shall require the use of design features such as redundancy and/or duplication of facilities, automatic changeover from main to standby facility in the event of a fault, remote monitoring and maintenance capability. This performance parameter is to be calculated for the duration of one calendar year.

(b) Availability is a measure of the operational availability of the system to users over the total time period that is required by users. It is normally quoted over the period of an average year or longer, and takes into account the time the service will be unavailable as a result of both unscheduled failures and scheduled or unscheduled maintenance.

(i) Availability Calculations:

Calculation: $A_o = T_a/T_t$

Where;

A_o = Operational Availability,

T_a = the total time that the service is actually available, and

T_t = the total time period that the service is required to be available.

(ii) Factors important in providing a high degree of facility availability are:

(1) facility reliability
(2) equipment designs providing good component accessibility and maintainability
(3) quick response of maintenance personnel to failures
(4) adequate training of maintenance personnel
(5) efficient logistic support
(6) provision of adequate test equipment
(7) standby equipment and/or utilities

(iii) As indicated above in (ii) (7), provision of standby power is necessary for many CNS services and facilities where continuity of service is a critical requirement. All CNS facilities shall have no-break standby power supply systems to ensure continuity.

3.1.1 **Mean Time Between Failures (MTBF)**

This parameter is to be calculated for each channel of the facility and for the complete facility. MTBF is the actual operating time of a facility divided by the total number of failures of the facility during that period of time.

Note: The operating time is in general chosen so as to include at least five and preferably more facility failures in order to give reasonable measure of confidence in the figure arrived. This parameter is to be calculated for each channel and for the complete facility.

3.1.2 MTBF calculation:-

T- Total time for five failures of the channel.

MTBF= T/5

Note:If total number of failure is less than five in a calendar year, MTBF need not be calculated by station and only the number of failures in the calendar need be sent. It may be seen that adjustment of MTBF will produce the desired degree of reliability.

3.1.3 Factors which affect MTBF and hence facility reliability are:

(a) Inherent equipment reliability
(b) Degree and type of redundancy
(c) Reliability of the serving utilities such as power and telephone or control lines
(d) Degree and quality of maintenance
(e) Environmental factors such as temperature and humidity

3.1.4 With regard to items (a) and (b), ANS provider shall take action to procure equipment having high reliability and adequate redundancy.

3.2 Reliability

Reliability is the probability that the ground installation operates within the specified tolerances.

3.2.1 **Calculation**

The reliability R in percentage is given by;

$R= 100\ e^{-t/m}$

Where;

e = base of natural logarithms

t = time period of interest

m= MTBF

3.2.2 It may be noted that reliability increases as MTBF increases. For high degree of reliability and for operational significant values of t, CNS provider shall have a large MTBF.
Reliability should be calculated for both individual facilities, and for the total population of a particular type. Calculating both values provides information on the type as a whole, and also allows identification of individual facilities which may be under performing.

3.3 Continuity

Where a service has duplicated or redundant facilities including standby power supply with automatic changeover or remote configuration, or main/standby capability, an additional parameter termed **continuity** shall also be quoted.

Continuity is a measure of time that a service takes to changeover from the main to standby facility, or to re-configure itself following a fault, including a power supply fault or failure. All CNS facilities services shall require continuity.

3.4 This is a measure of the ability of the service to provide a warning to users when the service should not be used, or when the error has occurred in the data transfer or computation. Integrity may be computed and presented in a variety of ways, e.g., as a Go/No Go warning based on internally measured parameters that utilize built-in test equipment or self-monitoring systems. Integrity values for CNS facilities are often stated as a probability of the loss of integrity over a number of events.

3.5 CNS maintenance personnel are to ensure that CNS facilities in which such capability is provided in the equipment, change over or shut down occurs in the event signal in space parameters or other operational parameters are out of tolerance. Non-occurrence of above, if reported/detected shall be investigated, immediate corrective action taken and full reports to this effect sent to the Authority.

The table below provides values of the performance parameters for a number of service types. Efforts shall be made to achieve the quoted values.

Service	**Availability (%)**	**Reliability (hours)**
Communication	>97.2	>1000
Radar data	>97.2	>1000
Navigational aids	>97.2	>1000