COMMUNICATION, NAVIGATION AND SERVEILLANCE MANUAL

VOLUME - VI

TECHNICAL SPECIFICATIONS

DEPARTMENT OF CIVIL AVIATION
MYANMAR

1st Edition, 2009

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Preface

This is the Sixth Volume in the series of seven volumes of CNS manuals prepared and maintained by CNS Directorate, HQ on behalf of Department of Civil Aviation, Myanmar for the use and guidance of its executives and staff. The topics covered under these volumes are as under:-

Volume I – Maintenance of CNS Facilities
Volume II – Communication Procedures
Volume III – Siting Criteria of CNS Facilities
Volume IV – Flight Inspection of CNS Facilities
Volume V – Lightning & Surge Protection and Earthing System of CNS Installations
Volume VI – Technical Specifications
Volume VII – Maintenance Schedules of CNS Facilities

This volume contains the Technical Specifications of major CNS systems and list of Navigation and Surveillance facilities installed and operated by DCA largely based on standards and recommended practices given in Myanmar Civil Aviation Requirement and ICAO Annex 10.

Use, comments and suggestions for improvement of this volume may be sent to D (CNS) so as to incorporate them in the next version of this volume.

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Record of Amendments

No.	Amendment Date	Incorporated on	Incorporated by

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Chapter-1

GENERAL

1. Title of the Document:

This document is identified as Communication, Navigation & Surveillance Manual – Vol. VI (CNSM- Vol. VI) "Technical Specifications."

2. Purpose of this Document:

2.1 Purpose of this document is to provide information and guidelines pertaining to technical specifications of CNS facilities and other guidelines related to CNS operations which are essential for the provision of safe and efficient air traffic services by Department of Civil Aviation, Myanmar. It is published for use and guidance of its CNS Maintenance and operational personnel.

3. Responsibility for documentation, review, amendments and publication:

3.1 The Director (CNS), DCA HQ is responsible for development, review and amendments of CNS – Manuals Vol. VI. He will ensure that the information and guidelines pertaining to selection of site for installation of CNS facilities, as detailed in this manual are in conformity with Standards and Recommended Practices (SARPs) given in the Annexes to Convention on International Civil Aviation and National regulations.

3.2 Director (CNS) is responsible for the approval of documentation & Amendments and publication of CNS-Manual.

4. Effective Date:

4.1 Effective date of Manual is indicated at the end of this chapter.

4.2 New edition will be indicated by the same date at the end of this chapter.

5. Change History:

5.1 This is 1st Edition of CNS Manual Vol. VI. Changes, if any, are indicated on 'Record of Amendments and corrigenda page'.

5.2 Amendments – documentation being inserted in the manual must contain headers and footers that are consistent with those given in this document.

6. Control of the manual:

6.1 Directorate of CNS will control this Manual electronically through DCA web site.

7 Distribution of the Manual:

7.1 Directorate of CNS may produce hard copies and control the distribution of these Copies, as deemed appropriate.

8 Master Copy:

8.1 An electronic and a hard master copy of each chapter contained in the Manual will be held and maintained by the CNS Directorate.

9. Checking Currency of Manual:

9.1 A current copy of the Manual will be published on Department of Civil Aviation, Myanmar web site.

10 Enquiries

10.1 Enquiries/Clarifications should be addressed to:

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11. Effective Date: 23rd Nov 2009

Chapter-2

Navigation Aids - Status Reporting

1. Purpose

1.1 This TSP establishes standards and practices for the provision of status information to Air Traffic Services and the transmission of warnings to control points specified in various International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs).

1.2 This standard applies to navigation aids used for civil aviation within the Myanmar Airspace that are owned by Department of Civil Aviation, Myanmar (DCA).

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1, Radio Navigation Aids.
B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Services
C) Annex 11 to the Convention of International Civil Aviation, Air Traffic Services.
D) Annex 14 to the Convention of International Civil Aviation, Aerodromes

3. Definitions

All definitions referred in Para 2 above, except the followings:

Navigation Aid: any radio frequency device or illuminated visual system operationally required for the navigation of an aircraft.

Immediate Reporting: the serviceability of the navigation aid is monitored continuously and the status is provided to the responsible Air Traffic Service (ATS) unit. Any change in the status of the navigation aid will be provided as per category of operation of ILS.

Standard Reporting: the equipment status is reported within 5 minutes of a change in Serviceability by the concerned watch keeping personnel to:-

a) shift in-charge where available:-
The shift in-charge immediately intimates the status of the equipment to the concerned section in-charge as well as to the ACS In-charge.

b) where shift supervisory officer is not available, section in-charge and ACS In charge.

Pilot Reporting: in the event of un-serviceability of a navigation aid observed by a pilot received either through ATC or directly from pilot, the shift in-charge or watch keeping staff shall immediately intimate to the section In-charge.

4. Standards and Practices

4.1 Operational Requirements for Remote Status Indication of Navigation Aids

4.1.1 Monitoring of the navigation aid performance is carried out by monitoring systems installed as part of the equipment. These monitors will take executive action if the performance of the facility is outside specified tolerances. The monitor system will shut down the equipment or in the case of duplicated equipment, change-over to the stand-by equipment. The monitoring system will also provide a status output at the equipment site. The remote reporting of this status shall be provided in accordance with this TSP.

4.1.2 The operational requirements for the remote status indication of navigation aids are Divided into three categories:-

• Approach Aids
any radio navigation aid used for a precision or non-precision approach and has a published approach/letdown procedure, shall have Immediate Reporting to the aerodrome control tower or unit providing approach control service. When approach control is not provided or the unit providing it is closed, reporting to ATS is not required. Standard Reporting shall be provided in all cases to the Shift Supervising Officer / responsible Technical personnel of the equipment room.

• Visual Aids
are illuminated visual systems essential for take-off, departure, approach, landing or surface movement procedures. These aids shall have Immediate Reporting to the aerodrome control tower or unit providing approach control service. When approach control is not provided or the unit providing it is closed, reporting is not required.

• En-route Aids
these are aids for which there are no published approach/letdown procedures or are not ATS Required Aids. These aids shall have Standard Reporting or Pilot reporting. Status indication of certain VOR and DMEs used for en route navigation may not be provided at a control point.

4.2 Status Reporting Location

4.2.1. Immediate Reporting facilities need only report at the Standard Reporting service level.

4.2.2 Approach Aids shall, in addition, provide a direct indication of status to the responsible ATS position in accordance with the prescribed reporting standard.

4.2.3 Remote status information may be provided to additional ATS positions where this is operationally required.

4.3 System of Equipment Status Reporting

4.3.1 The watch keeping staff shall report the unserviceability status of CNS facility to Shift in-charge.

4.3.2 The shift in-charge shall intimate to issue NOTAM when both channels of the facility are unserviceable and inform the section in-charge about the same.

4.3.3 The section in-charge shall intimate the status of unserviceability indicating reasons thereof to the DD(CNS) and copy to Hqs.(admin and plan) by AFTN signal/fax/e-mail /post .

4.3.4 The Deputy Director (CNS) shall arrange to issue the unserviceability information of CNS facilities at all the airports to D (CNS) at HQ. by 10 A.M everyday.

4.3.5 The D (CNS) shall provide the consolidated information regarding unserviceability status of CNS facilities at all the airports in the country to Director General to issue NOTAMN. The information shall also include analysis of recurrent failures if any with a view of increasing the availability of the facility.

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Chapter-3

Navigation Aid - Instrument Landing System (ILS)

1. Purpose

1.1 This document establishes standards and recommended practices for the operation of Instrument Landing Systems (ILS).

1.2 The TSP applies to all DCA staff engaged in implementing, maintaining or certifying instrument landing systems on behalf of DCA.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1, Radio Navigation Aids.
B) Myanmar Civil Aviation Requirements - Aerodrome Standards & Air Traffic Services
C) Navigation Aid - Siting Criteria CNS Manual Vol. III
D) Navigation Aid - Status Reporting
E) Navigation Aid - Test Transmissions
F) Navigation Aid - Distance Measuring Equipment (DME)
G) Navigation Aid - Flight Inspection CNS Manual Vol. IV
H) Manufacturer's Technical Manuals

3. Definitions: All definitions given in reference (2) above.

4. Standards and practices

4.1 License for Frequency

The authorization for use of ILS frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D(CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this ILS frequency is also coordinated with ICAO Regional office by D(CNS).

4.2 ICAO SARP Compliance

4.2.1 The ILS shall be implemented and operated in compliance with MCAR of DCA, Myanmar and ICAO Annex 10 Volume-1 including Standards and Recommended Practices specified in Section 3.1, except as prescribed below.

4.2.1.1 In measurement of difference in depth of modulation (DDM) the following equivalencies of measurement shall apply:

Localizer 0.155 DDM = 150 μA
Glide path 0.175 DMM = 150 μA.

4.2.1.2 Because of the siting problems and terrain limitations, some localizers/ Glide Paths may not meet the standard coverage area described above and may have restricted coverage. The information regarding such localizers/ Glide Paths is promulgated in AIP or disseminated through Notam for each specific system.

4.2.2 Exceptions and Amplification of SARPS
Para nos. given below refer to Annex 10, Volume 1 Chapter 3

3.1.2.1.1 The operational status of all ILS ground system components shall be reported in accordance with Navigation Aid - Status Reporting document.

3.1.2.7 At those locations where two separate ILS facilities serve opposite ends of a single runway, an interlock shall ensure that only the localizer serving the approach direction in use shall radiate, except where;

a) the localizers use different frequencies, and
b) no operational harmful interference due to the localizer's operation is present before an aircraft on the reciprocal ILS reaches the decision height, and
c) the approach direction is restricted to Category I operations at the time, and
d) auto lands are not conducted.

3.1.3.4.1 The course line should not have amplitudes which exceed the following:

30 μA at ILS Point 'A' decreasing at a linear rate to 15 μA at ILS Point 'B', and 15 μA between ILS Point 'B' and the ILS Reference Datum.

3.1.3.5.3 The modulating tones shall be 90 Hz and 150 Hz within ± 1.5 percent.

3.1.3.5.3.7 The localizer shall not be used for radiotelephone communications.

3.1.3.6.1 The mean course line shall be adjusted and maintained within limits equivalent to the following displacements from the runway centre line at the ILS reference datum:

a) for Facility Performance Category I localizers:
± 10.5 m, or the linear equivalent of 15 μA whichever is less;

b) for Facility Performance Category II localizers:
± 7.5 m.

c) for Facility Performance Category III localizer:
± 3 m.

3.1.3.7.1 Note that in conditions of decreased sensitivity from nominal the actual course sector angle may exceed the maximum nominal course sector angle of 6°. Refer to 3.1.3.7.2 {Ref. A} for allowable variation in sensitivity.

3.1.3.8 The localizer shall not be used for radiotelephone communications.

3.1.3.9 In addition to the requirements of 3.1.3.9, the identification shall be suppressed during periods that the localizer is not available for operational service. See TSP-3.13 Nav. Aids Test Transmission.

3.1.3.11.1 The warning to a designated control point shall be satisfied by compliance with Navigational Aids- Status Reporting Document.

3.1.3.12.2 The probability of not radiating false guidance signals in any one landing shall not be < 1-1.0 x 10^{-7} for Facility Performance Categories I.

3.1.3.12.4 The probability of not losing the radiated guidance signal shall be > 1- 4 x 10^{-6} in any period of 15 seconds for Facility Performance Category I localizers (equivalent to 1 000 hours mean time between outages).

3.1.5.4.1 For Facilities Performance Category I - ILS glide paths, bends in the glide path course relative to the mean course line shall not have amplitudes which exceed the following:

Zone:	**Amplitude (DDM) (95% probability)**
Outer limit of coverage to ILS Point "A":	30 μA
ILS Point "A" to ILS Point "B":	30 μA at ILS Point "A" decreasing at a linear rate to 20 μA at ILS Point "B"
ILS Point "B" to the ILS reference datum:	20 μA

3.1.5.5.2 The modulating tones shall be 90 Hz and 150 Hz within ± 1.5 percent.

3.1.5.7.1 The warning to a designated control point shall be satisfied by compliance with Navigation Aid - Status Reporting.

3.1.5.8.2 The probability of not radiating false guidance signals in any one landing shall not be < 1-1.0 x 10^{-7} for Facility Performance Categories I glide paths.

3.1.5.8.4 The probability of not losing the radiated guidance signal shall be >1- 4 x 10^{-6} in any period of 15 seconds for Facility Performance Category I glide paths (equivalent to 1 000 hours mean time between outages).

3.1.7.2.1 The marker beacons shall operate at 75 MHz with a frequency tolerance of ± 0.005 percent and shall utilize horizontal polarization.

3.1.7.6.6.3 The DME in 3.1.7.6.6 above shall conform with TSP-3.4 Navigation Aid - Distance Measuring Equipment - Narrow Band (DME-N)

3.1.7.7.1 The warning to a designated control point shall be satisfied by compliance with Navigation Aid - Status Reporting.

4.3 Spectrum

4.3.1 Throughout the service volume the presence of VHF FM broadcasting signals shall have levels in accordance with the following:

Frequency (MHz)	**Maximum level of unwanted signal at receiver input**
88-102	+15 dBm
104	+10 dBm
106	+5 dBm
107.9	-10 dBm

The receiving system is assumed to be a typical aircraft installation utilizing a receiver which complies with Section 3.1.4 of Annex 10, Volume 1.

4.4 Localizer Glide Path Interlock

When Localizer is removed from service due any reason, the Glide Path is required to be switched off manually. When the localizer is removed from service, provision may be made to manually reactivate the glide path independent of the localizer status as part of maintenance procedures.

NOTE: TSP 'Navigation Aid - Test Transmission' specifies standards for test transmission by navigation aids.

4.5 Siting and Site Restrictions

Siting and site restrictions specified in CNS Manual Vol. III shall be observed.

4.6 Power Supply

All ILS components shall continue to operate for an endurance of at least two hours after the interruption of the power source provided it is possible to maintain other parameters like equipment room temperature within limits.

4.7 Performance Assurance

4.7.1 The complete system shall be inspected to assure performance is in accordance with this TSP.

4.7.2 The ILS shall be flight inspected in accordance with CNS Manual Vol. IV.

4.7.3 The localizer and glide path components of ILS should be ground inspected periodically as given in the maintenance schedule. The periodicity indicated in the maintenance schedule shall be reviewed annually taking into consideration demonstrated accuracy, reliability and integrity of the system.

4.7.4 Marker beacons should be inspected periodically along with flight inspection of ILS.

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Chapter-4

Navigation Aid - VHF Omni Directional Radio Range (VOR)

1. Purpose

1.1 This TSP applies to VHF Omni directional Radio Range (VOR) and specifies technical standards and practices. Performance requirements apply to the complete facility inclusive of transmitter, antenna and site.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1, Radio Navigation Aids
B) Navigation Aid - Siting Criteria CNS Manual Vol. III
C) Navigation Aid - Status Reporting
D) Navigation Aid - Test Transmissions
E) Navigation Aid - Distance Measuring Equipment (DME-N)
F) Navigation Aid - Flight Inspection CNS Manual Vol. IV
G) Myanmar Civil Aviation Requirements - AERODROME STANDARDS & AIR TRAFFIC SERVICES
h) Manufacturer's Technical Manuals

3. Definitions

All definitions given in reference 2) above.

4. Standards and Practices

4.1 License For Frequency

4.1.1 The authorization for use of VOR frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D(CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this VOR frequency is also coordinated with ICAO Regional office by D(CNS).

4.2 General

4.2.1 Rotation

4.2.1.1 The VOR shall be constructed so that the phase difference between a 30Hz signal frequency modulated on to a 9960Hz sub-carrier and a 30Hz amplitude modulated signal increases, degree for degree, as a measurement point moves in a clockwise rotation around the VOR. The angular position of the measurement point shall be from the VOR with the zero degree reference being magnetic north.

4.2.2 Sensing

4.2.2.1 At other than magnetic north the phase of the 30Hz signal on the 9960Hz sub-carrier shall lead the phase of the 30 Hz amplitude modulated signal. At magnetic north the two signals shall be in phase.

4.3 Radio Frequency

4.3.1 Carrier Frequency

4.3.1.1 The VOR shall operate in the frequency range of 111.975 MHz to 117.975 MHz.

4.3.1.2 The highest assignable frequency shall be 117.975 MHz. Frequencies shall be allocated on channels selected in 50 kHz steps reference to the highest assignable frequency.

4.3.2 Frequency Tolerance

4.3.2.1 The frequency tolerance of the radio frequency carrier shall be ± 0.002percent.

4.3.3 Spectrum

4.3.3.1 Throughout the service volume the presence of VHF FM broadcasting signals shall have levels in accordance with the following:-

Frequency (MHz)	Maximum level of unwanted signal at receiver input
88-102	+15 dBm
104	+10 dBm
106	+5 dBm
107.9	-10 dBm

The relationship is linear between adjacent points designated by the above frequencies.

The receiving system is assumed to be a typical aircraft installation utilizing a receiver which complies with Section 3.3.8 of Annex 10, Volume 1.

4.4 Polarization and Pattern Accuracy

4.4.1 The emission from the VOR shall be horizontally polarized. The vertically polarized component of the radiation shall have the value as specified in CNS Manual Vol. IV

4.4.2 The accuracy of the bearing information conveyed by the horizontally polarized radiation from the VOR at a distance of approximately four wavelengths for conventional VORs and 300m for Doppler VORs for all elevation angles between 0 and 40 degrees, measured from the centre of the VOR antenna system, shall be within ± minus 2° .

4.4.3 Within the service volume the displacement of the course by a bend shall not exceed 3.5° from either the correct magnetic azimuth or the average on-course provided by the facility.

4.4.4 The environment in which the VOR is located should be carefully observed to detect changes which may degrade the accuracy of the radiated course information.

4.5 Coverage

4.5.1 The VOR shall provide signals such as to permit satisfactory operation of a typical aircraft installation at levels and distances required for operational reasons, and to an elevation angle of 40 degrees. The minimum signal strength within the service volume shall be 90 μV/m (-107 dBW/m^2).

4.6 Modulation of Navigational Signals

4.6.1 The radio frequency carrier as observed at any point within the service volume shall be amplitude modulated by two signals as follows:

a) a sub-carrier of 9960Hz of constant amplitude frequency modulation at 30 Hz and having a deviation ratio of 16±1 (i.e. 15 to 17), and
b) a 30 Hz amplitude modulation component.

4.6.2 The depth of modulation of the radio frequency carrier due to the sub-carrier of 9960Hz shall be within the limits of 28 to 32 percent.

4.6.3 The depth of modulation of the radio frequency carrier due to the 30 Hz or 9960 Hz signals, as observed at any angle up to 5°, shall be with the limits of 28 to 32 percent.

4.6.4 The '30 Hz' modulation frequency shall be 30 Hz within ±1 percent.

4.6.5 The sub carrier modulation mid-frequency shall be 9960 Hz within ±1 percent.

4.6.6 The percentage of amplitude modulation of the 9960 Hz sub carrier shall for a conventional VOR not exceed 5 percent and for a doppler VOR shall not exceed 40 percent when measured at a point at least 300 m from the VOR.

4.6.7 The sideband level of the harmonics of the 9960 Hz component in the radiated signal shall not exceed the following levels referred to the level of the 9960 Hz sideband:-

Sub-carrier	Level
9960 Hz	0 dB (reference)
2nd harmonic	-30 dB
3rd harmonic	-50 dB
4th harmonic and above	-60 dB

4.7 Voice Broadcast: Not used in Myanmar.

4.8 Identification

4.8.1 Each VOR shall be individually identified by a two or three letter International Morse Code groups transmitted at a rate corresponding to approximately 7 words per minute.

4.8.2 The identification signal shall be on the same radio frequency carrier as used for the navigation function. The radiation of this service shall be horizontally polarized.

4.8.3 The modulation tone of the identification shall be 1020 Hz ±50 Hz.

4.8.4 Modulation Depth

4.8.4.1 The modulation depth of the radio frequency carrier due to the identification signal shall be as close to, but not in excess of 10 percent except that, where a voice broadcast service is not provided, it shall be permissible to increase the modulation by the code identification signal to a value not exceeding 20 percent.

4.8.5 Repetition Rate

4.8.5.1 The complete identification shall be transmitted at least once every 30 seconds.

4.8.5.2 The identification signal should be transmitted at least three times each 30 seconds, equally spaced within that time period.

4.8.5.3 When associated with a Distance Measuring Equipment (DME), the VOR shall synchronize with the DME so that in a 40 second cycle, the VOR transmits the complete identification code 3 times in 30 seconds and the DME transmits the identification once within the remaining 10 seconds of the cycle.

4.9 Monitoring

4.9.1 A monitoring system shall be provided which continually samples the radiated signal and will take executive action to cease radiation or to remove the identification signal and navigation components from the carrier if any one or a combination of the following deviations from established conditions arises:

a) a change in excess of 1 degree at the monitor site of the bearing information transmitted by the VOR;
b) a change of 15 percent in the modulation component of the radio frequency carrier if either the sub carrier or 30 Hz amplitude modulation signals, or both;
c) the monitoring system itself fails.

4.9.2 The monitoring system should detect the following condition however no executive action is required.

a) a decrease in carrier power of more than 50 percent below that required for the service volume.
b) failure to transmit the identification signal.

4.9.3 The monitoring system shall take executive action within 10 seconds of the occurrence of the conditions described in 4.9.1

4.10 Status Reporting

4.10.1 Remote status reporting shall be provided in accordance with Navigational Aid-Status Reporting Document.

4.11 Service Availability

4.11.1 The availability of a VOR shall be sufficient to ensure the required operational performance is achieved.

4.12 Performance Assurance

4.12.1 The complete system shall be inspected to assure performance is in accordance with this TSP.

4.12.2 The VOR shall be flight inspected in accordance with CNS Manual Vol. IV.

4.12.3 The system should be inspected periodically as given in the maintenance schedules. The periodicity indicated in the maintenance schedules shall be reviewed annually taking into consideration demonstrated accuracy, reliability and integrity of the system.

Chapter-5

Narrow Band (DME-N)

1. Purpose

1.1 This TSP applies to Ultra High Frequency (UHF) Narrow Band Distance Measuring Equipment (DME-N) and specifies technical standards and practices. Performance requirements apply to the complete facility inclusive of transponder, antenna and site.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1, Radio Navigation Aids
B) Myanmar Civil Aviation Requirements – Aerodrome Standard & Air Traffic Services
C) Manufacturer's Technical Manuals
D) Navigation Aid - Siting Criteria CNS Manual Vol. III
E) Navigation Aid - Status Reporting, Chapter-1
F) Navigation Aid - Flight Inspection CNS Manual Vol. IV
G) Manufacturer's Technical Manuals

3. Definitions

All definitions given in reference 2) above.

4. Standards and Practices

4.1 License for Frequency

4.1.1 The authorization for use of DME-N frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D(CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this DME-N frequency is also coordinated with ICAO Regional office by D(CNS).

4.2 General

4.2.1 The DME system shall provide for continuous and accurate indication in an aircraft of the slant range distance of the aircraft from an equipped ground reference point.

4.2.2 An airborne interrogator shall interrogate a ground based transponder. The ground transponder shall reply to on-channel interrogations, as determined by frequency and pulse coding, with synchronized response pulses. Range is determined from the propagation delay and fixed delay in the ground transponder.

4.2.3 Association and Co-location

4.2.3.1 A DME may be combined with an instrument landing system (ILS) and VHF Omni directional Range (VOR). A DME may also be co-located with a non-direction beacon (NDB).

4.2.3.2 When associated with an ILS or VOR, the DME channel shall be paired with the frequency of the associated aid. Refer to Annex 10, Volume 1, Table A for channel and pairing information.

4.2.3.3 When associated with an ILS the DME should be located at a point close to the runway to minimize errors along the approach. Normally the DME is sited adjacent to the glide path antenna. In the situation of a localizer only facility the DME should be located close to or on the centre line of the served runway at a location to suit the approach procedure.

4.2.3.5 The DME antenna and zero reference point shall be as near as practicable to the centre point of a VOR and shall not be in excess of 30m from a conventional VOR and not in excess of 80m from a Doppler VOR.

4.2.3.6 There is no proximity or association requirement for NDB and DME.

4.2.3.7 The identification of the DME shall be synchronized with the associated aid.

4.3 System Characteristics

4.3.1 Coverage

4.3.1.1 When associated with a VOR the coverage of the DME should at least equal to the service volume of the VOR.

4.3.1.2 When associated with an ILS the DME coverage should be equal to the service volume of the ILS and extend to service the maneuvering area required to intercept the approach and throughout the missed approach segment.

4.3.2 Accuracy

4.3.2.1 The total system error, including airborne avionics and ground transponder, shall not exceed ± 370m (0.2 NM).

Note 1: This system accuracy is predicated upon the achievement of an airborne interrogator error contribution of not more than ± 315 m (0.17 NM)

Note 2: Geographic survey accuracy contributes to the total system error.

4.3.3 Channeling

4.3.3.1 DME operating channels shall be formed by pairing interrogation and reply frequencies and by pulse coding on the paired frequencies.

4.3.3.2 Channels shall be chosen from Annex 10, Volume 1, Table A. Refer to paragraph 4.2.3.2 for channel requirements when associated with other aids.

4.3.4 Aircraft Handling Capacity

4.3.4.1 The aircraft handling capacity of transponders in an area shall be adequate for the peak traffic of the area or 100 aircraft, which ever is the lesser.

4.3.4.2 Where the peak traffic in an area exceeds 100 aircraft, the transponder should be capable of handling that peak traffic.

4.3.5 Transponder Identification

4.3.5.1 All transponders shall transmit an identification signal consisting of a two or three letter International Morse Code group.

4.3.5.2 When the DME is not associated with another aid it shall generate an 'independent' identification code. If associated with an ILS or VOR the identification code shall be the same for both devices and is referred to as an 'associated' identification code.

4.3.5.4 The identification shall use signals, which shall consist of the transmission of an appropriate period of a series of paired pulses transmitted at a repetition rate of 1,350 pulse pairs per second. During the key down time, the identification generated pulses shall replace the normally occurring reply pulses. In the intervals between key down periods normally occurring reply pulses shall be transmitted.

4.3.5.5 The identification code shall be transmitted at least once every 40 seconds.

4.3.5.6 When associated, each 40 second interval shall be divided equally into 4 periods, with the transponder identification transmitted during one period only and the associated VOR or ILS facility transmitting identification during the remaining periods.

4.3.5.7 The maximum key down time shall not exceed 5 seconds per identification code group. The characteristics of the coding shall be:

a) the dot duration shall be between 0.1 and 0.16 seconds,
b) the dash duration shall be three time a dot duration,
c) the duration between elements shall be equal to one dot duration ±10 percent,
d) the duration between characters shall not be less than three dots, and
e) the total period for transmission of an identification code group shall not exceed 10 sec.

4.3.5.8 In the event of a failure of the associated aid, the DME transponder should continue to operate with 'independent' identification.

4.4 Transmitter

4.4.1 Frequency

4.4.1.1 The transponder shall transmit on the reply frequency appropriate to the assigned DME channel.

4.4.1.2 The radio frequency of operation shall not vary more than ± 0.002 percent from the assigned frequency.

4.4.2 Pulse shape and spectrum

4.4.2.1 Pulse rise time shall not exceed 3 μs.

4.4.2.2 Pulse duration shall be 3.5 μs ± 0.5 μs.

4.4.2.3 Pulse decay time shall nominally be 2.5 microseconds but shall not exceed 3.5 μs.

4.4.2.4 The instantaneous amplitude of the pulse shall not, at any instant between the point of the leading edge which is 95 percent of the maximum amplitude and the point of the trailing edge which is 95 percent of the maximum amplitude, fall below a value which is 95 percent of the maximum voltage amplitude of the pulse.

4.4.2.5 The spectrum of the pulse modulated signal shall be such that during the pulse the effective radiated power contained in a 0.5 MHz band centred on frequencies 0.8 MHz above and 0.8 MHz below the nominal channel frequency in each case shall not exceed 200 MW, and the effective radiated power contained in a 0.5 MHz band centred on frequencies 2 MHz above and 2 MHz below the nominal channel frequency shall not exceed 2 MW. The effective radiated power contained within any 0.5 MHz band shall decrease monotonically as the band centre frequency moves away from the nominal channel frequency.

4.4.2.6 To ensure proper operation of the thresholding techniques, the instantaneous magnitude of any pulse turn-on transients which occur in time prior to the virtual origin shall be less than one percent of the pulse peak amplitude. Initiation of the turn-on process shall not commence sooner than 1μs prior to the virtual origin.

4.4.3 Pulse spacing

4.4.3.1 The spacing of the constituent pulses of the transmitted pulses shall be for:-

Channel Suffix 'X' 12μS
Channel Suffix 'Y' 30μS

4.4.3.2 The tolerance on the pulse spacing shall be ± 0.25 μs.

4.4.3.3 The tolerance on the pulse spacing should be plus or minus 0.10 μs.

4.4.3.4 The pulse spacing shall be measured between the half voltage points on the leading edges of the pulses.

4.4.4 Peak Output Power

4.4.4.1 The peak equivalent isotropically radiated power shall not be less than that required to ensure a peak pulse power density of minus 89 dBW/m^2 under all operating conditions at any point within the service volume.

4.4.4.2 The peak power of a constituent pulse of any pair of pulses shall not differ by more than 1 dB.

4.4.4.3 The reply capability of the transmitter should be such that the transponder should be capable of continuous operation at a transmission rate of 2,700 ± 90 pulse pair per second (if 100 aircraft are to be served).

4.4.4.4 The transmitter shall operate at a transmission rate, including randomly distributed pulse pairs and distance reply pulse pairs, of not less than 700 pulse pairs per second except during identity. The minimum transmission rate shall be as close as practicable to 700 pulse pairs per second.

4.4.5 Spurious radiation

4.4.5.1 During the intervals between transmission of individual pulses, the spurious power received and measured in a receiver having the same characteristics as a transponder receiver, but tuned to any DME interrogation or reply frequency, shall be more than 80 dB below the peak pulse power received and measured in the same receiver tune to the reply frequency in use during transmission of the required pulses. This provision refers to all spurious transmissions, including modulator and electrical interference.

4.4.5.2 At all frequencies from 10 to 1800 MHz, but excluding the band of frequencies from 960 to 1215 MHz, the spurious output of the DME transponder transmitter shall not exceed minus 40 dBm in any one kHz of receiver bandwidth.

4.4.5.3 The equivalent isotropically radiated power of an continuous wave harmonic of the carrier frequency on any DME operating channel shall not exceed minus 10 dB.

4.5 Receiver

4.5.1 Frequency

4.5.1.1 The transponder shall receive on the interrogation frequency appropriate to the assigned DME channel.

4.5.1.2 The centre frequency of operation shall not vary more than ± 0.002 percent from the assigned frequency.

4.5.2 Sensitivity

4.5.2.1 In the absence of all interrogation pulse pairs, with the exception of those necessary to perform the sensitivity measurement, interrogation pulse pairs with the correct spacing and nominal frequency shall trigger the transponder if the peak power density at the transponder antenna is at least -103 dBW/m^2

4.5.2.2 The minimum power density specified in 4.5.2.1 shall cause the transponder to reply with an efficiency of at least 70 percent.

4.5.2.3 The performance of the transponder shall be maintained when the power density of the interrogation signal at the transponder antenna has any value between the minimum specified in 4.5.2.1 up to a maximum of minus 22 dBW/m^2 when associated with an ILS and minus 35 dBW/m2 when installed for other applications.

4.5.2.4 The transponder sensitivity level shall not vary by more than 1 dB for transponder loadings between 0 and 90 percent of its maximum transmission rate.

4.5.2.5 When the spacing of an interrogation pulse pair varies from the nominal value by up to ±1μs, the receiver sensitivity shall not be reduced by more than 1 dB.

4.5.3 Loading Limiting

4.5.3.1 When transponder loading exceeds 90 percent of the maximum transmission rate, the receiver sensitivity should automatically reduce in order to limit the transponder replies, so as to ensure that the maximum permissible transmission rate is not exceeded.

4.5.4 Noise

4.5.4.1 When the receiver is interrogated at the power density specified in 4.5.2.1 to produce a transmission rate equal to 90 percent of the maximum, the noise generated pulse pairs shall not exceed 5 percent of the maximum transmission rate.

4.5.5 Bandwidth

4.5.5.1 The minimum permissible bandwidth of the receiver shall be such that the transponder sensitivity level shall not deteriorate by more than 3 dB when the total receiver drift is added to an incoming interrogation frequency drift of ±100 kHz.

4.5.5.2 The receiver bandwidth shall be sufficient to allow compliance with the accuracy requirements of 4.3.2 when the interrogator signals are those specified in Annex 10Volume 1 Section 3.5.5.1.3.

4.5.5.3 Signals greater than 900 kHz removed from the desired channel nominal frequency and having power densities up to the values specified in 4.5.2.3 shall not trigger the transponder. Signals arriving at the intermediate frequency shall be suppressed at least 80 dB. All other spurious response or signals within 960 to 1,215 MHz band and image frequencies shall be suppressed at least 75 dB.

4.5.6 Recovery time

4.5.6.1 Within 8 μs of the reception of a signal between 0 dB and 60 dB above minimum sensitivity level, the minimum sensitivity level of the transponder to a desired signal shall be with 3 dB of the value obtained in the absence of signals. The requirements shall be met with echo suppression circuits, if any, rendered inoperative. 8μs are to be measured between the half voltage points on the leading edges of the two signals, both of which conform in shape with the requirements for airborne interrogators. The specification of interrogator pulse shapes is presented in Annex 10, Volume 1, Section 3.5.5.1.3.

4.5.7 Spurious radiation

4.5.7.1 Radiation from any part of the receiver or allied circuits shall meet the requirements stated in 4.4.5.

4.5.8 CW and echo suppression

4.5.8.1 CW and echo suppression should be adequate for the site at which the transponder will be used.

4.5.9 Protection against interference

4.5.9.1 Protection against interference outside the DME band should be adequate for the site at which the transponder will be used.

4.5.10 Decoding

4.5.10.1 The transponder shall include a decoding circuit such that the transponder can be triggered only by pairs of received pulses having pulse duration and pulse spacing appropriate to the operating channel.

4.5.10.2 The decoding circuit shall not be affected by signals arriving before, between, or after, the constituent pulses of a pair of the correct spacing.

4.5.10.3 An interrogation pulse pair with a spacing of ±2μs, or more, from the nominal value and with any signal level up to the value specified in 4.5.2.3 shall be rejected such that the transmission rate does not exceed the value obtained when interrogations are absent.

4.5.11 Time Delay

4.5.11.1 The time delay shall be the interval from the half voltage point on the leading edge of the first constituent pulse of the interrogation pair and the half voltage point on the leading edge of the first consistent pulse of the reply transmission. This delay shall be 50 μs for mode X, and 56 μs for mode Y channels.

4.5.11.2 Time delays to offset the zero reference point from the DME antenna shall not be implemented except where zero reference point is required to be changed during commissioning of the facility.

4.5.11.3 The transponder should be sited as near to the point at which the zero indication is required as possible.

4.5.12 Accuracy

4.5.12.1 The transponder shall not contribute more than ± 0.5μs (75m) to the over-all system error. (see 4.3.2).

4.5.13 Efficiency

4.5.13.1 The transponder reply efficiency shall be at least 70% at all values of transponder loading up to the maximum handling capacity of the system and the minimum sensitivity level specified in 4.5.2.4.

4.5.13.2 The transponder shall be rendered inoperative for a period normally not exceeding 60 microseconds after a valid interrogation decode has occurred. In extreme cases when the geographic site of the transponder is such as to produce undesirable reflection problems, the dead time may be increased but only by the minimum amount necessary to allow the suppression of echoes.

4.6 Monitoring and Control

4.6.1 The DME transponder shall have a monitoring system which shall take executive action to remove the transponder from service if:-

a) the transponder delay differs from the assigned value by 1μs (150m) or more;

b) if associated with a landing system, the transponder delay differs from the assigned value by 0.5μs (75m) or more;

c) failure of the monitor itself.

4.6.2 The monitor should take executive action if the spacing between the first and second pulse of the transponder pulse pair differs from the nominal value specified for the channel by 1μs or more.

4.6.3 The monitor should cause a suitable indication at a control point (refer to 4.7) if executive action is taken in accordance with 4.6.1 and additionally if any of the following conditions arise:

a) a fall of 3 dB or more in transponder transmitted power output;
b) a fall of 6dB in the minimum transponder sensitivity not associated with load limiting;
c) the spacing between the first and second pulse of the transponder reply pulse pair differs from the normal value by 1μs or more;
d) variation of the transponder receiver and transmitter frequencies beyond the control range of the reference circuits if the operating frequencies are not directly crystal controlled.

4.6.4 Monitor action may be delayed to overcome transient effects however this delay period shall be as short as practicable and shall not exceed 10 seconds.

4.6.5 The transponder shall not be triggered more than 120 times per second for either monitoring or automatic frequency control.

4.7 Status Reporting

4.7.1 Remote status reporting shall be provided in accordance with Navigational Aid-Status Reporting Document..

4.8 Service Availability

4.8.1 The availability of a DME shall be sufficient to ensure the required operational performance is achieved.

4.9 Performance Assurance

4.9.1 The complete system shall be inspected to assure performance is in accordance with this TSP.

4.9.2 The DME shall be flight inspected in accordance with CNS Manual Vol. IV.

4.9.3 The system should be ground inspected periodically as given in the maintenance schedules. The periodicity indicated in the maintenance schedule shall be reviewed annually taking into consideration demonstrated accuracy, reliability and integrity of the system.

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Chapter-6

Navigation Aid - Non Directional Beacon (NDB)

1. Purpose

1.1 This Technical Standard and Practices (TSP) applies to Non Directional Beacons, including locators, and specifies technical standards and practices. Performance requirements apply to the complete facility inclusive of transmitter, coupling unit, antenna and site.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1, Radio Navigation Aids
B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Service
C) Navigation Aid - Siting Criteria CNS Manual Vol. III
D) Navigation Aid - Status Reporting, chapter-1
E) Navigation Aid - Test Transmissions, Chapter-12
F) Navigation Aid - Flight Inspection CNS Manual Vol. IV
G) Equipment manual

3. Definitions: All definitions given in reference 2) above.

4. Standards and Practices

4.1 License for Frequency

4.1.1 The authorization for use of NDB frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D (CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this NDB frequency is also coordinated with ICAO Regional office by D (CNS).

4.2 Coverage

4.2.1 Specification

4.2.1.1 All notifications of NDB coverage shall be based on average radius of the rated coverage.

4.2.1.2 Where the radius of coverage is materially different in various operationally significant sectors, coverage should be expressed in terms of the average radius of rated coverage and the angular limits of coverage for each sector.
Rated Coverage: The volume in which the satisfactory performance of the NDB service is required.

4.2.1.3 Where the coverage of an NDB is limited by altitude, different day and night coverage or different coverage over land and water, the rated coverage shall be notified with appropriate qualification.

4.2.2 Field Strength

4.2.2.1 The minimum field strength of an NDB within the coverage volume shall be 70μV/m for facilities located south of the 30° south parallel and shall be 120μV/m for facilities located north of the 30° south parallel.

4.2.2.2 Within the service volume the minimum protection ratio between wanted and unwanted signal shall be 15dB.

4.2.3 Needle Fluctuation

4.2.3.1 Within the service volume the maximum needle fluctuation of an ADF shall be ± 10° for an NDB other than when used as a locator. For locators the maximum needle fluctuation shall be ± 5° when part of a procedure.

NOTE: See CNS Manual Vol. IV for guidance.

4.3 Limitation In Radiated Power

4.3.1 The power radiated from an NDB shall not exceed by more than 2dB that is necessary to achieve its rated coverage, except that this power may be increased if coordinated regionally or if no harmful interference to other facilities will result.

4.4 Radio Frequencies

4.4.1 The radio frequencies assigned to NDBs shall be selected from those available in that portion of the spectrum between 190kHz and 1750kHz for aeronautical radio navigation.

4.4.2 The lowest assigned frequency should be 200 kHz and frequencies assigned between 200 kHz and 526.5 kHz should be in 3 kHz steps commencing at 200 kHz. Frequencies available only for aeronautical radio-navigation should be allocated.

4.4.3 For the band 1606.5 to 1750 kHz the lowest assignment should be 1608 kHz and then in 3 kHz steps.

4.4.4 The same frequency shall not be assigned to two NDBs within a geographic area where the service volumes overlap.

4.4.5 Locators provided for twin locator approaches or as part of an instrument landing system procedure should be assigned frequencies not less than 15kHz and not more that 25 kHz separation.

4.4.6 Frequency Tolerance

4.4.6.1 The frequency tolerance for NDBs below 1605.5 kHz shall be 0.01 percent. The frequency tolerance for NDBs above 1605.5 kHz shall be 0.005 percent.

4.4.6.2 The frequency tolerance for all NDBs should be 0.005 percent.

4.5 Voice / Audio Modulation

4.5.1 Identification Code

4.5.1.1 Each NDB shall be individually identified by a two or three letter International Morse Code groups transmitted at a rate corresponding to approximately 7 words per minute.

4.5.1.2 The identification code should be selected to correspond with the location code or the facility. Except for facilities described in 4.5.1.3 below.

4.5.1.3 Repetition Rate

4.5.1.3.1 The complete identification shall be transmitted at least once in every 30 second interval.

4.5.1.3.2 For NDB without voice modulation the repetition rate should be at least 3 times in each 30 seconds.

4.5.1.4 Tone

4.5.1.4.1 The frequency of the modulation tone used for identification shall be 1020Hz ± 50Hz or 400Hz plus or minus 25Hz.

4.5.1.4.2 For NDB located in high density areas 400Hz should normally be used.

4.5.2 Voice: Not used in Myanamr.

4.5.3 Noise and Distortion

4.5.3.1 Unwanted audio frequency modulations shall total less than 5 percent of the amplitude of the carrier.

4.5.3.2 Modulation with frequencies between 30 Hz and 120 Hz should be as low as possible whilst remaining consistent with 4.5.3.1

4.5.4 Modulation

4.5.4.1 For NDBs without voice modulation the signal radiated shall be a continuous carrier with on/off keying of an amplitude modulating tone (NON/2A2) or a continuous carrier with a separate on/off keyed carrier displaced either 400Hz or 1020Hz from the continuous carrier. The depth of modulation shall be maintained as near to 95 percent as practicable.

4.6 Monitoring

4.6.1 For each NDB, suitable means shall be provided to enable detection and reporting of any of the following conditions in accordance with 4.7 below:-

a) a decrease in the radiated power of more than 50 percent below that required for rated coverage;
b) failure to transmit the identification signal;
c) malfunctioning or failure of the means of monitoring itself.

4.6.2 No executive action is required if conditions described in 4.6.1 are detected however automatic restoration should be initiated where provided.

4.7 Status Reporting

4.7.1 Remote status reporting shall be provided in accordance with TSP 3.1 Nav. Aids – Status Reporting.

4.8 Service Availability

4.8.1 The availability of an NDB shall be sufficient to ensure the required operational performance is achieved.

4.9 Performance Assurance

4.9.1 The complete system shall be inspected to assure that performance is in accordance with this TSP.

4.9.2 The NDB shall be flight inspected only when operationally required in accordance with CNS Manual Vol. IV.

4.9.3 The system should be inspected periodically as given in the ground maintenance schedules. The periodicity indicated in the maintenance schedules shall be reviewed annually taking into consideration demonstrated accuracy, reliability and integrity of the system.

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Chapter-7

Communication – H.F SSB Air-Ground-Air Voice Services

1. Purpose

1.1 This document establishes standards and recommends practices for the operation of high frequency single sideband (HF-SSB) air-ground-air voice services

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume III, Part 2.
B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Service
c) Equipment Manual

3. Definitions: All definitions given in reference 2) above.

4. Standards and Practices

4.1 License for Frequency

4.1.1 The authorization for use of HF SSB frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D (CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this HF SSB frequency is also coordinated with ICAO Regional office by D(CNS).

4.2 ICAO SARP Compliance

The HF-SSB service shall be implemented and operated in compliance with ICAO Annex 10 Volume 3 Part II including Standards and Recommended Practices specified in Section 2.

4.3 Power

4.3.1 The selection of transmitter site/s, frequency of operation and radiated power of the service should be to provide sufficient field strength for an appropriately equipped aircraft station located within the service volume to receive the transmission with a high reliability.

4.3.2 Sufficient field strength should be interpreted as a nominal field strength required to produce a receiver threshold pre-detection radio frequency signal to noise ratio of 45 dB/ Hz (or a signal to noise ratio of 10 dB for a receiver band width of 3 kHz).

4.3.3 High reliability should be interpreted as 99.99% availability of service with fault free performance by the aircraft system.

4.4 Time-Out Function

4.4.1 All HF transmitters should be provided with a facility which disables the transmitter after a period of not more than 5 minutes of continuous transmission.

Reactivation of the transmitter (following disabling by the time-out function) should be initiated only after the release and re-keying of the transmit control circuitry (e.g. release and re-operation of the 'press-to-talk'.)

4.4.2 Tone Warning**:** A short duration audio tone should be generated at the operator position whenever the time-out function disables a transmitter.

4.5 Sensitivity.

4.5.1 The design of the receiving system, including siting and characteristics of antennas, should provide for the reception of an aircraft station located with the service volume transmitting on one frequency of the service's frequency suite with high reliability.

4.6 SELCAL.

SELCAL will be provided with H.F SSB Air-Ground-Air Voice Services where operationally required.

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Chapter-8

(VHF) Air-Ground-Air (AGA) Voice Communication Service

1. Purpose

1.1 This TSP applies to ground based equipment utilized in the Very High Frequency (VHF) Air-Ground-Air (AGA) voice communication service utilizing double sideband amplitude modulation.

1.2 It does not apply to VHF data modes or to voice services using time domain multi access techniques.

1.3 The purpose of this TSP is to specify the technical performance standards and practices applicable to VHF AGA voice communications services.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume III, Part II, Voice Communications Systems.
B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Service
C) Equipment Manual

3. Definitions: All definitions given in reference 2) above.

4. Standards and Practices

4.1 General

4.1.1 License for Frequency

4.1.1.1 The authorization for use of VHF frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D(CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this VHF frequency is also coordinated with ICAO Regional office by D(CNS).

4.1.2 Polarization

4.1.2.1 The design polarization of emissions shall be vertical {Ref A:2.1.1.4}

4.2 Ground Transmitter

4.2.1 Frequency

4.2.1.1 The transmitter shall operate on the assigned frequency or frequencies.

4.2.2 Frequency Stability

4.2.2.1 The transmitted radio frequency, except as detailed in 4.2.2.2, shall not vary more than ± 0.002 percent from the assigned frequency.

4.2.2.2 Where 8.33 kHz channel spacing is implemented, the transmitted radio frequency shall not vary more than ± 0.0001 percent from the assigned frequency.{Ref A:2.2.1.1}

4.2.2.3 **Offset carrier systems:** The stability of individual carriers of an offset carrier system shall be such as to prevent first-order heterodyne frequencies of less than 4 kHz and, additionally, the maximum frequency excursion of the outer carrier frequencies from the assigned carrier frequency shall not exceed 8 kHz. Offset carrier systems shall not be used on 8.33 kHz spaced channels.{Ref A:2.2.1.1.1}

4.2.3 Spectral Characteristics

4.2.3.1 Spurious emissions radiated by the station shall be -70dB reference to an un-modulated carrier.{Ref A:2.1.1.2}

4.2.4 Modulation

4.2.4.1 The modulation shall be double sideband (DSB) amplitude modulated (AM) carrier.{Ref A:2.1.1.1}

4.2.4.2 A peak modulation factor of at least 0.85 (85%) shall be achievable.{Ref A:2.2.1.3}

4.2.4.3 Means should be provided to maintain the average modulation factor at the highest practicable value without over modulation.{Ref A:2.2.1.4}

4.2.5 Power

4.2.5.1 The radiated power of the station, except as permitted by 4.2.5.2, shall be such as to produce a field strength of at least 75μV/m (-109 dBW/m^2) at all points within the operational service volume of the station.{Ref A:2.3.2.2.1}. Each station shall identify operational service volume in coordination with ATC.

4.2.5.2 Extended range stations shall radiate power sufficient to produce a field strength of at least 30μV/m (-117 dBW/m^2) at all points within the operational service volume of the station.{Ref A:2.3.2.2.1}.

4.2.6 Time-Out Function

4.2.6.1 All transmitters used for two-way simplex communication on aeronautical frequencies shall be provided with a facility which disables the transmitter after a period of not more than 90 seconds of continuous transmission. Reactivation of the transmitter (following disabling by the time-out function) shall be initiated only after the release and re-keying of the transmit control circuitry (e.g. release and re-operation of the 'press-to-talk').

4.2.6.2 The time-out period should be adjusted to less than 90 seconds but long enough to allow normal communications without disruption. Recommended periods are:-

a) Tower, TMA and Radar Sectors, 30 seconds
b) Non-radar sectors, 90 seconds
c) Mobile and Portable and non-ATS fixed stations, 60 seconds

4.2.6.3 Tone Warning: A short duration audio tone should be generated at the operator position whenever the time-out function disables a transmitter.

4.2.6.4 Application: The Time-Out Function shall apply to all designated transmitters commissioned on or after 1 November 2000. Designated transmitters commissioned prior to 1 November 2000 shall comply with this standards by 1 November 2003.

4.3 Ground Receiver

4.3.1 Frequency stability.

4.3.1.1 Where 8.33 kHz channel spacing is employed the receiver frequency of operation shall not vary more than ± 0.0001 percent from the assigned frequency.{Ref A:2.2.2.1}

4.3.2 Sensitivity.

4.3.2.1 The sensitivity of the receiving function shall be such as to provide an audio output signal with a wanted/unwanted ratio of 15 dB, with a 50 percent amplitude modulated (A3E) radio signal having a field strength of 20μV/m (-120 dBW/m^2) or more at the receiving antenna. {Ref A:2.2.2.2}

4.3.2.2 The receiving antenna shall be sited and have a radiation pattern such that an aircraft station with the characteristics specified in Annex 10 Section 2.3 (Ref (a)) and located anywhere within the service volume, is be capable of producing a field strength as specified in 4.3.2.1{Ref A:2.2.2.2}

4.3.3 Effective acceptance bandwidth.

4.3.3.1 When tuned to a channel having a width of 25 kHz, 50 kHz or 100 kHz, the receiving system shall provide an adequate and intelligible audio output when the signal specified at 4.3.2.1 above has a carrier frequency within ± 0.005 percent of the assigned frequency. When tuned to a channel having a width of 8.33 kHz, the receiving system shall provide an adequate and intelligible audio output when the signal specified at 4.3.2.1 above has a carrier frequency within ± 0.0005 percent of the assigned frequency.{Ref A:2.2.2.3}

4.3.4 Adjacent channel rejection.

4.3.4.1 The receiving system shall ensure an effective rejection of 60 dB or more at the next assignable channel. {Ref A:2.2.2.4}

Note:--The next assignable frequency will normally be ± 50 kHz. Where this channel spacing will not suffice, the next assignable frequency will be ± 5 kHz, or ± 8.33 kHz.

4.3.5 Interference immunity performance

4.3.5.1 Receiving systems shall provide satisfactory performance in the presence of two signals, third-order inter modulation products caused by VHF FM broadcast signals having levels at the receiver input of -5 dBm. {Ref A:2.3.3.1}

4.3.5.2 Receiving system shall not be desensitized in the presence of VHF FM broadcast signals having levels at the receiver input of -5 dBm.{Ref A:2.3.3.2}

4.4 Service Availability

4.4.1 The availability of an individual transmitter and/or receiver shall be sufficient to ensure the required operational performance from the total system is achieved.

4.5 Performance Assurance

4.5.1 The complete system shall be inspected to assure performance is in accordance with this TSP.

4.5.2 The system should be inspected periodically as given in the maintenance schedules. The periodicity indicated in the maintenance schedules shall be reviewed annually taking into consideration demonstrated accuracy, reliability and integrity of the system.

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Chapter-9

Secondary Surveillance Radar (SSR)

1. Purpose

1.1 This TSP applies to SSR and specifies Technical Standard and Practices. Performance requirement apply to the complete facility inclusive of Transmitters, Receivers etc.

2. References

A) Annex 10 of ICAO, Volume IV, SSR and ACAS
B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Service
C) Manufacturer's Technical Manuals

3. Definitions:

All definitions are given in Reference 2) above.

4. Standards and Practices:

4.1 Licenses for Frequency:

The authorization for use of SSR frequency is obtained from Ministry of Communications, Post and Telegraphs, Government of Myanmar. D(CNS), coordinates with Post and Telegraph Department of Myanmar in this regard. The use of this SSR frequency is also coordinated with ICAO Regional office by D(CNS).

4.2 SSR Mode Interrogation Transmissions (1030 MHz)

An MSSR mode transmission consists of pulses P1, P2 and P3 for interrogation modes 1, 2, 3/A, B, C or D. P1 and P3 are the interrogation pulses and P2 is the control pulse. Control pulses are used by the airborne equipment for side lobe suppression (SLS).

4.3 SSR Mode Replies

Replies are received as 1090 MHz modulated pulse trains by the Receivers via the Receiver Interface. Pulse combinations are:-

Mode 1 - two framing pulses with 6 information pulse positions
Mode 2, 3/*A, B, C, D* - two framing pulses with 12 information pulse positions.

4.4 Mode S Interrogation Transmissions

Mode S interrogations are generated from a series of pulses numbered P1 to P6 with P1, P2 and P3 pulses being the same as those used in SSR modes. Mode S adds a further three pulses, P4, P5, and P6, which are used in various combinations with the existing pulses to create the three types which make up the Mode S interrogation set. These interrogation types are:-

(a) The Mode A/C/S All - call interrogation which is used for surveillance of SSR Mode A/C transponders and for the acquisition of Mode S transponders.

(b) The Mode A/C-only All-call elicits a reply from SSR Mode A/C transponders but not from Mode S transponders.

(c) The Mode S interrogation which only elicits a reply from Mode S transponders. This interrogation, with various codings in P6, is used for Mode S only All-call, Mode S addressed surveillance, and data link. New aircraft can enter the coverage area at any time and All-call interrogations must be transmitted at a continuous low rate to acquire these new aircraft. In the acquisition phase, either of two All-call formats can be used. The Mode A/C/S All-call I interrogation (the P4 All-call) elicits a reply in a downlink format. This reply contains data fields which include the aircraft address and other pertinent information. The second All-call type is the Mode S-only All – call which utilizes a Mode S uplink format. When acquired, Mode S track data are maintained by Mode S scheduled interrogations.

4.5 Mode A/C/S and Mode A/C-only All –calls

The Mode A/C/S and Mode A/C-only All -calls are similar to SSR interrogations, but with an additional pulse, P4, following P3. A P4 pulse width of 1.6μs is used in the Mode A/C/S All -call interrogation, while a P4 pulse width of 0.8 μs is used in the Mode A/C-only All-call. Mode A/C transponders are not affected by the presence of the P4 pulse, and thus they respond with the appropriate Mode A or Mode C reply. A Mode S transponder detects the P4 pulse and if it is short (0.8 us) recognizes the interrogation as an SSR Mode A/C-only All-call and does not reply. However, if the P4 is long (1.6 us) the Mode S transponder recognizes the reply as a Mode S All-call and sends a Mode S reply containing its address.

In the above two interrogation types, side-lobe suppression is accomplished by the transmission of the P2 pulse on a side-lobe suppression control pattern. If this pulse is received by either an SSR Mode A/C or a Mode S transponder at amplitude above that of the P1 pulse the tr5ansponder will not reply.

4.6 Mode S only All-calls:

The Mode S only all- call utilizes a Mode S uplink format which contains two control fields:

(a) the interrogator identifier (II) field, which identifies the interrogator; and
(b) the probability of reply field, which performs certain control functions. The format also elicits the All-call reply format.

4.7 Mode S Scheduled Interrogations:

The Mode S interrogation is formed by three pulses P1, P2 and P6 Pulses P1 and P2 form the preamble and are spaced 2μs apart. An SSR Mode A/C transponder which receives this interrogation interprets the pairs as an SSR side-lobe suppression command and will suppress for a period of time between 25 and 45 us. The P6 pulse is transmitted from the Interrogator during this period. Without such suppression the P6 pulse would, with high probability, trigger the SSR Mode /C transponder causing a spurious reply. The P6 pulse of the Mode S interrogation is either 16.25 or 30.25μs long and contains the data in the form of differential phase shift keyed (DPSK) modulation. The data chips are 0.25μs long and a phase reversal at the beginning of each chip represents a binary "1", while the absence of such a reversal denotes a binary "0". The chip length represents a

4 Mbps rate, which permits transmission of 112-bit messages within the minimum available suppression interval.

4.8 Side-lobe suppression:

It is accomplished for Mode S interrogations by the transmission of the P5 control pulse on a side-lobe suppression pattern. If the control pulse amplitude received by the transponder exceeds the amplitude of the interrogation, the sync phase reversal will be obscured, and the interrogation will be rejected. With discrete address interrogations, transmitted side-lobe suppression is not required to prevent side lobe replies because, in general, an aircraft will be interrogated only when in the main beam of the interrogating antenna. However, transmitted side-lobe suppression on All-call interrogations prevents side-lobe replies, because all transponders which are not locked out could reply.

4.9 Mode S. Replies:

A Mode S reply consists of a preamble and a data block containing 56 or 112 pulses. The preamble consists of a series of four 0.5μs pulses. The data block begins 8μs after the leading edge of the first preamble pulse. Binary data transmitted at a 1 Mbps data rate using pulse position modulation in the following way:-
In the 1μs interval corresponding to each data bit, a 0.5μs pulse is transmitted in the first half of the interval if the data bit is a "1" and in the second half if the data bit is "0". The group of four pulses forming the preamble is designed to be easily distinguishable from Mode A and Mode C replies. ppm for the data block permits reliable bit detection in the presence of SSR (Modes A and C) interference.

4.10 Plot Extraction:

In the Receivers, the incoming RF signals are mixed with the 1030 MHz Local Oscillator signal, amplified in a linear and then in a logarithmic amplifier and converted to an 8 bit digital output in the analogue to digital converter. Sum (∑) or control (Ω) or difference (Δ) data are output and additionally, raw video.
The Plot Extractor system accepts outputs from the Receivers, i.e. 8bit (∑, Δ or Ω, and produces output plots in a variety of formats.

5. BRIEF SPECIFICATION

5.1 Transmitter

Coverage	:	360 deg azimuth, 250 NM.
Beam Width	:	2.4 deg at 3 dB point
Range Accuracy	:	± 30 feet 25 ft rms jitter
Azimuth Accuracy	:	0.068 deg, 1sigma rms error
Frequency	:	1030±0.01MHz ∑ (sum) and Ω (control)
Output power	:	30.5 dBW min (∑), 30.0 dBW min (Ω)
Pulse Width	:	0.8 ± 0.05 μs
Power droop	:	not to exceed 1.0 dB from start to end of interrogation (SSR and Mode S)
Mismatch	:	Operation into a 1.5:1 load mismatch with 0.3 dB reduction in power.

Peak duty cycle	:	Constant duty cycle of 4.2% up to 40°C (∑ channel). Constant duty cycle of 0.1% up to 40°C (∑ channel).
Frequency spectrum	:	CW at 1030±0.2 MHz not to exceed -76 dBm when not interrogating.
Pulse frequency Spectrum	:	80 dB relative to peak power outside the range 930 MHz to 1130 MHz (excluding harmonics) Harmonic radiated power at least 60 dB below fundamental radiated power.
Polarization	:	Predominantly vertical

5.2 Receiver:

Centre frequency	: 1090 MHz nominal
Local oscillator frequency	: 1030±0.01 MHz
Intermediate frequency	: 60MHz
Bandwidth 3 dB	: 1085.5±0.5 MHz to 1094.5±0.5 MHz
40dB	: >1078 and <1102 MHz
60dB	: >1065 and <1115 MHz
Mean of -3 dB points	: 1090±0.5 MHz
Spurious & image response	: 60 dB below response at 1090 MHz
Tangential sensitivity	: better than -90 dBm
Dynamic range	: -16 to -96 dBm
Video output	: 8 bits digitized for (∑) Sum (Δ) difference and (Ω) (control) 1 bit (left/right of bore sight), 1 bit sign confidence 16 MHz
Video Processing	: Range gating 2 km to 500 km. : Sensitivity Time Control (STC), site adaptable and on/off control with selectable linear, sector or on/off control. : Pre-settable sensitivity rejection of multi path and jamming : Short pulse elimination : 6dB detection : Receiver side lobe suppression (RSLS) : Phase detector/ sign indication

5.3 Mode / Trigger Selection

Interrogation Modes:

Mode	Pulse spacing (us)	
1	3	P1 to P3 pulse spacing, each
2	5	pulse is 0.8μs in width at 2μs
3/A	8	from P1
B	17	
C	21	
D	25	

Mode Interlace : Sixteen SSR modes and four Mode S interlace programmes are available for programming. All 20 are defined with default settings encompassing the above modes in various combinations of single dual, triple sequences etc.
The Mode S interlace patterns allows the combination of SSR Mode A/C interrogations with the three types of Mode S All-call.

Internal trigger : Selectable 50 to 450 Hz in 1 Hz steps

Staggered trigger : The trigger may be staggered by 5% of the PRF in a pseudo-random sequence.

Trigger outputs
Suppression :

Mode1	6us
Mode2	8us
Mode 3/A	11us
Mode B	20us
Mode C	24us
Mode D	28us

System trigger : 1.0±0.1μs width,
PRF as internal or external divided down, position adjustable between P3 and P3-500μs steps.

Display trigger : 1.0±0.1us width, position variable between P3-30 and P3+97us

Plot Extractor
Trigger : 0.5±0.1us at P3-30 us

Mode identity pulses
(TX Ident) : P1 and P3

5.4 Control

Transmitter controls :
Trigger Stagger; Linear/Staggered
Stagger Variation; Low/Off
RF (TX) Enable; Off/On
PRF Value (Hz)
Modes interlace programme selection;
1-16 Non-Mode S operation
17-20 Mode S operation

Receiver Decoder
Correlator :
STC (SSR/All Call); Off/Linear /Programmed
Mode S Scheduled STC; Off/On

Tracker	:	primitive Zones; Off/On Self-Adaptive Reflectors; Off/On Site Monitor; Off/On
Operational Modes	:	Channel Mode; Operational/Maintenance

5.5 Plot Extraction

Azimuth determination

Mono pulse with sliding window processing when no mono pulse data is available

Video Processing

- Spike elimination
- Dynamic and minimum threshold detector
- Jamming detection
- 6dB detection
- RSLS flag generation
- Internal/external range amplitude threshold (STC)
- PSV generation
- Short pulse elimination
- Leading edge and trailing edge detection (with pseudo leading edge generation)
- Wide pulse elimination
- Low difference threshold
- Sum difference ratio generator

Decoding

- Mode 1,2,3/A,B,C,D and S
- Bracket detection
- Range zero determination and range gating
- Measure reply range and azimuth
- Determine code and code garble including emergency and special identity replies (both civil and military)
- Hardware defruiting (all modes) ON/OFF selectable
- Preamble detection
- Mode-S CRC checking
- Mode-S reply data extraction

Plot and Track Processing

- Reply to reply correlation
- Surveillance (Track) processing
- Mode S Interrogation Scheduling
- Reflector Detection and reflection suppression
- Mode S to SSR Track combination
- Target report formatting
- Output; protocol handling
- Mode-S Datalink
- Interface for Uplink and Downlink data
- Extended Length Message (ELM) Processing

Azimuth distribution

- Accepts serial data - azimuth count pulses (ACP) with north marker or 14 bit parallel azimuth data
- Azimuth data for Interrogator
- Azimuth data for external equipments e.g. RMM/PPI, PSR etc.

Self test

- Self test reply data generator
- Synthetic target data generator
- Built-in self test (BIST) includes PROM, RAM or MPC and so on

Monitoring

- Azimuth data
- Trigger
- Clocks
- Watchdog
- LEDs for error, failure in process indication etc.
- Transmitter/Receiver, power supply, mode generator cabinet and other external sources via a serial link to the control and BIT PEC.

6.0 Service Availability

6.1 The availability of SSR shall be sufficient to ensure that the required operational Performance is achieved.

7.0 Performance Assurance:

7.1 The complete system shall be inspected to assure performance is in accordance with this TSP

7.2 This system should be inspected periodically as given in the maintenance schedules. The periodicity indicated in the schedule shall be reviewed annually taking in to consideration demonstrated accuracy, reliability and integrity of the system.

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Chapter-10

Air Traffic Services - Time Standards

1. Purpose

1.1 This TSP states the standards for 'time of day' clocks used in air traffic services.

1.2 The TSP does not apply to a chronometer that forms part of an electronic system and is necessary for the correct operation of the system. An example application is a chronometer necessary for the synchronization of a digital link. The performance requirements of such chronometers will be a function of the system design.

2. References

A) Annex 11 to the Convention on International Civil Aviation, Air Traffic Services

B) Myanmar Civil Aviation Requirements – Aerodrome Standards & Air Traffic Service

3. Definitions

Time of day: The time expressed in hours and minutes and, when required, seconds of the 24-hour day beginning at midnight based on Co-ordinated Universal Time.

UTC: Co-ordinated Universal Time as calculated by the Bureau International des Poids et Mesures (BIPM)

4. Standards and Practices

4.1 Types of Time Systems:

The following systems shall be in operation at the airports and control center:-

a) Digital Master / Slave Clocks System
b) Clock System based on GPS
c) Stand Alone Clock System

4.2 Time Display

4.2.1 Time displays in Air Traffic Service units shall display the time in hours, minutes and seconds, clearly visible from each operating position in the unit concerned.

4.2.2 For units not using data link communications the displayed time shall be set to UTC ± 1 second and maintained within ± 5 seconds of UTC.

4.2.3 For units using data link communications the display time shall be set and maintained within ± 1 second of UTC.

4.3 Time Synchronization:

4.3. Where Master/Slave clock system is in operation, the master clock is to be corrected / synchronized every day in the morning at 0230 UTC from the time signal obtained from Myanmar Radio or from a standard time station.

4.3.2 All the slave clocks shall require to be synchronized with the master clock. The clocks can also be corrected and synchronized through GPS wherever such system is installed.

4.3.3 The time of stand alone working positions like Radars, AMSS, DVTR/Voice Loggers and other positions shall be required to be synchronized through GPS wherever such system is installed.

4.3.4 The stations where master/slave clock system is not provided the time of stand alone clocks provided at working positions, the time shall be corrected /synchronized with the time signal obtained from Myanmar Radio or from a standard time station.

4.3.5 An entry in the daily shift log book shall be recorded for time correction / synchronization of all operational clocks.

4.4 Loggers and Recorders

4.4.1 Time stamping introduced by a logger or recorder shall be set to UTC ± 1 second and maintained within ± 30 seconds of UTC

4.4.2 Logger and recorder time should be maintained within ± 5 seconds of UTC where practical.

4.4.3 In the situation where reproduction of a recorded signal requires greater accuracy than specified in 4.2.1 a more accurate timing record shall be stored either as part of the required signal or as a separate timing signal on the recording media.

4.5 Performance Assurance

4.5.1 The complete system shall be inspected to assure the performance is in accordance with this TSP.

4.5.2 The system should be inspected periodically at nominal interval of one month to assure compliance with this TSP.

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Chapter-11

Competency Requirement for Personnel Maintaining CNS Systems

1. Purpose:

1.1 This Scheme establishes standards and practices for the assessment of proficiency of personnel authorized to remove, carry out required maintenance and restore to service CNS systems, to work on live CNS systems and to certify the technical performance of CNS system.

2. References

A) ICAO Annex 1

3. Definitions:

Proficiency Assessment Scheme: A scheme approved by the Member (Operations), which controls the certification of CNS personnel authorized to remove from or restore to service, work on live equipment or certify a prescribed element of the CNS System. There will be two level of maintenance and operational requirements:-

Level –I This covers the maintenance and operations of the system in the field including the capability to repair the equipment up to module/ card level and also handle the associated software.

Level –II This covers Level I and all other related matters including the capability of high level software management and to work in the respective Special Maintenance Unit (SMU). The level II shall be decided on case to case basis after approval of Member (Ops.)

Current accreditation: In full compliance with the requirements of the scheme at the time an action is taken.

CNS Authority: A competent person authorized to act for DCA on CNS matters for a particular facility.

Prescribed element: A facility, system, equipment or software scheme determined by a CNS Authority to have an effect on the ability of the CNS system to provide a high integrity and safe service.

Live equipment: A prescribed element which is in operational service. (Note: In this context this definition does not have the same meaning as for electrical safety definition).

4 Standards and Practices

4.1 As far as possible only persons holding current accreditation in accordance with proficiency assessment scheme shall remove from or restore to service, work on live equipment or certify the technical performance of a prescribed element of the CNS System. Non proficient personnel can work under the supervision and guidance of proficient personnel can remove from or restore to service, work on live equipment

4.2 Scope and coverage of the Scheme

4.2.1 For the purpose of rating, the various equipment being maintained by Communication (Maintenance) discipline are grouped in six groups, namely:

Group I –

(a) HF and NDB Maintenance, VHF & VCCS, Voice Recorders & ATIS Maintenance

(b) AMSS Maintenance and Operation

(c) AMSS operation

Group II -

VOR/DVOR Maintenance, DME (LP and HP) Maintenance and ILS Maintenance.

Group III -

PSR and MSSR Maintenance

Group IV-

HF operations MWARA, RDARA at International Stations or RDARA at other Stations.

Note : For proficiency examination on HFRT, the executive should have performed not less than 60 duties on HFRT position at International (30 duties each on RDARA/MWARA) under a rated executive, within 12 months period of completing training course.

Group V

(a) System Administration.

(b) CPDLC Maintenance

(c) Automatic Data Processing (Both HW and SW) for Area control Centre

Group VI

(a) VSAT & RCAG Maintenance

4.2.2 Eligibility Criteria:

4.2.2.1 1 All executives in the CNS discipline in the cadre of Technical, Communication & Electronics up to the rank of General Managers are eligible to draw the Proficiency allowance. The proficiency in various facilities can be taken only in sequential manner. An executive becomes eligible to appear in proficiency examination of group only after he/she becomes proficient in all facilities of previous group.

4.2.3 Criteria for awarding proficiency

All executives who pass in written and subsequent practical/viva-voce examination in a particular facility/equipment would be declared proficient in that particular facility/equipment.

4.2.4 Procedure for assessment for Level –I

4.2.4.1 Assessment for the purpose of rating shall be carried out through written test and practical/oral assessment.

4.2.4.2 Written Test: The paper shall be separate for each group of equipment and be of conceptual in nature with 75% marks for objective type questions and 25% marks for descriptive questions. Pass percentage shall be 60% put together.

4.2.4.3 Practical examination shall be conducted equipment-wise and with 60% as minimum pass marks. Overall pass percentage for combined performance in written test and practical assessment shall be 70%.

4.2.4.4 Board for examination: The Boards for practical and written examination shall be constituted as below:

(i) Nominated Directors/General Managers/DD(CNS)/DGM from CNS discipline shall function as Chairperson of the Board. In Case DD (CNS)/DGM are nominated as Board chairman same should be approved by D (CNS).

(ii) The two other board members shall be nominated by D (CNS)

4.2.4.5 Award of proficiency after CATI Training:-

(i) Executive who pass the "**concept level"** training in particular equipment at CATI or at various canters under the supervision of CATI will be considered pass in the written examination for the equipment. They will be eligible to appear for practical/Viva-voce on the equipment thereafter.

(ii) Those who pass the " **Module** " level training in particular equipment at CATI or at various canters under the supervision of CATI will be considered having acquired " Level –I" proficiency in the equipment.

4.2.5 Procedure for assessment for Level –II

Those who pass the "System Level and Component Level" level training in particular equipment at CATI or at various canters under the supervision of CATI will be considered having acquired " Level –II" proficiency in the equipment. Level II proficiency shall be applicable on posting at concerned Facilities installation & Maintenance Unit.

4.2.6 Failure in practical & Viva – voce examination

4.2.6.1 After passing written examination if an executive fails in practical & viva voce examination, he/she is entitled to avail one more chance for passing the practical & Viva-voce exams. If the concerned executive fails twice in practical/viva-voce examination, he shall have to appear in the theory examination afresh to become

eligible for any further practical test. In case of HFRT, he has to undergo a short term refresher course either at CATI before appearing in the theory examination.

4.2.6.2 Restoration of Proficiency in case of HFRT operation is subject to passing of a practical examination conducted through a nominated a nominated a nominated regional committee, which should clearly establish that the executive has overcome the deficiencies, noted in the investigations. The test shall however be after a period of no less than 16 duty shifts in the same unit, out of which at least 4 duties shall be under the supervision/monitoring of executive with current rating, so authorized by local head of office.

4.2.7 Re-validation

4.2.7.1 through Refresher Course:

4.2.7.1.1 All executives in CNS discipline will under go refresher course at CATI or at a centre under the supervision of CATI at least once in three years. The executives who are working currently on particular equipment for last one year need not under go refresher course on the same equipment. Passing the refresher course by the executive will revalidate proficiency in that particular facility, even though he is not posted at a station where the facility is not available.

4.2.7.1.2 Facilities pertaining to Group –I will not require revalidation.

4.2.7.2 On Transfer:-

4.2.7.2.1 If the equipment /facility on which he has the proficiency, is not available at the new station as per Para 4.2.7.1 above.

4.2.7.2.2 If an Executive having proficiency in Group –II and above is transferred to a station having make/model of the equipment/system different from the one on which he holds the proficiency:

(a) He shall acquire proficiency on the new make / model of the particular system on which he has been deployed within a period not exceeding six months of his reporting at the new station. The proficiency could be attained for new equipment/Model after passing in practical/Viva-Voce examination conducted by a committee dully constituted by DD(CNS). However in case the examination is not conducted in stipulated time of six months, the Executives will continue to draw 100 % proficiency till results are declared.

(b) If a qualified officer is posted at a station where such electronic equipment/system/facility, service does not exist, he shall revalidate his proficiency on an annual basis after performing duties for 5 days on the type of system/facility/service he is qualified. Revalidation of proficiency in HFRT will be done by a committee dully constituted by DD (CNS). However in case the examination is not conducted in stipulated time of six months, the Executives will continue to draw 100 % proficiency till results are declared. However if an Executive does not pass Practical/Viva-Voce his proficiency will be as Para 4.2.6.1

(c) In case an HFRT rated Executive is transferred from one station to another station where HFRT is not available, he will be eligible to draw only 50Percent of the allowances provided he revalidates his rating before expiry of six months. In case HFRT exists at the station of his posting, he is expected to acquire the rating within a period of six months at the new station and he continues to draw hundred percent proficiency allowances. However, in case tan executive the proficiency at new station, within six months, he would not be eligible to draw HFRT proficiency allowance.

4.2.8 Conditions of withdrawal of proficiency:-

Proficiency to an executive would be withdrawn under following conditions:-

4.2.8.1 In case a duly constituted enquiry finds that the level of operational efficiency/breakdown/un-serviceability is attributable to failure or negligence on the part of the concerned Executive, the proficiency could be restored after the executive goes through the refresher course and qualifying examination thereafter.

4.2.8.2 In case of an accident while using a particular Landing/Nav-aid, if a post accident flight check report establishes deficiency in the operation of the system, the team of executives the facility would cease to draw the proficiency allowance forthwith and same will be restored only after approval of HQ in due course.

4.2.8.3 In case of HFRT, if mistake and/or negligence on the part of the executives leads to air-misses or incident /accident and would be restored after going through the laid down procedures.

4.2.8.4 A qualified executive remains absent on leave or otherwise from duty for a continuous period exceeding 120 days. The proficiency in such cases would be restored after going through refresher course and examination thereafter.

4.2.8.5 During the period proficiency of executives remain withdrawn for any of the above reasons, they will also not be eligible to draw the general proficiency.

4.2.9 Proficiency by executives in ex-cadre posts.

The executives of CNS discipline who move on lateral movement to ex-cadre posts will continue to get proficiency allowance as applicable in CNS or general proficiency in the ex cadre post as per the written option of the executive. However, on return to the parent cadre after a lapse of 3 years or more, they will be eligible to draw CNS proficiency as per the eligibility criteria subject to passing of refresher course stipulated in Para 4.2.7 above.

4.2.10 Changeover from General Proficiency to Discipline Proficiency and Vice Versa:

CNS executives will be permitted to changeover from General Proficiency to Discipline Proficiency and Vice Versa under following condition :-

4.2.10.1 The general proficiency allowance will be payable to all direct recruits and departmental executives promoted from non-executives to executive cadre.

4.2.10.2 The executives recruited/promoted may changeover from General proficiency to CNS proficiency at his request in writing. The effective date of changeover will be the 1st Day of the next month after submission of the application.

4.2.10.3 However, the executive will have the option to changeover from discipline proficiency to General proficiency and vice versa only once, on transfer to new station at his request in writing.

4.2.11 Maintenance of Proficiency records:-

4.2.11.1 Records of all proficient CNS personnel containing details viz. Name, Designation, CNS number, System/Equipment on which proficiency is given, Date of award of proficiency etc. shall be maintained in the computer database at CNS directorate of HQ as well as with Principal's office of CATI.

4.2.11.2 A certificate shall be made available to the proficient personnel by HQ/CATI.

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Chapter-12

Navigation Aid - Test Transmissions

1. Purpose

1.1 This TSP establishes standards which apply to the radiation of signals from radio navigation aids for the purpose of testing or experimentation.

1.2 The purpose of issuing this TSP is to ensure that information on the status of signals radiated by a navigation aid is available to pilots so that pilots will not operationally use a facility which is not radiating correct and verified signals.

1.3 This standard applies to all staff involved in the maintenance, pre commissioning or experimental work on radio navigation aids.

2. References

A) ICAO Annex 10

3. Definitions:

All the Definitions in Reference A) above

4. Standards and Practices

4.1 Conducting Test Transmissions

4.1.1 Test transmissions shall be minimized in terms of power and duration commensurate with achieving the test objective.

4.1.2 Test transmissions shall be within the performance envelope specified by the radio license.

4.2 Notification

4.2.1 When transmission of a noncommissioned or out-of-service facility is required a NOTAM shall be issued, except as provided in 4.2.2.

4.2.2 It is permissible to conduct a test transmission of a navigation aid associated with an aerodrome without issuing a NOTAM provided the following conditions are met;

a) an ATC tower service is active,

b) the senior ATC on duty has determined that the information that would be contained in a NOTAM is not of direct operational significance, and

c) the senior ATC on duty has by alternative means notified all controllers with jurisdiction aircraft within the navigation aid service volume of the testing.

4.2.3 The NOTAM should contain the following information {Ref. A, Annex5-3}:-

a) type of facility;
b) duration of tests;
c) location and frequency;
d) the words 'NIL IDENT' or 'IDENT XP';
e) the words 'ON TEST';
f) other relevant information;
g) the following warning 'NOT TO BE USED FOR NAVIGATION'.

4.2.4 A test transmission within a radio navigation frequency band but not resembling an established navigation aid and could not be interpreted to be a navigation aid does not require a NOTAM to be issued.

4.3 Suppression of identification or use of 'XP'

4.3.1 The suppression of the identification signal or substitution by the identification code of 'XP' is supplementary to, and not a substitute for, the issue of notification required by 4.2

4.3.2 The identification code 'XP' is allocated for use on aids undergoing testing or of an experimental nature.

4.3.3 To indicate that an aid must not be used for navigation the normal station identification shall be suppressed. The aid may radiate with no identification or may radiate the special identification 'XP'. This suppression shall apply to various aids in the following manner:-

a) Previously commissioned ground-based radio navigation aids which have been temporarily placed out of service shall not transmit station identification during test transmissions. The station identification shall not be restored at any time whilst the integrity of the facility is in doubt. For example, during a performance inspection, the station identification can be radiated to set identification monitor functions only after the other navigation parameters have been checked and found satisfactory.

b) Other newly installed radio aids which have not been successfully flight inspected shall have all identification suppressed or transmit 'XP' during test transmissions.

c) Aids of an experimental nature will transmit the identification 'XP' during transmission.

4.4 Instrument Landing Systems

4.4.1 When a localizer is being tested notification in accordance with 4.2 shall be given and the normal station identification suppressed.

4.4.1.1 The associated glide path should be removed from service.

4.4.2 When a glide path is radiating test signals, except as permitted by 4.4.3, the associated localizer shall be removed from service and notification given in accordance with 4.2.

4.5 Remote Nav-aid Commissioning

4.5.1 At remotely located navigation aid sites where technical staff will not be available to activate the station identification after formal commissioning and with the prior approval of the D (CNS), the Flight Inspector in consultation with the Pilot in Command and Accredited Technical Officer, has the authority to allow the aid to continue radiating the station identification following a flight inspection and pending commissioning if the Flight Inspector considers use of the aid will not lead to navigation errors.

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Chapter-13

Criteria for issuance of No Objection Certificate (NOC)

1. Purpose

1.1 This TSP establishes standards and practices for issuance of NOC for proposed construction of a building, structure of mast within and in the vicinity of airport.

1.2 This TSP applies to all civil and military airports refer paragraph 9 of this TSP.

2. References

A) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1: Radio Navigation Aids
B) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume II: Communications Procedures including those with PANS status.
C) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume III.
D) Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume IV: Surveillance Radar and Collision Avoidance System.
E) Annex 14 Aerodromes Volume I: Aerodrome Design and Operations
F) CNS Manual volume III: Siting Criteria.

3. Definitions

Aerodrome Reference Point (ARP): It is designated point, which is established, in the horizontal plane at of near the geometric center of landing area.

Approach Surface: It is an inclined plane or combination of planes preceding the runway strip and established for each runway direction intended to be used for the landing of aircraft.

Clearway: A defined rectangular area on the ground or water selected or prepared as a suitable area over which an aero plane may make a portion of its initial climb to a specified height.

Conical surface: It is a surface sloping upward and outward from the periphery of the inner horizontal surface to ensure safe visual maneuvering in the vicinity of aerodrome.

Elevation or reduced Level: It is a vertical distance of a point or a level on or affixed to the surface of earth measured from mean sea level.

Inner Horizontal Surface (IHS): It is a surface in a horizontal plane located above an aerodrome and its vicinity for controlling of new obstacles and removal on marking of exiting obstacles to ensure safe visual maneuvering of aircraft in the vicinity of aerodrome and it is located 45 m above the elevation of lowest runway threshold.

Instrument Runway: One of the following types of runway intended for the operation of aircraft using instrument approach procedures;

(a) Non-precision approach runway: An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.

(b) Precision approach runway, category I: An instrument runway served by ILS and /or MLS and visual aids intended for operations with a decision height not lower than 60 m (200 ft.) and either a visibility not less than 800 m or a runway visual range not less than 550 m.

(c) Precision approach runway, category II: An instrument runway served by ILS and / or MLS and visual aids intended for operations with a decision height lower than 60 m (200 ft.) but not lower than 30 m (100 ft.) and a runway visual range not less than 350 m.

(d) Precision approach runway, category III A: A precision instrument approach and landing with :-

(a) a decision height lower than 30 m (100 ft), or no decision height; and
(b) a runway visual range not less than 200m.

(e) Precision approach runway, category III B: A precision instrument approach and landing with :-

(a) a decision height lower than 15 m (50 ft), or no decision height; and
(b) a runway visual range less than 200m but not less than 50 m.

(f) Precision approach runway, category III B: A precision instrument approach and landing with no decision height and no runway visual range limitations

Outer Horizontal Surface (OHS): It extends from periphery of conical surface around an aerodrome with distance of 15000 m from ARP.

Runway Strip: A defined area including the runway and stopway, if provided, intended to reduce the risk of damage to aircraft, running off a runway and to protect aircraft flying over it during take off and landing operation. A uniformly graded area of 150 m on either side of centerline of runway which extend 60 m beyond each extremities of the runway and/ or associated stopway of instrument runway (precision approach / non-precision approach) for runway code 3 and 4 and 75 m in case of non-instrument runway code 3 and 4 and non-precision approach runway code 1 and 2, and 40 m in case of code 2 ,30 m in case of code 1 for non-instrument runways.

Take-Off Climb surface: Take-off climb surface is an inclined plane located beyond the end of runway or end of clearway where it is provided. The inner edge of take- off climb surface is horizontal and perpendicular to the centerline of the runway and located either at a specific distance (60 m) beyond the end of runway or at the end of clearway when such is provided. The two sides originating at the ends of the inner edge diverging uniformly at a specified rate 12.5% in case of runway code no. 3 and 4 and 10% in case of runway code 1 and 2 from the take-off trace to a specified final width (1200 m in case of runway code 3 and 4, 580 m in case of runway code 2 and 380 m in case of runway code 1) and continuing thereafter at that width for the remainder of length of take-off climb surface and on outer edge horizontal and perpendicular to specified take-off track.

Threshold: The beginning of that portion of runway usable for landing.

Transitional Surface: It is a complex surface sloping up to inner horizontal surface from the sides of runway strip and from part of side of approach surface and is established for every runway intended to be used for landing.

4. Standards and Practices

Before issue of "NOC" for a Building, Mast or any other structure in the vicinity of an aerodrome, it is required to be examined with a view to ascertain that this object is not likely to cause an obstruction from the point of view of safety of aircraft operations in all respects, i.e., Aerodrome & Ground Aids (AGA), Operations and Communication points of view. The parameters which should be taken into consideration in respect of Aerodrome and Ground Aids (AGA) point of view are as follows:

4.1 Runway Strip

A runway and any associated stop-way shall be contained in a rectangular runway strip. The dimensions of the runway strip are given in the Table below:

RUNWAY	INSTRUMENT RUNWAY		NON-INSTRUMENT RUNWAY	
Code Length No. (meter)	Width Extending Laterally on either side of Runway Centre Line (meter)	Length beyond Runway End/Stop-way (meter)	Width Extending Laterally on either side of Runway Center Line (meter)	Length beyond Runway End/ Stop-way (meter)
1. <800	75	60	30	30
2. 800<1200	75	60	40	60
3. 1200<1800	150	60	75	60
4. 1800 & Above	150	60	75	60

Note: Where there is no possibility of having a runway strip of 300mt for instrument runways, there is no point in applying that yard stick for the purpose of NOC.

4.2 Clearway

The rectangular area beyond runway extremity extending laterally for a distance of at least 75m on each side of the extended centre line of the runway, up to a distance not exceeding half the length of the take-off run available, provided that the land is under the control of the appropriate authority maintaining the Aerodrome.

4.3 Transitional Surface

It is a complex surface sloping upwards and outwards up to the Inner Horizontal Surface from the edge of the Approach Surface and from a line originating at the end of the inner edge of each approach area, drawn parallel to the runway centre line in the direction of landing. Its slope shall be measured in a vertical plane perpendicular to the centre line of each runway as given below:

4.4 The outer limit of the Transitional Surface is determined by its intersection with the plane containing Inner Horizontal Surface.

In case of Instrument Runway, its slope shall be 14.3% i.e. (1:7). In case of Non-Instrument Runway, the slope shall be 20% i.e. (1:5) for runway length less than 1200 metres and 14.3% i.e. (1:7) for runway length 1200 m and above.

4.5 Approach Area and Surface

The approach area shall be established from the smaller ends of the runway strip for each runway direction intended to be used for the landing of aeroplanes. The limits and slopes are given in the Table below:

Dimensions and Slopes of Approach Surface

RUNWAY	INSTRUMENT RUNWAY [DIVERGENCE 15% ON EITHER SIDE]		NON-INSTRUMENT RUNWAY [DIVERGENCE 10% ON EITHER SIDE]
Code No. Length (meter)	First Section Length Slope (meter)	Second Section Length Slope (meter)	Length Slope (meter)
1. <800	3000 2.5%	3600 3%	1600 5%
2. 800<1200	3000 2.5%	3600 3%	2500 4%
3. 1200<1800	3000 2%	3600 2.5%	3000 3.33%
4. 1800 & Above	3000 2%	3600 2.5%	4.3.6 2.5%

NOTE:

1) The permissible elevations shall be restricted to that of either Approach or Inner Horizontal Surface/Conical Surface, whichever is the lowest.

2) For Datum of Approach surface refer para 4.9.1.

4.6 While examining cases for the issue of "NOC the following points should be kept in view:

4.6.1 At aerodrome where there are more than one runway with over- lapping approach areas and associated surface the criteria shall be as prescribed for the main runway.

4.6.2 For determining the approach area, the physical extremities of the runway shall only be considered irrespective of the fact that a runway threshold is displaced due to any reason.

4.6.3 At Aerodrome, where the proposals for runways extension exist, the requisite surface shall be determined from the proposed extended runway strip/associated clearway, as applicable.

4.7 Inner Horizontal Surface Area

4.7.1 The dimension and permissible height of Inner Horizontal Surface are given in the Table below:

DIMENSIONS AND PERMISSIBLE HEIGHTS OF INNER HORIZONTAL SURFACE

RUNWAY		INSTRUMENT RUNWAY		NON-INSTRUMENT RUNWAY	
Code No.	Length (meter)	Radius (meter)	Length (meter)	Radius (meter)	Length (meter)
1.	<800	3500	45	2000	45
2.	800<1200	3500	45	2500	45
3.	1200<1800	4000	45	4000	45
4.	1800 & Above	4000	45	4000	45

NOTE For Datum of Inner Horizontal Surface refer para 4.9.2.

4.7.2 Where the runway length is 1525 m or more, the Inner Horizontal Surface shall be a composite pattern, which consists of two circular areas centred at the two runway ends with a radius of 4000 meters. These areas shall be joined tangentially to form an elliptical shape.

4.7.3 Where it is required to protect two or more widely spaced long runways, an even more complex pattern involving four or more circular areas are formed. These areas should be joined tangentially by straight lines and the I H S shall be defined by the external limits of the resulting pattern.

4.8 Adjoining Aerodromes with Overlapping Circuits:

When two aerodromes are close to each other with overlapping circuits the HIS will be drawn as prescribed in para 4.6.6 .The inner horizontal surfaces of these two aerodromes shall be joined tangentially to form one common HIS.

4.9 Landing Grounds without Paved Runways

For the landing ground without paved runways a clearance of 4% (1:25) from the boundary of aerodrome in all directions shall be applied to a distance of 460m and beyond that a uniform elevation of 45m above A.R.P. elevation be permitted upto a distance of 2600 m. A conical surface extending upwards and outwards from the edge of the area ending at 2600m should be provided upto a distance of another1525m. with a slope of 5% (1:20).

4.10 In case of common horizontal surface serving two aerodromes, the elevation of the I.H.S. will be of higher category of the two aerodromes.

4.11 In case of complex I.H.S. for two runways at the same aerodrome, a common surface need not be worked out. However, when these surfaces overlap each other, the lower surface be regarded as over-riding.

4.12 Conical Surface

The conical surface shall be projected upwards and outwards from the periphery of the Inner Horizontal Surface (I H S). The slope of the conical surface measured above the I H S in a vertical plane shall be 5% (1:20). The outer limits and permissible heights of the conical surface are given in the table below:

OUTER LIMITS AND PERMISSIBLE HEIGHTS OF CONICAL SURFACE

RUNWAY		INSTRUMENT RUNWAY		NON-INSTRUMENT RUNWAY	
Code No.	Length (meter)	Horizontal Distance of Conical Surface Beyond I.H.S (meter)	Maximum Height above I.H.S (meter)	Horizontal Distance of Conical Surface Beyond I.H.S (meter)	Maximum Height above I.H.S (meter)
1.	<800	1200	60	700	35
2.	800<1200	2100	105	2100	105
3.	1200<1800	2100	105	2100	105
4.	1800 & Above	2100	105	2100	105

For Datum of conical surface refer para 4.9.2.

4.13 Outer Horizontal Surface

4.13.1 The Outer Horizontal Surface (OHS) shall extend to 15000 m from the Aerodrome Reference Point (ARP) for Aerodrome with runway code 3 and 4.

4.13.2 In case of Aerodromes with Runway code-2, the Outer Horizontal Surface (OHS) shall extend to 14740 m from Aerodrome Reference Point (ARP) for Instrument runways and 13740 m for Non-Instrument runways.