TABLE OF CONTENTS

Part 173 - Aeronautical Telecommunication Services

SUBPART A – GENERAL

§ 173.1 Applicability. 3
§ 173.3 Restrictions on Aeronautical Telecommunication Service Providers. 4
§ 173.5 Restrictions on Flight Inspection Service Providers. 4
§ 173.7 Coordination Requirements. 5
§ 173.9 Regional Air Navigation Agreements. 6
§ 173.11 Identification Codes and Call Signs. 6
§ 173.13 Notification of Aeronautical Facility Information. 7
§ 173.15 Information Provided by an Aeronautical Facility. 7
§ 173.17 Applicability of the Standards of the International Civil Aviation Organization. 8
§ 173.19 Safety Risk Assessment of new system or changes to functional system. 9
§ 173.21 Compliance Matrix. 10
§ 173.23 Regulatory Oversight. 11

SUBPART B – PERSONNEL

§ 173.31 Personnel Requirements. 12
§ 173.33 Air Traffic Safety Electronics Personnel (ATSEP) Qualifications. 12
§ 173.35 Staffing Levels and Training. 15
§ 173.37 Human Performance. 16

SUBPART C – MANUAL REQUIREMENTS

§ 173.51 General. 17
§ 173.53 Manual Contents. 17
§ 173.55 Operating and Maintenance Instructions. 19
§ 173.57 Documentation. 19

SUBPART D – FACILITIES

§ 173.71 Radio Navigation Aids. 21
§ 173.75 Aeronautical Facility Requirements. 21
§ 173.77 Security Program. 23
§ 173.79 Periodic Inspection and Testing. 24
§ 173.81 Aeronautical Facility Performance. 25
§ 173.83 Inspection, Measuring, and Test Equipment. 26
§ 173.85 Procedures for the Notification of Aeronautical Facility Information. 27
§ 173.87 Aeronautical Facility Check after Accident or Incident. 27
§ 173.89 Facility Malfunction Incidents. 27
§ 173.91 Spare Parts. 28

SUBPART E – OPERATING REQUIREMENTS
§ 173.101 Continued Compliance. 29
§ 173.105 Temporary Aeronautical Facility. 29
§ 173.107 Limitations on Aeronautical Telecommunication Service Providers. 30
§ 173.109 Changes to Provider's Organization. 30
SUBPART F – QUALITY ASSURANCE
§ 173.121 Quality Assurance. 32
SUBPART G – RECORDS AND REPORTS
§ 173.141 Facility Incident Reports. 34
§ 173.143 Records. 34
APPENDIX A TO GACAR PART 173 – COMMUNICATION SYSTEMS 36
APPENDIX B TO GACAR PART 173 – RADIO NAVIGATION SYSTEMS 90
APPENDIX C TO GACAR PART 173 – SURVEILLANCE EQUIPMENT AND SYSTEMS 154
APPENDIX D TO GACAR PART 173 – FLIGHT INSPECTION SERVICE PROVIDERS 217
APPENDIX E TO GACAR PART 173 – SOFTWARE SAFETY ASSURANCE IN ANS EQUIPMENT ... 233

SUBPART A – GENERAL

§ 173.1 Applicability.

(a) Except as provided in (c) and (d), this part prescribes rules governing—

(1) The provision of aeronautical telecommunication services in the Kingdom of Saudi Arabia (KSA) by an aeronautical telecommunication services provider that holds or is required to hold an Air Navigation Service Certificate (ANSC) under General Authority of Civil Aviation Regulation (GACAR) Part 170;
(2) Each person employed or used by an aeronautical telecommunication services provider when providing aeronautical telecommunication services under this part; and
(3) Flight inspection service providers who provide flight inspection services under this part.

(b) This part also prescribes rules for each air traffic service (ATS) provider authorized under GACAR Part 171 to incorporate certain items in their air traffic service procedures manual (ATSPM).

(c) This part does not apply to a person who operates an aeronautical facility on an aeronautical radio frequency and—

(1) The aeronautical facility—

(i) Is a radio communication transmitter that does not support an air traffic service; or
(ii) Is a radio navigation aid that does not support IFR flight or an air traffic service;
(iii) Is a surveillance facility that does not support an air traffic service;

(2) The aeronautical facility is not operated in accordance with—

(i) The applicable system characteristics prescribed in Annex 10, Volume III, Part II, Chapter 2 or Annex 10, Volume I, Chapter 3 to the Convention on International Civil Aviation; and
(ii) The applicable communication procedures prescribed in Annex 10, Volume II to the Convention on International Civil Aviation.

(3) The aeronautical facility does not interfere with any other aeronautical telecommunication service or aeronautical facility;

(4) A radio apparatus license has been granted by the Communications and Information Technology Commission for the aeronautical facility; and

(5) An identification code or a call sign has been allocated for the aeronautical facility under GACAR § 173.11.

(d) This part does not apply to a person who operates a ground mobile radio on an aeronautical radio frequency and—

(1) The radio is not used to support an air traffic service;
(2) The radio is operated in accordance with the applicable communication procedures prescribed in Annex 10, Volume II to the Convention on International Civil Aviation;
(3) The radio transmission does not interfere with any other aeronautical telecommunication service or aeronautical facility; and
(4) A radio apparatus license has been granted by the Communications and Information Technology Commission.

§ 173.3 Restrictions on Aeronautical Telecommunication Service Providers.

(a) No person may provide aeronautical telecommunication services in the KSA unless the person complies with the provisions of this part, and they have been certificated by the President under GACAR Part 170 to provide such service.

(b) Except as provided in GACAR Part 170, each aeronautical telecommunication services provider must comply with the limitations and provisions of their certificate, operation specifications and their manual as specified under Subpart C of this Part.

(c) No aeronautical telecommunication services provider authorized under this part may operate the following aeronautical telecommunication systems in the KSA:

(1) Microwave Landing System (MLS); and
(2) Precision Approach Radar (PAR) systems.

§ 173.5 Restrictions on Flight Inspection Service Providers.

(a) No person may provide a flight inspection service in the KSA unless the person complies with the applicable provisions of this part, they have been certificated by the President under GACAR Part 170 and they have been authorized by the President in accordance with Appendix D requirements to provide such service.

(b) Except as provided in GACAR Part 170, each flight inspection service provider must comply with the limitations and provisions of their certificate, operations specifications and their manual prepared under Appendix D to this part.

§ 173.7 Coordination Requirements.

Each aeronautical telecommunication services provider must establish systems and procedures for ensuring effective coordination with each of the following agencies—

(a) General Authority of Civil Aviation (GACA);

(b) Any other aeronautical telecommunication services provider authorized under this part;

(c) Each air traffic service (ATS) provider operating under GACAR Part 171;

(d) Each instrument flight procedure service (IFPS) provider operating under GACAR Part 172;

(e) Each meteorological service (MET) provider operating under GACAR Part 179;

(f) Each aeronautical information service (AIS) provider operating under GACAR Part 175;

(g) Each operator of a water aerodrome certified under GACAR Part 137 if the aeronautical telecommunication services provider is operating and maintaining Communication, Navigation, Surveillance (CNS) facilities at the aerodrome;

(h) Each operator of a heliport certified under GACAR Part 138 if the aeronautical telecommunication services provider is operating and maintaining Communication, Navigation, Surveillance (CNS) facilities at the heliport;

(i) Each operator of an aerodrome certified under GACAR Part 139;

(j) Each search and rescue (SAR) authority;

(k) Foreign aeronautical telecommunication services providers and ATS providers in adjoining States or Flight Information Regions (FIR);

(l) Aircraft operators; and

(m) The Saudi Arabian Armed Forces.

§ 173.9 Regional Air Navigation Agreements.

(a) Each aeronautical telecommunication services provider must coordinate with the GACA when interacting with foreign States or foreign AIS providers, and when there are implications for Regional Air Navigation Agreements for which the KSA is a party.

(b) Each aeronautical telecommunication services provider must ensure that any infringement of the Procedures prescribed in ICAO Annex 10 and related to international aeronautical telecommunication services, observed during the operation and maintenance of Communication, Navigation, Surveillance (CNS) facilities, is immediately reported to the President in accordance with the requirements of GACAR Part 4, and must be the subject of direct communication with the concerned parties.

§ 173.11 Identification Codes and Call Signs.

(a) No person may operate—

(1) A radio navigation aid, unless it has been allocated an identification code by the President under paragraph (c);
(2) A radio communication transmitter on an aeronautical radio frequency other than one operated under GACAR § 173.1(d), unless it has been allocated a call sign by the President under paragraph (c);
(3) A primary or secondary surveillance system on an aeronautical frequency and where appropriate an identification code allocated by the President under paragraph (c).

(b) An applicant for the allocation of an identification code or a call sign must complete and submit an application in a form and manner acceptable to the President.

(c) The President may allocate an identification code for a radio navigation aid/surveillance system

or a call sign for a radio communication transmitting aeronautical facility if the President is satisfied that the allocation of a code or call sign is not contrary to the interests of aviation safety.

§ 173.13 Notification of Aeronautical Facility Information.

(a) A person operating an aeronautical facility must—

(1) Forward to the provider of each AIS authorized under GACAR Part 175—

(i) Information on the operational details of the aeronautical facility, for publication in the KSA AIP;
(ii) Information concerning any change in the operational status of the aeronautical facility, for the issue of a NOTAM.

(2) Check, if applicable, that the information forwarded under paragraph (a)(1) has been accurately published; and
(3) Notify the President of any promulgated information incident in accordance with GACAR Part 175.

(b) Each aeronautical telecommunication services provider must give notification of the normal hours of service of stations and offices of the international aeronautical telecommunication service under its control to the aeronautical telecommunication agencies designated to receive this information by other concerned Administrations.

(c) Whenever necessary and practicable, each aeronautical telecommunication services provider must give notification of any change in the normal hours of service, before such a change is effected, to the aeronautical telecommunication agencies designated to receive this information by other concerned Administrations. Such changes must also, whenever necessary, be promulgated by NOTAM in accordance with the coordination procedures established with the aeronautical information service (AIS) provider certified under GACAR Part 175.

(d) When a station of the international aeronautical telecommunication service, or an aircraft operator, requests a change in the hours of service of another station, such change must be requested as soon as possible after the need for change is known. Each aeronautical telecommunication services provider must ensure that the station or aircraft operator requesting the change is informed of the result of its request as soon as possible.

§ 173.15 Information Provided by an Aeronautical Facility.

A person operating an aeronautical facility must not permit the facility to continue in operational service if that person suspects or has any cause to suspect that the information being provided by that facility is erroneous.

§ 173.17 Applicability of the Standards of the International Civil Aviation Organization.

(a) In addition to the requirements of Appendix A to this part, communications services, including fixed, mobile and broadcast services, must comply with the applicable Standards and Recommended Practices (SARPs) of ICAO Annex 10 Volume II – Communication Procedures, including those with PANS status, and Volume III – Communication Systems.

(b) Each aeronautical telecommunication services provider must provide:

(1) services in full compliance with the procedures and the applicable Standards of the International Civil Aviation Organization (ICAO). Specifically, the Standards and Recommended Practices as prescribed in ICAO Annexes 10 & 11, Regional Supplemental Procedures as specified in ICAO Doc. 7030 and Air Traffic Management Procedures as specified in ICAO Doc. 4444 (PANS-ATM).
(2) Aeronautical Radio Navigation aids in accordance with the provisions specified in ICAO Annex 10, Volume I including all amendments;
(3) International aeronautical telecommunication services in accordance with general procedures specified in Chapter 3 of Annex 10, Volume II.
(4) Aeronautical fixed services (AFS) in accordance with the provisions specified in Chapter 4 of Annex 10, Volume II.
(5) Aeronautical mobile services —voice communications in accordance with the provisions specified in Chapter 5 of Annex 10, Volume II including all amendments;
(6) Aeronautical Broadcasting Services in accordance with the provisions specified in Chapter 7 of Annex 10, Volume II including all amendments;
(7) Aeronautical Mobile Services — Data Link Communications in accordance with the provisions specified in Chapter 7 and Chapter 8 of Annex 10, Volume II including all amendments. Digital data communications systems in accordance with ICAO Annex 10 Aeronautical Telecommunications Volume III, Communication Systems Part I – Digital Data Communication Systems including all amendments;
(8) Voice Communication Systems in accordance with ICAO Annex 10 Aeronautical

Telecommunications Volume III, Communication Systems Part II – Voice Communication Systems including all amendments;

(c) Each aeronautical telecommunication services provider must install, maintain and operate a Secondary Surveillance Radar (SSR) used as an aid to air traffic services, in accordance with the provisions of ICAO Annex 10 Aeronautical Telecommunications Volume IV, Surveillance Radar and Collision Avoidance Systems.

Note: Where General Authority of Civil Aviation has filed differences to SARPs, these will be published in the Kingdom of Saudi Arabia (KSA) Aeronautical Information Publication (AIP).

§ 173.19 Safety Risk Assessment of new system or changes to functional system.

(a) Each Aeronautical Telecommunication provider planning the deployment of a new system or a change to a functional system must—

(1) notify the President prior to the planned deployment or change;
(2) provide detailed information on the deployment or change;
(3) inform other service providers and, where feasible, aviation stakeholders affected by the planned deployment or change and keep them updated on modifications and related information;
(4) publish the appropriate aeronautical information related to the planned deployment or change to ensure that users and stakeholders are aware of this deployment or change and its potential impact on their activities;
(5) determine the dependencies of the deployment or change with other internal and external systems;
(6) identify the assumptions and risk mitigations related to internal and external systems;
(7) ensure that a Safety Risk assessment is carried out using covering the scope of the deployment or change, and the following elements:

(i) the equipment, procedural and human elements affected by the deployment or change;
(ii) interfaces and interactions between the elements of the deployment or change and other functional systems;
(iii) interfaces and interactions between the elements of the deployment or change and the context in which it is intended to operate;
(iv) the life cycle of the deployment or change from definition to operations including transition into service;

(v) planned degraded modes of operation during the deployment or change of the functional system; and
(vi) provide assurance, with sufficient confidence, via a complete, documented and valid argument that the safety criteria identified are valid, and will be satisfied and will remain satisfied.

(b) Each Aeronautical Telecommunication provider must ensure that the safety risk assessment referred to in paragraph (a) comprises—

(1) the identification of hazards;
(2) the determination and justification of the safety criteria applicable to the deployment or change;
(3) the risk analysis of the effects related to the deployment or change considering the types of operations and affected stakeholders;
(4) the risk mitigations for the deployment or change such that it can meet the applicable safety criteria;
(5) the verification that the assessment corresponds to the scope of the deployment or change and meets the safety criteria;
(6) the specification of the monitoring criteria necessary to demonstrate that the service delivered by the deployment or changed functional system will continue to meet the safety criteria.

Note: A functional system means a combination of procedures, human resources and equipment, including hardware and software, organised to perform a function within the context of Air Navigation Services.

§ 173.21 Compliance Matrix.

Each aeronautical telecommunication services provider must establish methods, through their Quality Management System processes or otherwise, to:

(a) develop a Compliance Matrix against all applicable requirements;

(b) ensure that the Compliance Matrix is regularly reviewed and amended where necessary to reflect the current compliance status.

(c) submit on annual basis an amended Compliance Matrix to the President.

Note: The frequency of review of the Compliance Matrix should be commensurate with the degree of technical and operational, and where appropriate, organisational change that each aeronautical telecommunication services provider is experiencing. The Compliance Matrix may also be used by the services provider to direct internal audit arrangements, to assist with audit scoping and planning and to provide assurance of compliance with minimum regulatory intervention.

§ 173.23 Regulatory Oversight.

Each aeronautical telecommunication services provider must establish methods, through their Quality Management System processes or otherwise, to:

(a) Each aeronautical telecommunication services provider and each flight inspection service provider must allow the President to make any regulatory oversight visits i.e., audits and inspections, at any time, to allow the President to determine compliance with this part and applicable ICAO provisions;

(b) The scope and conduct of the compliance regulatory oversight activities must be determined, in part, by the statements contained in the Compliance Matrix prescribed under §173.21.

SUBPART B — PERSONNEL

§ 173.31 Personnel Requirements.

Each aeronautical telecommunication services provider must employ, contract, or otherwise engage—

(a) A senior person, acceptable to the President, identified for the purposes of this part as the Director of aeronautical telecommunication services, who—

(1) Has the authority within the organization to ensure that all activities undertaken by the organization can be financed and carried out to meet applicable operational requirements;
(2) Is responsible for ensuring that the organization complies with the requirements of this part;

(b) A senior person or persons responsible:

(1) to the Director of aeronautical telecommunication services for ensuring that the organization complies with its manual; and
(2) for the safe operation of aeronautical facilities that are under the responsibility of the aeronautical telecommunication services provider.

(c) Sufficient support staff and qualified technical personnel to install, inspect, supervise, and maintain the facilities listed in the manual; and

(d) The senior person or persons required under paragraph (b) must be able to demonstrate competency and experience relevant to the management of safety systems and the activities of the service provider.

§ 173.33 Air Traffic Safety Electronics Personnel (ATSEP) Qualifications.

(a) Each aeronautical telecommunication services provider must ensure that each ATSEP is competent and holds appropriate qualifications to install, operate, maintain, release from, and return into operations equipment of a functional aeronautical telecommunication system.

(b) Each aeronautical telecommunication services provider must:

(1) establish a competency-based training and assessment programme to ensure that each ATSEP is qualified and competent for the assigned functions, duties, and responsibilities;
(2) ensure that ATSEP are proficient in the language(s) required to perform their duties taking into account the language requirements related to operating instructions, manuals, and the need to communicate across operational boundaries that require a common language.

(c) Each aeronautical telecommunication services provider must ensure that the competency-based training and assessment program is developed in accordance with ICAO PANS-TRG (Doc 9868) and ICAO Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment (Doc 10057) and includes, at least, the following:

(1) the training policy and the description of all training activities, environment, methodology, material, scheduling, and the interrelations between different training activities;
(2) the description of the minimum qualifications of trainees or required entry levels;
(3) the description of knowledge outcome and performance objectives;
(4) the description of the qualifications of instructional and competence assessment personnel;
(5) routine evaluation of the effectiveness of the training programme that ensure:

(i) the training and assessment plans are relevant to the ATSEPs in the specific context and environment to which they may be assigned after training;
(ii) the training plan is designed to enable the trainees to meet the interim (if defined) and final competency standards; and
(iii) remediation actions are taken if in-training or post-training evaluation indicates a need to do so;

(6) sufficient and appropriate practical and on-the-job training to ensure that the competencies appropriate to the exercise of duties are consistently achieved. The practical and on-the-job training must be conducted:

(i) under the supervision of an instructor qualified and competent in the technical domain for which the competency will be awarded.
(ii) In accordance with the accepted safety management system of the aeronautical telecommunication services provider.

(7) the procedures used to manage training and competence assessment records of trainees,

instructors, and competence assessment personnel participating in the training; and
(8) the feedback mechanisms used to allow trainees to provide an assessment of the training and competence assessment program.

(d) Each aeronautical telecommunication services provider must ensure that ATSEP have successfully completed:

(1) the initial and the qualification training. The subjects, topics, and sub-topics of the initial and qualification training must be defined based on ICAO Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment (Doc 10057).
(2) the system/equipment training that:

(i) is applicable to the duties to be performed and include one or several theoretical, practical courses; and on-the-job training; and
(ii) ensure that ATSEP acquire knowledge and skills pertaining to:

(A) the functionality of the system and equipment;
(B) the actual and potential impact of ATSEP actions on the system and equipment;
(C) the impact of the system and equipment on the operational environment.

(e) Each aeronautical telecommunication services provider must give each ATSEP a certificate that:

(1) Names the ATSEP;
(2) Describes the operation and maintenance functions, and duties that the ATSEP is authorized to perform.
(3) Describes the types of facility or facilities for which the ATSEP is qualified and authorized to perform those functions, and duties; and
(4) States the period during which the certificate is effective and valid.

(f) Each aeronautical telecommunication services provider must:

(1) Develop a continuation training which comprise periodic and comprehensive refresher training program, equipment/systems upgrades and modifications, and/or emergency training to ensure that each ATSEP maintains the appropriate level of qualifications, knowledge and skills. The established period of the continuation training must not exceed 12 months;
(2) Establish, implement and document processes for:

(i) assessing the ongoing competence of ATSEP using specific criteria related to knowledge, technical and behavioural skills;
(ii) addressing a failure or degradation of ATSEP competence; and
(iii) ensuring adequate supervision of personnel who have not been assessed as competent;

(3) Maintain proficiency record for each ATSEP showing how often an individual performs maintenance duties on a specific system/equipment, facility and/or lapses in competence on a specific system/equipment.

(g) Each aeronautical telecommunication services provider must develop and publish job descriptions for all technical staff assigned to install, operate, maintain, release from, and return into operations equipment of a functional aeronautical telecommunication system.

(h) When ATSEP are employed by a contracted organisation, the aeronautical telecommunication services provider must ensure that those ATSEP have received the applicable training and competences defined under this Subpart.

(i) The authorised persons who are competent to operate, maintain, release from, and return into operations equipment of a functional aeronautical telecommunication system may be information technology (IT) personnel, technicians, or engineers with maintenance tasks.

Note: Personnel that maintain 'power supply' and 'air conditioning' systems are not considered as ATSEP. In general, ATSEP do not work on these systems, but rather control and manage the release of power supply and air conditioning systems, to and from operational service.

§ 173.35 Staffing Levels and Training.

Each aeronautical telecommunication services provider must –

(a) Establish arrangements that define the person responsible and the process to be followed to ensure an adequate number of suitably trained, qualified, and competent staff are available in respect of communication, radio navigation aids, and surveillance facilities installation, operation, maintenance, and routine checks.

(b) Define the method by which staffing levels are determined in relation to the maintenance

requirements for communication, radio navigation aids, and surveillance facilities and the availability of appropriate engineering facilities.

(c) Establish arrangements that define the management responsibilities and process for ensuring adequate staff supervision. Arrangements must include the mechanisms that ensure only trained and competent staff undertakes the maintenance functions of aeronautical telecommunication systems.

§ 173.37 Human Performance.

Each aeronautical telecommunication services provider must ensure that Human Factors and performance are applied in the management of navigation systems. The following activities must be conducted:

(a) Mandating Human Factors input to specific tasks/projects within navigation aids technical activities;

(b) Raising awareness of Human Factors and initiating Human Factors and performance training across all concerned departments in an appropriate manner;

(c) Keeping abreast of developments within Human Factors and performance and applying this knowledge as appropriate; and

(d) Considering Human Factors and performance aspects in incident investigation.

Note: The main ICAO guidance material on Human Factors and performance includes Human Factor Guidelines for Air Traffic Management (ATM) Systems (Doc. 9758), Manual on Human Performance (HP) for Regulators (Doc 10151), Human Factors Training Manual (Doc 9683), and Human Factors Guidelines for Safety Audits Manual (Doc 9806).

SUBPART C – MANUAL REQUIREMENTS

§ 173.51 General.

(a) This subpart prescribes requirements for each aeronautical telecommunication services provider to prepare and maintain a manual.

(b) Additional requirements for ATS providers authorized under GACAR Part 171 to incorporate certain elements into their ATSPM are prescribed in other subparts and appendices of this part.

§ 173.53 Manual Contents.

(a) Each aeronautical telecommunication services provider must provide the President with a manual containing—

(1) A statement signed by the Director of aeronautical telecommunication services, on behalf of the organization confirming that—

(i) The manual defines the organization and demonstrates its means and methods for ensuring ongoing compliance with this Part;
(ii) The manual, and all associated manuals, operating, and maintenance instructions, must be complied with by the organization's personnel at all times.

(2) The titles and names of the senior person or persons required under GACAR § 173.31(b);
(3) The positions, duties, responsibilities, functions, accountabilities and authority of the senior person or persons in paragraph (a)(2), including matters for which they have responsibility to deal directly with the President on behalf of the organization. Changes in these positions must be subject of safety impact assessment and notified to the President prior to each change.
(4) An organization chart showing lines of responsibility of the senior persons in paragraph (a)(2) and covering each location listed under paragraph (a)(7);
(5) A summary of the organization's staffing structure at each location listed under paragraph (a)(7);
(6) A list of each type of aeronautical facility operated by the aeronautical telecommunication services provider with:

(i) A written declaration of conformity or compliance with the applicable requirements of

ICAO Annex 10, and technical specifications issued by applicable Standards Developing Organizations (SDOs);
(ii) Details on the aeronautical facility manufacturer and main components (system and equipment) lifecycle.

(7) A summary of the scope of activities at each location where the organization's personnel are based to provide or maintain the types of facilities listed under paragraph (a)(6);
(8) A summary of the operational details of each aeronautical facility associated with each location listed under paragraph (a)(7);
(9) The detailed procedures required under GACAR § 173.121 regarding internal quality assurance; and
(10) The detailed procedures, or an outline of the procedures including information that identifies the documentation that contains the detailed procedures, that are required under—

(i) GACAR § 173.33 regarding the competence of personnel;
(ii) GACAR § 173.75(a)(1) regarding the design, installation, and commissioning of facilities;
(iii) GACAR § 173.75(b) and (c) regarding the operation of temporary facilities for site tests;
(iv) GACAR § 173.57 regarding the control of documentation;
(v) GACAR § 173.79 regarding periodic inspections and testing of facilities;
(vi) GACAR § 173.81 regarding facility performance;
(vii) GACAR § 173.83 regarding the control, calibration, and maintenance of inspection, measuring, and test equipment;
(viii) GACAR § 173.85 regarding the notification of facility information;
(ix) GACAR § 173.87 regarding facility checks after notification of an accident or incident;
(x) GACAR § 173.89 regarding facility malfunction incidents; and
(xi) Appendix A regarding the identification, collection, indexing, storage, maintenance, and disposal of records.

(11) Details on the certified flight inspection service providers contracted to conduct flight inspection activities on behalf of the aeronautical telecommunication services provider; and
(12) Detailed procedures to control, amend, and distribute the manual.

(b) Each manual, and its revisions, must be acceptable to the President;

(c) Each aeronautical telecommunication services provider must—

(1) Ensure that its manual is amended, as required, to remain a current description of the aeronautical telecommunication services provider's organization, services, and facilities;
(2) Ensure that any amendments made to its manual meet the applicable requirements of this Part;
(3) Comply with the manual amendment procedure contained in its manual;
(4) Provide the President with a copy of each amendment to its manual;
(5) Make such amendments to its manual as the President may consider necessary in the interests of aviation safety.

§ 173.55 Operating and Maintenance Instructions.

(a) Each aeronautical telecommunication services provider must—

(1) Have operating and maintenance instructions that set out the requirements for operating and maintaining each aeronautical facility listed in its manual;
(2) Provide the operating and maintenance instructions required under paragraph (1) for the use and guidance of its personnel and the relevant staff of each ATS provider authorized under GACAR Part 171.

(b) The operating and maintenance instructions required under paragraph (a)(1) must include—

(1) Details of the critical performance parameters for each aeronautical facility;
(2) The associated minimum performance levels for those critical performance parameters referred to in paragraph (b)(1);
(3) Details of the test equipment required for the measurement of those critical performance parameters referred to in paragraph (b)(1);
(4) Details of the mandatory inspections and test procedures for the operational service;
(5) Details of the mandatory inspection and test procedures for the operation and maintenance of each aeronautical facility.

§ 173.57 Documentation.

(a) Each aeronautical telecommunication services provider must hold copies of relevant equipment manuals, technical standards, practices, instructions, and any other documentation that are

necessary for the provision and operation of the facilities listed in the manual.

(b) Each aeronautical telecommunication services provider must establish a procedure for the control of the documentation required under paragraph (a) and any other applicable GACAR part.

(c) The procedure required under paragraph (b) must require that—

(1) All documentation is reviewed and authorized by an appropriate senior person referred to in GACAR § 173.31(b) before issue;
(2) Each document has a record of amendments and corrigenda;
(3) Current issues of all relevant documentation are accessible to staff at all locations if required for the provision and operation of aeronautical facilities;
(4) All obsolete documentation is promptly removed from all points of issue or use;
(5) Changes to documentation are reviewed and authorized by an appropriate senior person referred to in GACAR § 173.31(b);
(6) The current version of each item of documentation can be identified.

SUBPART D – FACILITIES

§ 173.71 Radio Navigation Aids.

(a) Except as provided for in (b), each aeronautical telecommunication services provider must only install and operate radio navigation aids that comply with ICAO Standards and Recommended Practices contained in Annex 10 Volume I which include:

(1) The instrument landing system (ILS) including the localizer and glide path sub-systems;
(2) The global navigation satellite system (GNSS);
(3) The VHF omnidirectional radio range (VOR);
(4) The non-directional radio beacon (NDB);
(5) The distance measuring equipment (DME);
(6) The en-route VHF marker beacon.

Note: The VHF omnidirectional radio range (VOR) may be co-located with the distance measuring equipment (DME) or the Tactical Air Navigation System (TACAN).

(b) Where a VORTAC facility is operated the relevant ICAO Annex 10 Standards and Recommended Practices relating to DME must be applied to the distance measuring element of the VORTAC which is derived from the associated TACAN, and the facility must comply with the technical specifications for the DME and TACAN specified in Appendix B to this Part;

(c) Differences in radio navigation aids in any respect from the technical standards of Appendix B to this part or Standards and Recommended Practices contained in Annex 10 Volume I, Chapter 3 must be approved by the President and published in the KSA AIP.

(d) Wherever there is installed a radio navigation aid that is not an ILS, but which may be used in whole or in part with aircraft equipment designed for use with the ILS, full details of parts that may be so used must be published in the KSA AIP.

Note. — Guidance material for the application of the standards and recommended practices for ILS, VOR, NDB, and DME are defined in Attachment C to Annex 10, Volume I.

§ 173.75 Aeronautical Facility Requirements.

(a) Each aeronautical telecommunication service provider must establish a procedure to ensure

that—

(1) Each aeronautical facility listed in the manual—

(i) Is designed, installed, and commissioned to meet the applicable operational specification for that facility;
(ii) Conforms with the applicable system characteristics and specification standards prescribed in Appendix A to this part for communications systems, Appendix B to this part for navigation systems and Appendix C to this part for surveillance systems;
(iii) Has been allocated an identification code or call sign, if a code or call sign is required under GACAR § 173.11; and
(iv) Conforms with all applicable siting and installation requirements prescribed in GACAR Part 139 (Ref. ICAO Annex 14, Chapter 8) for equipment installed on the operational areas of aerodromes.

(2) Information on the operational status of each radio navigation aid listed in the manual, that is essential for the approach, landing, and takeoff at an aerodrome, is provided to meet the operational needs of—

(i) The air traffic control unit providing an aerodrome control service for that aerodrome while that service is being provided; and
(ii) The air traffic control unit providing an approach control service for that aerodrome while that service is being provided. If the approach control service is provided remotely and the information on the operational status of radio navigation services essential for approach, landing and take-off at the aerodrome cannot be provided at the required location, working arrangements between aerodrome control tower and approach control service must be agreed and signed to keep this latter currently informed of the operational status of radio navigation services and visual aids essential for take-off, departure, approach and landing procedures as shown in the monitoring panels or devices installed at the aerodrome control tower.

Note.— Guidance material on the application of this requirement in the case of PBN-based operations supported by GNSS is contained in the Performance-based Navigation (PBN) Manual (Doc 9613).

(3) Each aeronautical facility listed in the manual is installed with suitable power supplies and means to ensure continuity of operation appropriate to the needs of the air traffic service or

radio navigation service being supported;
(4) Each aeronautical facility listed in the manual is installed in accordance with the security program required under the GACA Security Regulations to minimize any risk of destruction, damage, or interference with the operation of the facility; and
(5) Any critical site area of any aeronautical facility listed in the manual is—

(i) Clearly identified on the site drawings for the aeronautical facility;
(ii) Physically protected by suitable signposts on the site; and
(iii) Protected by written agreements with the site owner, aerodrome operator, and air traffic control unit, as appropriate, to ensure that site restrictions are not infringed by buildings, fences, vehicles, machinery, or aircraft.

(6) All aeronautical telecommunication facilities listed in the manual, including end systems and intermediate systems of the Aeronautical Telecommunication Network (ATN), must be protected from unauthorized direct or remote access.

(b) Each aeronautical telecommunication service provider who intends to operate a temporary aeronautical facility to carry out site tests must establish a procedure for conducting those tests.

(c) The procedure required under paragraph (b) must require that—

(1) The operation of the temporary facility does not cause any interference with any other operating aeronautical facility;
(2) Appropriate information regarding the operation of the temporary facility is forwarded to the AIS provider authorized under GACAR Part 175 for the issue of a NOTAM, and if appropriate the publication of a Supplement to the KSA AIP; and
(3) An appropriate NOTAM has been published.

§ 173.77 Security Program.

Each aeronautical telecommunication services provider must ensure that the security program for the facilities, listed in the aeronautical telecommunications manual, specify the physical security requirements, practices, and procedures to:

(a) be followed for the purposes of minimising the risk of destruction of damage to, or interference with the operation of any aeronautical facility operated under the authority of the service provider;

(b) ensure that each aeronautical facility is always subject to positive access control to prevent unauthorized entry;

(c) follow in the event of a bomb threat or other threat of damage to an aeronautical facility;

(d) monitor an unattended aeronautical facility building to ensure that any intrusion or interference is immediately detected;

(e) monitor, control and record remote access for diagnostics, performance monitoring or software upgrades and limit the privileges of the remote user to prevent inappropriate actions and prevent cyberthreats;

(f) notify, investigate and report security incidents in accordance with the applicable national security requirements.

§ 173.79 Periodic Inspection and Testing.

(a) Each aeronautical telecommunication services provider must establish a procedure for the periodic inspection and testing of the aeronautical facilities listed in the manual to verify that each aeronautical facility meets the applicable operational requirements and performance specifications for that facility.

(b) The procedure required under paragraph (a) must—

(1) Include ground inspections and tests, and if necessary, flight inspections.
(2) Include the criteria for establishing or changing the interval between the periodic tests for each aeronautical facility listed in the manual, having regard to—

(i) Any applicable information published by ICAO (e.g., Annex 10, Volumes I to V and Doc 8071);
(ii) Any applicable reliability data for the aeronautical facility including archived flight inspection data and facility ground monitor correlation documented records;
(iii) Information on the proven reliability performance of the aeronautical facility, and of other similar aeronautical facilities, and the stability of the aeronautical facility’s operating environment.

(3) Ensure that the grounds for establishing or changing the interval between the periodic tests and inspections for each aeronautical facility listed in the manual are documented.

(c) Each aeronautical telecommunication services provider must establish—

(1) A program of periodic ground inspections for each aeronautical facility listed in the manual;
(2) A program of periodic ground tests for each aeronautical facility listed in the manual;
(3) A program of periodic flight inspections for each radio navigation aid listed in the manual;
(4) Methods used for flight testing of each ATS surveillance system listed in the manual.

(d) The programs required by paragraphs (c)(2) and (c)(3) must be based on the criteria required under paragraph (b)(2) and must specify the maximum interval between the inspections for each aeronautical facility.

(e) All flight inspections must be performed by a flight inspection service provider who has been authorized by the President under Appendix D to this part.

(f) Each aeronautical telecommunication services provider must notify the President of any radio navigation aid that is not subjected to periodic flight inspections.

§ 173.81 Aeronautical Facility Performance.

(a) Each aeronautical telecommunication services provider must establish a procedure to ensure that no aeronautical facility listed in the manual is placed into operational service unless—

(1) The person placing the aeronautical facility into operational service has been assessed as competent and authorized according to the procedures required under GACAR § 173.33;
(2) The appropriate checks detailed in the operating and maintenance instructions required under GACAR § 173.55 have been carried out to verify the performance of the aeronautical facility;
(3) The aeronautical facility record has been completed according to the procedures required under GACAR § 173.143.

(b) Each aeronautical telecommunication services provider must:

(1) collect and analyse information regarding the performance of systems of aeronautical facility, operation and maintenance, including unusual transmission phenomena;

(2) take immediate remedial actions on identified adverse trends and deficiencies; and
(3) report any facility malfunction resulting in degradation or loss of services or functions in accordance with the requirements of GACAR Part 4.

§ 173.83 Inspection, Measuring, and Test Equipment.

(a) Each aeronautical telecommunication services provider must ensure that appropriate inspection,

measuring, and test equipment is available for personnel to maintain the operation of each aeronautical facility listed in the manual.

(b) Each aeronautical telecommunication services provider must establish a procedure to control, calibrate, and maintain all the inspection, measuring, and test equipment required under paragraph (a) to ensure that each item of equipment has the precision and accuracy that is necessary for the measurements and tests to be performed.

(c) The procedure required under paragraph (b) must require that each item of test equipment required for the measurement of critical performance parameters is—

(1) Calibrated before use or at prescribed intervals with the calibration traceable to an appropriate national standard;
(2) Identified with a suitable indicator to show its calibration status;
(3) Controlled to—

(i) Safeguard against adjustments that would invalidate the calibration setting;
(ii) Ensure that the handling, preservation, and storage of the test equipment is such that its accuracy and fitness for use is maintained.

(d) If hardware and software systems are used for the performance testing of any aeronautical facility, the procedures under paragraph (b) must require the functions of those testing systems to be checked—

(1) Before being released for use; and
(2) At prescribed intervals to establish that those testing systems are capable of verifying the true performance of the aeronautical facility.

§ 173.85 Procedures for the Notification of Aeronautical Facility Information.

(a) Each aeronautical telecommunication services provider must establish a procedure to ensure that the requirements of GACAR § 173.13 are met for each applicable aeronautical facility listed in the manual.

(b) The procedure required under paragraph (a) must include a means to confirm that—

(1) The operational details of the aeronautical facility as notified to the AIS provider have been accurately published in the KSA AIP; and
(2) Any change to the operational status of the aeronautical facility has been published by NOTAM.

§ 173.87 Aeronautical Facility Check after Accident or Incident.

(a) Each aeronautical telecommunication services provider must establish a procedure to check and accurately record the operating condition of any aeronautical facility they operate that may have been used by an aircraft, or an air traffic service, that is involved in an accident or incident.

(b) The procedure required under paragraph (a) must require that—

(1) The check of the aeronautical facility's operating condition is carried out as soon as practicable after notification to the aeronautical telecommunication services provider of the accident or incident;
(2) The record of that check, and the recorded history of the aeronautical facility, is kept in a secure place for possible use by any subsequent accident or incident investigation; and
(3) The records required to be secured under paragraph (b)(2) are retained for 3 years from the date of the last entry made on that record.

§ 173.89 Facility Malfunction Incidents.

Each aeronautical telecommunication services provider must establish procedures—

(a) To notify, investigate, and report facility malfunction incidents in accordance with the requirements of GACAR § 173.141; and

(b) To implement corrective actions to eliminate the cause of a facility malfunction incident and prevent its recurrence.

§ 173.91 Spare Parts.

Each aeronautical telecommunication services provider must ensure that an adequate stock of spare parts is available for use all the time for the critical components of the facilities supporting the ATS systems. This stock must be stored and managed in accordance with supplier/manufacture requirements.

SUBPART E — OPERATING REQUIREMENTS

§ 173.101 Continued Compliance.

Each aeronautical telecommunication services provider must—

(a) Continue to meet the standards and comply with the requirements of this part;

(b) Comply with all procedures referred to in its manual;

(c) Hold at least one complete and current copy of its manual at each location listed in its manual where a senior person is based; and

(d) Make each applicable part of its manual available to personnel who require those parts to carry out their duties.

§ 173.105 Temporary Aeronautical Facility.

If a temporary aeronautical facility is operated for the purpose of site tests, experiments or trials, the aeronautical telecommunication services provider:

(a) must ensure that the facility is compliant with applicable ICAO Standards and procedures and that the frequency used will not cause interference to other facilities;

(b) must take of all possible precautions, such as the choice of frequency and of time, and the reduction or, if possible, the suppression of radiation.

(c) must ensure any harmful interference resulting from tests and experiments is eliminated as soon as possible.

(d) is not required to comply with any requirements of this part, except for GACAR § 173.1(c) (2) and § 173.75(b) and (c).

§ 173.107 Limitations on Aeronautical Telecommunication Service Providers.

(a) Except for the operation of a temporary aeronautical facility for site tests according to the procedures required under GACAR § 173.75(b), each aeronautical telecommunication services provider may not permit an aeronautical facility to continue in operational service under this part if they have any cause to suspect the integrity of the information being provided by the facility.

(b) Each aeronautical telecommunication services provider may not operate a radio transmitting aeronautical facility on an aeronautical radio frequency except under a radio apparatus license granted by the Communications, Space and Technology Commission for the facility.

(c) Except when a site test is carried out according to the procedures required under GACAR § 173.75(b), each aeronautical telecommunication services provider may not operate an aeronautical facility unless—

(1) The aeronautical facility is listed in the certificate holder's manual;
(2) The performance of the aeronautical facility meets the applicable information published for that facility under GACAR § 173.13;
(3) The performance of the aeronautical facility meets the applicable requirements in GACAR § 173.75(a);
(4) Any integrity monitoring system for the aeronautical facility is fully functional; and
(5) All the periodic tests for the aeronautical facility are completed according to the programs established under GACAR § 173.79(c).

§ 173.109 Changes to Provider's Organization.

(a) Each aeronautical telecommunication services provider must apply and obtain prior acceptance by the President if they propose to change any of the following—

(1) The Director of aeronautical telecommunication services:
(2) The listed senior persons:
(3) The types of aeronautical facility operated under the authority of the certificate; and
(4) The flight inspection service provider.

(b) The President may impose any conditions, that the President considers necessary in the interests of aviation safety, on the aeronautical telecommunications service provider while any

changes under paragraph (a) are occurring or as a consequence of those changes.

(c) Each aeronautical telecommunication services provider must comply with any conditions imposed by the President under paragraph (b).

SUBPART F – QUALITY ASSURANCE

§ 173.121 Quality Assurance.

(a) Each aeronautical telecommunication services provider must establish a quality assurance system to ensure compliance with, and the adequacy of, the procedures required under this part.

(b) The quality assurance system must include—

(1) A safety policy and safety policy procedures, including the procedure required under GACAR § 173.87 for investigating facility malfunction incidents;
(2) A procedure to ensure quality indicators, including equipment availabilities, malfunctions, faults, and personnel and customer feedback, are monitored to identify existing problems or potential causes of problems within the quality assurance system;
(3) A procedure for corrective action to ensure existing problems that have been identified within the quality assurance system are corrected;
(4) A procedure for preventive action to ensure that potential causes of problems that have been identified within the quality assurance system are remedied;
(5) An internal audit program for the organization to ensure conformity with the procedures in the manual and to achieve the goals set in the safety policy; and
(6) Management review procedures, that should include the use of statistical analysis if appropriate, to ensure the continuing suitability and effectiveness of the quality assurance system in satisfying the requirements of this Part.

(c) The procedure required under paragraph (b)(3) for corrective action must specify how—

(1) To correct an existing quality problem;
(2) To follow up a corrective action to ensure the action is effective;
(3) To amend any procedure required under this part as a result of a corrective action; and
(4) Management will measure the effectiveness of any corrective action taken.

(d) The procedure required under paragraph (b)(4) for preventive action must specify how—

(1) To correct a potential quality problem;
(2) To follow-up a preventive action to ensure the action is effective;
(3) To amend any procedure required under this part as a result of a preventive action;

(4) Management will measure the effectiveness of any preventive action taken.

(e) The internal audit program required under paragraph (b)(5) must—

(1) Specify the frequency and location of the audits taking into account the nature of the activity to be audited;
(2) Measure the effectiveness of any preventative or corrective action taken by the personnel responsible for the activity being audited since the last audit; and
(3) Require preventative or corrective action to be taken by the personnel responsible for the activity being audited if problems are found by the audit.

(f) The procedure for management review required under paragraph (b)(6) must—

(1) Specify the frequency of management reviews of the quality assurance system taking into account the need for the continuing effectiveness of the system; and
(2) Identify the senior person responsible for the management reviews referred to in paragraph (f)(1).

(g) The senior person responsible for the quality assurance system must—

(1) Ensure that the safety policy and the safety policy procedures are understood, implemented, and maintained at all levels of the aeronautical telecommunication services provider’s organization;
(2) Ensure that the audits are performed by trained auditing personnel who are independent of those having direct responsibility for the activity being audited;
(3) Ensure that the results of the audits are reported to the personnel responsible for the activity being audited;
(4) Ensure that all corrective and preventative actions are followed up to review the effectiveness of those actions;
(5) Ensure that the results of the management review are evaluated and recorded; and
(6) Have direct access to the chief executive on matters affecting the integrity of the facilities operated under the authority of the aeronautical telecommunications service provider.

SUBPART G – RECORDS AND REPORTS

§ 173.141 Facility Malfunction Incident Reports.

(a) Each aeronautical telecommunication services provider must submit a facility incident report to the President within 24 hours for any facility malfunction resulting in degradation or loss of services or functions as defined in Appendix D to GACAR Part 4.

(b) The report must include the following information-

(1) Date and time of the incident;
(2) Brief description of events;
(3) Identification, type, name, frequency, and provider of the aeronautical telecommunication facility involved;
(4) Whether the aeronautical telecommunication services provider making the notification has instituted an investigation into the incident and, if so, expected time of completion; and
(5) Name and contact details of the person notifying the incident.

§ 173.143 Records.

(a) Each aeronautical telecommunication services provider must establish procedures to identify, collect, index, store, and maintain the records that are necessary to record—

(1) The safe provision of the aeronautical telecommunication services;
(2) GNSS data relevant to GNSS based operations permitted in the KSA; and
(3) The safe operation of each aeronautical facility listed in the manual.

(b) The procedures required under paragraph (a)(1) and (a)(3) must require that accurate records of the following are maintained:

(1) For each aeronautical facility, a record—

(i) Documenting the operating performance of the aeronautical facility; and
(ii) Providing a history of the maintenance, and the periodic inspections and tests of the aeronautical facility, that are traceable to the person or persons responsible for each of the recorded activities.

(2) For each aeronautical facility, a record of the establishment of, or a change in, the periodic tests required under GACAR § 173.79(a);
(3) For each item of test equipment required under GACAR § 173.83(c) that is used for the measurement of an aeronautical facility's critical performance parameters, a record that includes a traceable history of the location, maintenance, and the calibration checks for the item of test equipment;
(4) For each facility incident reported under GACAR § 173.141, a record that includes—

(i) Details of the nature of the malfunction;
(ii) The findings of the investigation;
(iii) The follow up corrective actions; and
(iv) If applicable, a copy of the facility malfunction incident report submitted to the President under GACAR § 173.141(a).

(5) A record of each internal audit required under GACAR § 173.121(b)(5), and of each management review required under GACAR § 173.121(b)(6); and
(6) For each person who is authorized in accordance with GACAR § 173.33(b) to place aeronautical facilities into operational service, a record that includes details of the person's experience, qualifications, training, competence assessments, and current authorizations.

(c) The procedures required under paragraph (a) must require—

(1) All records to be legible and of a permanent nature;
(2) All GNSS recordings required under paragraph (a)(2) be retained for a period of at least 14 days. When the recordings are pertinent to accident and incident investigations, they must be retained for longer periods until it is evident that they will no longer be required by the National Transport Safety Centre (NTSC)
(3) All aeronautical facility records required under paragraph (b)(1) to be retained for a period of at least three years unless a longer period is required—

(i) By the President;
(ii) To establish a performance history for the aeronautical facility.

(d) Each aeronautical telecommunication services provider must establish procedures to identify and dispose of those records that are no longer required.

APPENDIX A TO GACAR PART 173 – COMMUNICATION SYSTEMS

A.1 - VOICE / DATA RECORDING EQUIPMENT

I. General.

(a) The recording equipment must provide a complete, identified, intelligible and accurate record of the communications to be recorded which may be used, in the event of an incident, in any investigation by the National Transport Safety Centre (NTSC).

(b) The recording equipment must comply with:

(1) The Minimum Performance Specification described in the Annex A1.1 to this appendix;
(2) The recording equipment or system must employ voice coding techniques which ensure the replay quality of previously archived radio communication messages will achieve a minimum Mean Opinion Score (MOS) of 4.0 (Good);
(3) The voice coding scheme must be able to cope with different types of voice, multiple voices, background noise without any significant deterioration in quality.

(c) Each aeronautical telecommunication services provider must coordinate with the GACA to ensure that the recording equipment is compatible with the replay facilities and working practices in use and must present evidence to support this.

II. Time-Recording Devices.

(a) Voice/Data Recording equipment must include time-recording devices or techniques to ensure the 'time-stamping' of ATS communications.

(b) ATS Unit Clocks and Time-Recording Devices must use Coordinated Universal Time (UTC) and must express the time in hours and minutes and seconds of the 24-hour day. Midnight must be designated as 2400 for the end of the day and 0000 for the beginning of the day.

(c) ATS Unit Clocks and Time-Recording devices must be checked as necessary to ensure correct time to within plus and minus 15 seconds of UTC.

(d) The clock or time-recording device in the recording equipment must be checked as necessary to

ensure that the timestamps are maintained within plus and minus 2 seconds of either the ATS Unit master clock source where this exists and another common reference source, or Global Positioning System signals.

(e) Wherever Data Link Communications are in operation, clocks and time-recording devices must be accurate to within plus and minus 1 second of UTC.

III. Communications to be Recorded -Air-Ground Communications (Aeronautical Mobile Service).

(a) Direct pilot-controller communications between aircraft stations and aeronautical stations, must be recorded.

(b) The voice communications to be recorded must be derived from a receiver in the aeronautical station providing 'off-air' signals of the pilot and controller transmissions.

(c) Where the voice communications to be recorded are routed via a Voice Communications System (VCS) or other air traffic service equipment to the recording equipment, the continuity of recording must be ensured in the event of a failure of either the VCS or air traffic service equipment.

(d) Voice communications derived from appropriate points at the controller’s operating position should be recorded.

IV. Ground-Ground Communications (Aeronautical Fixed Service).

(a) Communications within Jeddah Flight Information Region.

(1) Direct communications between ATS Units and between ATS Units and appropriate Military units must be recorded.

(b) Communications between adjacent ATS units.

(1) Direct communications, between Area Control Centers serving contiguous control areas, must be recorded.
(2) Direct communications, between adjacent Area Control Centers, must be recorded.

V. Surface Movement Control Service.

Surface Movement Control Service Communications, used for the control of vehicles and personnel on the manoeuvring area, must be recorded.

VI. Communications within an Air Traffic Control Unit.

Communications between operational positions at an Air Traffic Control Unit must be recorded.

VII. Recoding equipment Installation.

(a) The recording equipment must be installed in accordance with the manufacturer's, supplier's or agent's instructions to ensure correct and reliable operation.

(b) The archival media storage facilities must be constructed maintained and operated in accordance with the manufacturer's, supplier's or agent's instructions to ensure the reliable retention of data and achievement of expected media lifetimes.

VIII. Equipment and Power Supply Configuration.

(a) The equipment and power supply configuration must be such as to ensure the availability of recording, without interruption, when an ATS is being provided. Backup power supply from either a central battery system or individual UPS units must ensure the availability of power to the recording equipment and other essential equipment in the event of a mains interruption.

(b) The equipment configuration must take into account such factors as the hours of operation of the ATS Unit, provision for maintenance/repair, ability to replay recorded archival media while continuing to record or exchange current media.

Note: The provision of main and standby equipment will be necessary to achieve the required availability. The incorporation of suitable mains conditioning devices as part of the mains / backup power supply arrangements may be useful in preventing equipment malfunction due to surges, spikes and noise on the power supply.

(c) Where the equipment and power supply configuration is such that the availability of recording, withoutinterruption,cannot be ensured while theATS isbeing provided,theneitherthe provision of the ATS must cease within a time period defined in the Local Instructions for the Air Traffic Control Unit or a written record must be kept.The traffic mustbetransferred toanother ATS unit.

IX. Alarm / Status Indications.

(a) The local and remote alarm/status indications of the recording equipment must be used as appropriate to alert Air Traffic Control and maintenance staff to take the necessary actions to ensure the continued operation of the equipment.

(b) The remote alarm/status indications must be 'latching' such that they require positive intervention to check that the recording equipment is operating correctly before any alarm can be cancelled.

X. Working Facilities.

Working facilities must be provided to enable authorized staff to operate the equipment and undertake other duties such as replay and copying, maintenance, repair and inspection.

XI. Disposal of Recording Equipment.

Before the disposal of any Recording Equipment, the National Transport Safety Centre (NTSC) and GACA must be consulted to determine whether there is a need to retain the equipment as a replay facility for any impounded recordings.

XII. Operation and Maintenance.

(a) Operating and Maintenance Manual and Procedures. The operating and maintenance manual of the recording equipment must describe, for each telecommunication, surveillance or radio navigation service provided:

(1) The kind and location of each facility;
(2) The technical specification of each kind of facility;
(3) How each facility interconnects with any other facility or service; and
(4) The way in which the aeronautical telecommunication services provider monitors each facility to ensure that it is operating in accordance with its technical specification.

(b) Procedures for the operation and maintenance of the recording equipment must be produced and incorporated into the operations and maintenance instructions associated with each ATC Unit.

(c) Details of the operation and maintenance of the recording equipment, the management of the

archival media, and visits by authorized persons must be recorded in a logbook and preserved for a period of one year.

(d) A daily check must be made of the serviceability and recording function of the recording equipment without interrupting the recording of any active communications and including intermediate and archival media storage devices. The results of these checks must be recorded in the logbook.

(e) Systems using internal storage devices must have the capability to archive to external media for investigation purposes and where necessary to achieve the required minimum retention period.

(f) When external long-term storage or archival media are used, the data must be transferred in the proprietary format with minimal human intervention. The data must also be protected from loss or corruption during its transfer from the Hard Disc Drives (HDD) and Solid-State Drives (SSD) to long-term storage or to removable media. Corrupted or incomplete data may result in the inability to replay archived recordings from removable media.

(g) A daily check must be made of the time and date function of the recording equipment, at intervals appropriate to the accuracy of the ATS Unit Clock or time recording device used as the source. The results of these checks must be recorded in the logbook.

(h) Each aeronautical telecommunication services provider must take any one or more of the following precautions during a test transmission:

(1) A reasonable time before commencing the transmission, the AIS provider must be informed about the transmission. The AIS provider must issue a NOTAM on the test transmission;
(2) At the commencement of the transmission, the aeronautical telecommunication services provider identifies the transmission as a test transmission;
(3) The transmission contains information identifying it as a test transmission.

(i) Each aeronautical telecommunication service facility or facilities must be tested and maintained using test equipment that is maintained and calibrated in accordance with this part.

XIII. Management of Archival Media Identification.

Each item of removable archival media must each have a unique identity, which must be used in entries made in the logbook and must be shown by the use of an indelible written or printed label firmly attached to the media.

XIV. Storage Capacity.

(a) The use of the maximum storage capacity available on the archival media, where this equals or exceeds 60 days, must only be used where the reliability of the recording equipment and the archival media has been demonstrated and the risk of losing data due to the failure of the recording equipment, archival drive or media itself has been minimized.

(b) The archival media should be changed on a daily basis, at appropriate times related to the provision of the ATS Service or corresponding to ATC and maintenance staff duty changes.

XV. Lifetime of Removable Archival Media.

The removable archival media must be replaced before any deterioration results in the loss of recorded data and any impounded recordings still required by either the President or the National Transport Safety Centre (NTSC) must be accurately transferred onto new media if necessary.

XVI. Retention of Recordings.

Recordings on archival media must be retained for a minimum period of 60 days from the date of the last recorded message.

XVII. Impounding of Recordings.

On receiving a detailed request concerning recorded transmissions from either the National Transport Safety Centre (NTSC) or GACA, normally within the 60-day retention period, archival media containing the specific recorded transmissions must be removed from normal storage or extracted from HDD/SDD and placed in a separate and secure storage area pending further instructions.

XVIII. Access to Recording Equipment.

Access to the Recording Equipment must be permitted to authorized persons from the National Transport Safety Centre (NTSC) or GACA for the purposes of replaying and making copies of original recordings.

XIX. Prevention of Inadvertent Loss of Recorded Communications.

The inadvertent loss of recorded communications, while operating the recording equipment, must be prevented by means of procedures in conjunction with equipment security functions where available.

ANNEX A1.1 TO APPENDIX A - MINIMUM PERFORMANCE SPECIFICATION FOR RECORDING EQUIPMENT

I. Scope.

This annex comprises the minimum performance specification for analogue and digital recording equipment used at Air Traffic Control Units for the recording of voice and data link communications.

II. Equipment Configuration.

(a) The equipment must be designed with appropriate options to ensure the uninterrupted availability of communications recording. The appropriate options might include the duplication of critical internal units such as electronic modules, power supply units, intermediate and archival storage media drives and the ability to interconnect main and standby recording equipment.

(b) Where an option to interconnect main and standby equipment is available, an automatic changeover function must be provided, which operates the main and standby equipment in parallel to ensure continuity of recordings, for an adjustable time period with a recommended minimum of 10 minutes.

III. Alarm / Status Indications.

(a) The equipment must provide appropriate local and remote alarm/status indications including an output to indicate the overall operational status of the equipment.

(b) The remote alarm/status indications must not be affected by any loss and/or subsequent restoration of electrical power to the equipment. Urgent and non-urgent alarms may be used to distinguish between problems which require immediate attention, such as failure of the recording equipment, and those which do not, such as an impending recording archival media change.

IV. Time and Date Information.

(a) The equipment must automatically record time (hours/minutes/seconds) and date (day/month /year) information.

(b) Coordinated Universal Time (UTC) in hours, minutes, and seconds of the 24-hour day beginning at midnight must be used.

(c) The time must have an accuracy such that it can be maintained within plus and minus 15 seconds (UTC), except when data link communications are utilized, when the accuracy must be plus and minus 1 second (UTC), within a reasonable period of time and at least for the duration of recording time on a single archival storage media.

(d) The time must have a resolution of 1 second.

(e) Where an external source is used to derive time and date information the equipment must incorporate an internal source to be used in the event of failure of the external source or temporary loss of signal from radio time code receivers.

V. Line Interface.

(a) Line interfaces must be provided which are compatible with telephone connections made via the Public Switched Telephone Network or private lines.

(b) Line interfaces must be provided which are compatible with radio connections made via the Public Switched Telephone Network or private lines to transmitter, receiver and associated control equipment at 2 Wire or 4 Wire level.

(c) Optional modules to provide telephone connection Off-Hook and Ring Detect signals for the contact activation circuits may be incorporated into the line interfaces.

VI. Recording Initiation.

(a) *Voice Activation.*

(1) Voice Activation or Voice Operated Switch (VOX) can be used to initiate recording of telephone signals or other ground-ground communications.

(2) The sensitivity of the voice activation circuit must be adjustable.
(3) An adjustable time delay must be provided after the voice activation circuit releases before recording stops.
(4) An adjustable minimum time period must be provided for the voice activation to prevent spurious responses to noise pulses.

Note: Due to the inherent delay with the voice activation circuit responding to initial syllables of speech and delays due to the mechanical inertia in the magnetic tape transport system of analogue equipment, it is possible that initial syllables of speech may not be recorded. The use of a circuit to buffer the signals to be recorded may be used to reduce this effect. The setting of the voice activation sensitivity is more critical for varying input levels, such as radio signals, which may result in communications not being recorded. Voice activation is not generally acceptable for radio signals due to these possible effects.

(b) *Contact Activation.*

(1) Contact activation derived from on/off hook, ring detect or other signalling conditions, may be used to initiate recording of telephone signals or other ground-ground communications.
(2) Contact activation derived from transmitter push-to-talk (PTT) and receiver squelch or mute lift conditions must be used to initiate recording of radio signals.

VII. Analogue Signal Conditioning.

(a) Options for adjusting or disabling Automatic Gain Control (AGC) for individual inputs should be provided where it is used to compensate for variations in line interface levels.

(b) Compression and Expansion techniques may be used to match the dynamic range of the line interface levels to that of the recording equipment.

VIII. Human Machine Interface.

(a) *Audio Output.*

(1) A front panel loudspeaker, volume control and on/off switch must be provided on the equipment or on a separate remote-control panel if this option is provided.
(2) A front panel standard headphone jacks and volume control must be provided on the equipment or on a separate remote-control panel if this option is provided.

(b) *Copy Output.*

(1) A front panel or easily accessible output connector for making copy recordings must be provided, which may have a pre-set output adjustment.
(2) The output must comprise one audio channel, which must be the selected recorded channel, and another audio channel which must have either a voice synthesized (spoken) time output or tone coded time markers from, or derived from, the time and date information of the original recording.

(c) *Security of Recordings.* Techniques must be used to reduce the possibility of inadvertent erasure of recorded information. The use of software-controlled password, electronic or mechanical key switch access or other measures may be appropriate. Where the use of such devices is not feasible, for example with analogue reel to reel magnetic tape-recording equipment, then the disabling of the recording/erase mechanism may be necessary, which would then require the provision of a separate bulk erase machine. The use of a single action to record without verification or protection must be avoided.

IX. Archival Media.

(a) The equipment must utilize removable archival media for the recording of communications.

(b) Guidance on the handling and storage of media must be provided, as appropriate, with the equipment documentation.

X. Replay Functions.

The equipment must be capable of replaying the original recorded communications on archival media in a continuous 'real time' mode and presenting the time and date information separately from but synchronized with the recorded communication.

Note: The capability to replay in a continuous ‘real time’ mode means that the messages can be replayed continuously without interruption or any manual intervention, with any periods of silence or absence of recorded messages re-inserted.

XI. Analogue Equipment.

(a) Analogue recording equipment is classified as that which records analogue signals in real time directly onto the archival media. Typically, magnetic tape reel to reel or cassette transport systems utilizing electronic, electrical and mechanical devices are used.

(b) *Recording Check.* Devices and/or techniques must be incorporated to provide a check for successful recording onto archival media.
Note: Magnetic tape transport systems can employ off-tape monitoring to establish that successful recording has taken place.

(c) *Recording Quality*.

(1) When compared with a reference of –10dBm at 1,200 Hz, the amplitude variation from 300 Hz to 3,400 Hz must not exceed ± 3dB.
(2) Signal to noise ratio must be better than 40 dBA (38dB) when the reference signal is replayed.
(3) Harmonic distortion of the reference signal, replayed at 0dBm, must not exceed 2.5%.
(4)Crosstalk from adjacent channels must not exceed 40 dB.
(5) Wow and Flutter must not exceed 1%.

XII. Digital Equipment.

(a) Digital recording equipment is classified as that which records digital signals onto intermediate storage media and then regularly transfers the data onto the archival storage media.
Magnetic/Optical media archival storage drives utilizing electronic, electrical and mechanical devices are used.

(b) *Analogue to Digital Conversion. (1) Voice Coding Scheme.*

(i) The voice coding scheme must use coding techniques which provide a Mean Opinion Score (MOS) of 2 (Unreadable), 3 (readable), 4 (Good) or 5 (Excellent), also known as "high quality network speech" or "toll quality speech".
(ii) The voice coding scheme must be able to cope with different types of voice, multiple voices, background noise without any significant deterioration in quality.
(iii) The voice coding scheme must comply with published International standards where available.

Note: – Voice coding schemes using waveform coding techniques include CCITT G.711 - A/μ-law PCM, CCITT G.721 - ADPCM and CCITT G.728 - LD-CELP.

(c) *Data Compression.* The amount of data compression applied at the analogue to digital conversion either as part of the voice coding scheme or as a separate process, should not

significantly degrade the recorded communications.

(d) *Intermediate Storage.*

(1) Where an intermediate storage device is used, the process by which the communications are transferred onto the archival media must be automatic (not requiring human intervention) and must be secure from attempts to select, alter or interfere in any way with the data.
Note: Digital recording equipment may utilize an intermediate storage device such as a hard disk drive (HDD), on which the communications are recorded in real time, before being transferred onto the archival media at regular intervals.
(2) The information on the intermediate storage media must be transferred onto archival storage media via an appropriate drive mechanism at regular intervals.
(3) The equipment must use a safe shutdown mode, in the event of power failure or equipment malfunction, to ensure that intermediate storage data is not lost and that the communications can be replayed normally from the archival storage media.

(e) *Archival Media.*

(1) The equipment must use a safe shutdown mode, in the event of power failure or equipment malfunction, to ensure that any necessary file management information can be written to the archival media, so that the communications can be replayed normally from the archival storage media.
(2) Recording Check. Devices and/or techniques must be incorporated to provide a check for successful recording onto archival media.

(f) *Recording Quality*. The recording quality must meet the requirements as for analogue equipment as appropriate.

Note: It is anticipated that a suitable measure of recording quality will be defined for digital recording equipment but in the absence of this the quality must be comparable with that of analogue equipment.

A.2 - VHF AERONAUTICAL RADIO STATIONS

I. General.

(a) This appendix applies to fixed, stationary, vehicle, portable and hand-held equipment categories comprising transmitter, receiver and transceiver equipment types operating in the VHF Aeronautical

Mobile (R) Service allocation 118 MHz to 136.975 MHz, using Double Sideband (DSB) Amplitude Modulation (AM) full carrier with 8.33 kHz or 25kHz channel spacing, intended for analogue voice and 25 kHz Minimum Shift Keying (MSK) (ACARS) or Differential 8 Phase Shift Keying (D8PSK) (VDL Mode 2) or Gaussian Frequency Shift Keying (GFSK) (VDL Mode 4)data link communications.

(b) The equipment and systems at Aeronautical Radio Stations must provide complete, identified, accurate and uncorrupted voice and data link communications for air traffic services.

(c) The equipment, systems, services and facilities must comply with the applicable:

(1) Requirements of this part;
(2) Applicable standards and recommended practices prescribed in Annex 10, Volume III, Part II - Voice communication systems,
(3) Applicable standards and recommended practices prescribed in Annex 10, Volume III, Part I - Digital Data Communication Systems
(4) Radio Regulations of the International Telecommunications Union.

II. Radio Spectrum Management.

(a) The equipment and systems must be designed and constructed to operate within the Aeronautical Mobile (R) Service allocation 117.975 MHz to 137.000 MHz. The first and last assignable frequencies being 118.000 MHz and 136.975 MHz. For radiotelephony channel spacing is either 25 kHz or 8.33 kHz using Double Sideband (DSB) Amplitude Modulation (AM) full carrier with ITU emission designator 6K80A3EJN for 25 kHz and 5K00A3EJN for 8.33 kHz channel spacing. For data link communications channel spacing is 25 kHz using Double Sideband (DSB) Amplitude Modulation (AM) full carrier with ITU emission designators 13K0A2DAN for ACARS using MSK modulation, 14K0G1D for VDL Mode 2 using D8PSK modulation and 13K0F7D for VDL Mode 4 using GFSK modulation.

(b) The equipment and systems must be installed, operated and maintained in compliance with the terms of specific location dependent or general frequency assignment(s) and any additional terms and conditions established by the President.

(c) The designated operational coverage (DOC) associated with the frequency assignments must be published to enable aviation users to restrict the use of Air to Ground Communications to the

designated airspace.

(d) The effective radiated power must be such to provide minimum field strength of 45 dB μ V/m within the radio service area for air traffic services, or such a minimum field strength or minimum effective radiated power.

III. Aeronautical Radio License.

All Aeronautical Radio Stations must be appropriately licensed under the Communications, Space & Technology Commission prior to any transmissions being made.

IV. Maintenance of Aeronautical Radio Stations.

(a) Maintenance arrangements must be established for equipment and systems at Aeronautical Radio Stations associated with the provision of Air Traffic Control Services.

(b) Maintenance procedures must be established for equipment and systems at Aeronautical Radio Stations associated with the provision of Flight Information Service (FIS) and Air-Ground Communication Service (AGCS). Appropriate actions must be taken to ensure the continued compliance with the Aeronautical Radio License and other applicable standards or requirements.

(c) Regular functional and performance checks, including measurements to verify transmitter frequency, modulation depth, output power and a determination of effective radiated power using calibrated measurement equipment, should be undertaken.

(d) A record of any functional test, flight checks and particulars of any maintenance, repair, overhaul, replacement or modification must be kept in respect of the equipment and systems at Aeronautical Radio Stations, as required and the records must be preserved for a period of one year or longer as directed by President.

V. Specific Requirements Communications Availability.

The design, installation, operation and maintenance of equipment and systems must be such as to ensure an availability of communications appropriate for the air traffic services being provided.

VI. Radio System Design.

(a) Communications of a specified quality of service must be provided within the radio service area

appropriate to the services being provided. The maximum field strength outside the DOC, as specified in the frequency assignment, must not be exceeded.

(b) Where co-channel and adjacent channel interference are the limiting factors, signal quality is directly related to the desired-to-undesired (D/U) signal ratio criteria used in the frequency assignment planning process, the results of which give a minimum field strength within the DOC which should be achieved and a maximum field strength outside the DOC which must not be exceeded. The signal quality at the receiver can be affected by local noise and interference effects such as man-made noise and precipitation static.

(c) The Radio Service Area should be published to provide aviation users with information on the anticipated service volume within which reliable communications may be expected. The antennas must be installed such as to provide vertically polarized radiation.

VII. Equipment Configuration.

(a) The equipment configuration must be such as to ensure the availability of communications appropriate to the service being provided.

Note: The configuration of equipment includes associated antennas, cables, filters, commutation units and other equipment necessary for the operation of the equipment and systems.

Note: Equipment provided in addition to the above would be considered to be Contingency Equipment.

(b) The equipment type must be appropriate for the service being provided and be compatible with the equipment configuration.

(c) For Flight Information Services, a transceiver or separate transmitter and receiver are considered suitable as main equipment, with a handheld or portable transceiver being used for emergency equipment.

VIII. Duty Cycle - Radio Transmitters / Power Supply Units.

The duty cycle for Radio Transmitters and associated Power Supply Units must be appropriate for the service being provided.

IX. Power Supply.

(a) For an Air Traffic Control Service, the power supply for the emergency equipment must be independent of that for the main equipment.

(b) Users must be provided with an indication of failure of the power supply to the emergency equipment and instructions must be provided in Part 2 of the ATSPM required under GACAR Part 171 for user actions in the event of failure.

(c) For an Air Traffic Control Service, a primary and alternative power supply must be provided to increase the availability of power to equipment and systems in the event of an interruption to one of the power supplies. Change over between supplies should be on a 'no break' basis. The primary and alternative supplies should be independent of each other for a known period of time. An indication of failure for each power supply should be provided to the user and corrective action taken in the event of failure.

Note: Emergency equipment is operationally independent of the Main and Standby Equipment, rapidly available for use when required for a limited period of time until resumption of normal operations.

X. Alarm / Status Indications.

(a) For an Air Traffic Control Service, the system must provide an indication of system failure that may have an effect on the service being provided, in a timely manner, so that actions can be taken to ensure the safe continued provision of an ATC Service or if necessary, the controlled withdrawal of the service.

(b) The significance to the user of the indication of failure must be obvious from the indication given. The failure indication must remain obvious to the user while the condition causing the failure indication remains.

XI. Interface to Voice / Data Recording Equipment.

(a) The system at Aeronautical Radio Stations must provide all the necessary signals and information to the Voice/Data Recording Equipment in compliance with the provision of Annex A1.1 to this Appendix.

(b) If a separate receiver is used to record aircraft station transmissions, the antenna and receiver

combination must provide a signal comparable in strength and reception area to that of the main antenna and transceiver.

XII. Provision of Off-Air Sidetone.

Where off-air sidetone is provided for air traffic services, it must be a replica of the transmitted voice communications without any degradation of quality such as to cause annoyance or disturbance to the operator.

XIII. Provision of Emergency Frequency 121.500 MHz.

The emergency frequency 121.500 MHz must be provided at area control centers and flight information centers; aerodrome control towers and approach control offices serving international aerodromes and international alternative aerodromes.

XIV. Unintentional or Continuous Transmissions.

(a) The equipment and systems at Aeronautical Radio Stations must not fail in a manner such as to cause unintentional or continuous transmissions.

(b) New equipment and systems at Aeronautical Radio Stations must incorporate features to prevent unintentional or continuous transmissions, unless this is contrary to the intended purpose for which they have been designed. For existing equipment and systems, consideration should be given to incorporating such devices by retrofit, modification or add-on circuitry where appropriate.

A.3 - VOICE COMMUNICATIONS SYSTEMS (VCS)

I. General.

(a) This appendix sets out the engineering requirements for VCS communications facilities established or used at locations within the Kingdom of Saudi Arabia providing air traffic services.

(b) The VCS must enable direct, rapid, continuous and intelligible two-way voice communications for air traffic services.

(c) The equipment, systems, services and facilities must comply with the applicable international standards and procedures for air navigation services.

II. Communications Facilities.

(a) The operator must have clear visual and audible indication of the status of all available lines of communication.

(b) The operator must have the ability to select or deselect independently lines of communication or facilities in any combination, without affecting the operation of other lines of communication or facilities available at that or any other position.

(c) Where the system configuration can be changed, a means of quickly restoring the last set option configuration before any failure must be provided.

(d) Headsets must be provided except at units with very low-density operations where loudspeaker and free-standing microphone (i.e., no headset capability) may be used.

(e) Loudspeaker and headset earphone volume must be audible at the operating position when set to their minimum level.

Note: The air-ground communications may be switchable between headset and loudspeaker as traffic conditions dictate.

Note: Split headset mode implies the following:
1) RTF Communications only – Transmissions heard in both earpieces.
2) RTF Communications and Ground-Ground Communications – RTF transmissions heard in one earpiece and Ground-Ground Communications heard in the other earpiece. When the operator makes an RTF Communications transmission sidetone is heard in both earpieces.

Note: Handsets, desk or hand microphone may be used in combination with the desk loudspeaker where the ambient noise or traffic levels permit such operations.

(f) Operating positions must have a loudspeaker which will allow selected lines of communication to be monitored.

(g) Operating positions must have provision for the connection of a number of headsets enabling instructor/trainee, dual operator and supervisor monitoring facilities.

(h) The instructor/trainee facility, where provided, must enable direct communications via headsets.

(i) The instructor/trainee facility, where provided, must enable the instructor to interrupt any trainee

communications at any time.

Note: The instructor/trainee interrupt may be achieved by use of a dedicated instructor PTT Press- To-Talk control incorporating separate switches for RTF Communications and Ground-Ground Communications.

(j) Operating positions must have provision for at least two momentary action PTT controls, one of which must permit 'hands-free' operation. The controls must be used to control RTF communications transmissions.

Note: Typical PTT controls may be panel mounted switches, headset in-line switches, foot switches, switches incorporated into desk or handheld microphones and handsets.

(k) The audio level of each audio outlet must be independently adjustable, and any communications must still remain audible and intelligible to the operator when the minimum level is selected.

(l) Separate controls for the audio level of RTF Communications and Ground-Ground Communications must be provided with the setting in use being apparent to the operator.

(m) All lines of communication must incorporate an automatic gain control function in order to maintain adequate speech signal levels.

(n) Where an automatic gain control function is used, only one device or function must operate on any signal path.
Note: Where such devices or functions are incorporated, a signal gain path memory or similar feature can be used to prevent distortion of the initial syllables of speech at the beginning of a transmission or after pauses in speech. The principle of operation being that the last dynamic gain/attenuation setting is stored and used for subsequent transmissions.

(o) The design and implementation of the voice switch must be such that any input can be connected to any output without the possibility of blocking occurring.

III. RTF Communications.

(a) Communications on appropriate frequencies must be provided.

(b) Two-way radiotelephony communication facilities must be provided for aerodrome (surface movement) control service for the purpose of controlling vehicles on the manoeuvring area, except where communication by a system of visual signals is deemed to be adequate.

Note: This communication facility is normally provided by UHF radio equipment and systems, but the use of VHF Aeronautical Mobile Service frequencies may be permitted for ground-to-ground communications in specific circumstances. (Currently achieved via VHF and UHF channels)

(c) Where conditions warrant, separate communication channels should be provided for the control of vehicles on the manoeuvring area.

(d) RTF communications which have been selected must always be available irrespective of the state of other lines of communication.

(e) The operator must be provided with a degree of assurance that Air-Ground Communications transmissions have been successful.

Note: The normally accepted method of implementing this is to provide off-air sidetone to the operator's headset derived from either the radio receiver associated with the transmitter for that radio channel, or from a separate receiver. It is recognized that the future widespread implementation of digital telecommunications systems may mean that off-air sidetone cannot be implemented in all situations, in which case alternative ways of indicating the successful transmissions may be used.

(f) The operator must be provided with a degree of assurance that two-way radiotelephony communications for the control of vehicles on the manoeuvring area transmissions have been successful.

Note: The normally accepted method of implementing this is to provide off-air sidetone to the operator's headset. Where UHF Radio Equipment and Systems are used, it may be necessary to provide a separate receiver in addition to the base station receiver, in order to derive the off-air sidetone signal for both directions of transmission.

(g) The operator must be provided with the capability to select more than one air-ground communications frequency simultaneously. When the PTT control is operated communications must be transmitted on all selected frequencies to aircraft. When the PTT is released, the operator must be provided with the combined audio signals from all selected frequencies. When frequency coupling technique is used, only one transmission is passed to the controller.

Note: The operator will normally be provided with off-air sidetone derived from a combination of all the received audio signals from all selected frequencies. It is recognized that the operator is

unlikely to be able to determine whether transmissions on each and every selected frequency have been successful; alternative ways of indicating the successful transmissions may be required. It is also acknowledged that the combination of the received audio signals may result in distortion of the overall off-air sidetone. Particular attention may be required in the design and implementation.

(h) When two or more ATS frequencies are being used by a controller, transmissions on any of the frequencies must be simultaneously retransmitted on the other frequencies in use thus permitting aircraft stations within range to hear all transmissions to and from the controller.

(i) The operator must be provided with the capability to select the state of any available radio channel and an appropriate visual/aural indication must be given to indicate the selection made.

Note: Typical states normally found:
(1) Channel off. (Not if configured to any position)
(2) Channel receive only.
(3) Channel transmit and receive.
(4) Selection of duplicated transmitters and/or receivers.
(5) Selection of Cross-coupling.

(j) The operator must be provided with a visual/aural indication of the status of available radio channels.

Note: Typical status reports normally found:
(1) Aircraft or vehicle call/receiver mute lift.
(2) PTT operation.

(k) The delay between operating the PTT control and the appropriate electrical or electronic signal being present at the interface with the VCS must be as low as practical.

Note: A delay of 20ms or less should be achievable.

(l) The delay between receiving the appropriate electrical or electronic signal at the interface with the VCS and the activation of any electrical or electronic device, visual or aural indication must be as low as practical.

Note: A delay of 20ms or less should be achievable.

(m) When Air-Ground communications transmissions to aircraft are in progress, Ground-Ground

communications also in progress at the same time must not be transmitted to the aircraft. An indication must be given to the other party that Air-Ground communications are in progress, and this may be achieved by relaying the operators' speech.

(n) The VCS must not fail in a manner such as to cause unintentional or continuous transmissions.

IV. Ground-Ground Communications.

(a) The ATS provider must be consulted to ensure that the Aeronautical Fixed Services equipment is adequate for the task for which it is to be used. Among other things, consideration must be given to reliability, integrity, levels of redundancy, and hours of service, classification of airspace and complexity of traffic.

(b) Ground-Ground Communications must be provided for the telecommunications services required by the air traffic control unit.

(c) There must be provision for direct and immediate break-in (override call) interposition communications (intercom) between supervisors/operators at different positions which must be possible irrespective of the state of other lines of communication.

Note: In some cases, it may be necessary to provide an indication of the receipt of an intercom call and to identify the operating position from which the call originated.

(d) Intercom communications must not be transmitted on any RTF frequency or Ground-Ground Communications.

(e) An adequate number of connection(s) to the public telephone system must be provided.

(f) Other Aeronautical Fixed Services are to be provided as appropriate.

Note: They may include a means of communicating:
(1) Positions within the unit.
(2) Directly with adjacent ATS units including the parent Area Control Centre.

Note: In certain circumstances an automated dialing system may satisfy the requirements.

(g) Operating positions must have provision for connection to the Public Switched Telephone

Network.

Note: Access to Telecommunications Network Operators is essential to the implementation of a Ground-Ground Communications network required for the operation of an Air Traffic Control Unit. Access may be via the Public Switched Telephone Network or via private lines and networks.

(h) Where mobile, cellular or personal communications networks are used to fulfil the requirement to access the Public Telecommunications Network, the availability under conditions of congestion must be considered, and a priority access facility arranged with the network operator.

Note: The method of access to a Telecommunications Network Operator is not limited to landline connections and may be by means of optical fiber, microwave radio or by mobile cellular or personal communications networks.

V. Interface to Voice / Data Recording Equipment.

The VCS must provide all the necessary signals and information to the Voice / Data Recording Equipment in compliance with the provisions of Annex A1.1 to this Appendix.

VI. System Performance.

The clarity and volume of communications must be 'readable' or 'perfectly readable'.

VII. Voice Transmission Quality – Radio Transmissions.

The voice transmission quality of those communications facilities that utilize radio transmissions, the Aeronautical Mobile Service and the Surface Movement Control Service, must meet or exceed a quality defined by the following:

(a) The frequency response must be such that the gain at any frequency between 300Hz and 3.4 kHz must be within ± 3dB of the gain at 1kHz.

(b) The Total Harmonic Distortion (THD) must not exceed 2% at any frequency between 300Hz and 3.4kHz with any gain controls adjusted to give the maximum permitted audio level at the headset or handset.

(c) Residual noise and hum on any correctly terminated idle voice circuit must not exceed -60dBm.

Note: The minimum voice channel audio frequency bandwidth for Air-Ground Communications using VHF Aeronautical Mobile radio frequencies has been determined as 400 Hz to 2.7 kHz for 25 kHz channel spacing.

Note: The voice transmission quality requirements apply to the voice channel only and do not include microphone and headset characteristics.

VIII. Voice Transmission Quality – Non-Radio Transmissions.

(a) The voice transmission quality of non-radio transmissions must meet or exceed those requirements as may be defined in standards for systems which are connected to the Public Switched Telephone Network.

(b) In the absence of any such standards referred to in (a), the following must be met:

(1) The frequency response must be such that the gain at any frequency between 300Hz and 3.4 kHz must be within ± 3dB of the gain at 1kHz.
(2) The Total Harmonic Distortion (THD) must not exceed 2% at any frequency between 300Hz and 3.4kHz with any gain controls adjusted to give the maximum permitted audio level at the headset or handset.
(3) The Crosstalk level on any voice circuit must not exceed -60dBm when a 1kHz tone is injected into any other circuit at a level of 10dB above nominal test tone level, with all voice circuits correctly terminated.
(4) Residual noise and hum on any correctly terminated idle voice circuit must not exceed -60dBm.

Note: The voice transmission quality requirements apply to the voice channel only and do not include microphone and headset characteristics.

IX. Maintenance of Voice Communications Systems.

(a) Maintenance arrangements must be established for Voice Communications equipment and systems associated with the provision of Air Traffic Control Services.

(b) Maintenance procedures must be established for Voice Communications equipment and systems associated with the provision of Flight Information Service (FIS).

(c) Regular functional and performance checks, including measurements to verify voice output power and a determination of effective dbm for incoming and outgoing voice channels using

calibrated measurement equipment, should be undertaken.

(d) A record of any functional test, flight checks and particulars of any maintenance, repair, overhaul, system failures, replacement or modification (VCS map change) must be kept in respect of the Voice Communications equipment and systems, as required and the records (communication system log) must be preserved for a period of one year or longer as directed by the National Transport Safety Centre (NTSC) or GACA.

A.4 - ATC DATALINKS

I. General.

(a) Data link technology is intended to provide enhancements to the processes used within the provision of air traffic services. In its most simplistic form, the radio communications between Air Traffic Control (ATC) and aircraft could be accomplished by digital data transmission using data link. However, the provision of data link facilities may give rise to significant benefits in the following areas:

(1) Capacity
(2) Range
(3) Reliability
(4) Speed
(5) Security

(b) The provision of this section applies to the use of data link technologies and applications for 'Low risk' functions. (i.e., those which are not critical in terms of safety and/or time.) It is applicable to both Aeronautical Fixed Services and Aeronautical Radio Stations.

(c) The use of private networks for data link applications, such as those provided by ARINC and SITA is permitted.

(d) To ensure that the level of safety of the ATM function is maintained or improved during installation, transition and operation of data link equipment, applications and procedures a comprehensive safety assessment of the data link application/system and its interfaces with existing ATC equipment, people and procedures must be performed. Provided the Safety Assessment concludes that the data link system/application is at least tolerably safe, then the use of private data link networks, may be permitted for the following categories of communications messages:

(1) Meteorological Communications
(2) Flight Regularity Communications
(3) Aeronautical Information Service Messages
(4) Network/Systems Administration

(e) Communications in categories assigned a higher priority than those listed above may be permitted if the aeronautical telecommunication services provider provides evidence, in addition to the safety assessment, proving that:

(1) The application is not time critical and
(2) Procedures exist for ensuring that the failure of data link systems has no long term, short term, or immediate effect on the ability of the aircraft or ATSU to complete the communication at an appropriate time.

A.5 - INFORMATION AND ALERTING SYSTEMS

I. General.

This appendix sets out the safety requirements for information and alerting systems used at locations within the Kingdom of Saudi Arabia providing air traffic services.

II. Status Indicators.

(a) Any equipment or facility which has a direct effect on aircraft safety must have a display showing its status, if not readily apparent, visible to the controller. Examples of such equipment/facilities are runway arrester gear or barriers, radars, VCS, etc.

(b) Where indications of system failures are presented at multiple air traffic controller workstations, an adequate safety risk assessment must be conducted to assess the effects of multiple audible or flashing indicators, the cancellation procedures for multiple alarms including the cancellation of alarms in other remote locations, the need to cancel alarms at unmanned positions, and any distraction that may be caused to operational tasks and during the provision of air traffic services.

III. Data Display Systems (DDS).

(a) Prior to implementation, each aeronautical telecommunication services provider must ensure that the ATS provider, certified under GACAR Part 171, is satisfied and has declared that the system is

adequate for its purpose by design and has defined procedures in ATSPM Part 2 which mitigate deficiencies to ensure that a failure (total or partial) is not hazardous. The procedures must include details of alternative sources of safety-related information.

(b) Each aeronautical telecommunication services provider must ensure that all systems on which information is displayed to ATC for operational use must be designed, installed, configured and maintained in a manner which ensures the integrity of the information. The integrity requirements must be defined considering the criticality of the phase of flight and potential consequences of passing incorrect, misleading, corrupt or anomalous information.

(c) Data Display Systems for operational use by air traffic controllers must be easily visible from relevant control positions. The display must be clear and free from reflections. Systems must not divert the attention of controllers at operational positions unless specifically designed to do so.

IV. Flight Data Display.

Flight data displays (such as paper or electronic flight progress strips) must be provided. Shared displays (for example where two radar controllers work side by side with the data display between them) may be used if authorized by the President and must be identified in the operational specifications (OpSpecs) of the aeronautical telecommunication services provider.

V. Flight Data Processing Systems (FDPS) and Electronic Flight Progress Strips (EFPS) Systems.

(a) Prior to implementation, each aeronautical telecommunication services provider must ensure that the ATS provider, certified under GACAR Part 171, is satisfied and has declared that the system is adequate for its purpose by design and has defined procedures in ATSPM Part 2 which mitigate deficiencies to ensure that a failure (total or partial) is not hazardous. The procedures must include details of alternative sources of safety-related information.

Note: If the system is not capable of demonstrating the required level of safety, for example because integrity or reliability is not as predicted, then it will be acceptable to include procedures in Part 2 of the ATSPM of the ATS provider required under GACAR Part 171 in order to mitigate deficiencies to ensure that a failure (total or partial) is not hazardous. Included in these procedures will be details of alternative sources of safety-related information.

(b) The FDPS and EFPS systems must comply with requirements for retention of records as prescribed in GACAR Part 171 §171.855.

(c) Each aeronautical telecommunication services provider must ensure that, at least, the following aspects are considered as part of the FDPS and EFPS systems and safety assurance development:

(1) The provision of handwritten flight progress strips arrangements as backup in case of system failure;
(2) Timely printing of flight progress strips well before aircraft entry into an ATS Unit area of responsibility (AoR);
(3) Adequate training of Air Traffic Controllers and operators in human machine interfaces including interaction with directly displayed information and lower-level information that needs to be retrieved from other sources, general use of system controls, generation and handling of strips, understanding of warning messages and particular attention to inadvertent closing of displays and processing systems;
(4) Arrangements for procedural control and separation in case of FDPS failure (including Training on Unusual Circumstances and Emergencies (TRUCE) …etc.);
(5) Inadequate changes to flight plan/routing information to an ATS Unit;
(6) Adequate alerting and sharing of information on VFR flights to all relevant ATC units, in case systems only forward IFR related data;
(7) Incorrect assumption of wake vortex category if aircraft type is not recognised by the system;
(8) Two flight plans in the system for the same flight;
(9) Incorrect identification of aircraft types;
(10) Mixing of messages between aircraft relating to two aircraft messages being received or input at the same time;
(11) Planned outages or maintenance not being synchronised with unusual circumstances such as bad weather and flight delays to numerous aircraft;
(12) Inadequate Service Level Agreements (SLA) with external (e.g. aerodrome operator) stakeholders affecting related devices such as connections resulting in unserviceability of systems/links and hence a need for manual intervention;
(13) Ability of flight progress strips to display sufficient information or provision of easy access to additional information (strip message space limited).

VI. Flight Plans management.

(a) For ATS Units having the capability and responsibility for flight plans management, the FDPS and EFPS Systems must ensure adequate checking of data format, data conventions and accuracy and must indicate acceptance of flight plans.

(b) The FDPS and EFPS must ensure:

(1) adequate communications between all affected ATS Units, and stakeholders;
(2) Changes to flight plans are communicated adequately to all stakeholders to ensure safe conduct of flights;

(c) The use of FDPS and EFPS must be supported by appropriate working methods and operating procedures that comply with the following ICAO provisions:

(1) Chapter 3, paragraph 3.3 (Flight Plans) of ICAO Annex 2 – Rules of the Air;
(2) Chapter 4, paragraph 4 (Flight Plan), and Chapter 11, paragraph 11.4.2.2. (Filed flight plan messages and associated update messages) of ICAO PANS-ATM Doc 4444;
(3) Chapter 2 (Flight Plans), and Chapter 6, paragraph 6.12 (ATS Messages) of Regional Supplementary Procedures, Doc 7030/5 – MID/ASIA.

VII. Flight Data Exchange between ATC Units using Automatic Systems.

(a) The flight data exchange between ATC Units using automatic systems must comply with the conformity and verification requirements of the interoperability specifications. At least, the following aspects must be considered to derive systems specifications and testing scheme:

(1) Information contents and handling;
(2) Warnings of failures and anomalies;
(3) Recording of data;
(4) Data updates and change input arrangements;
(5) Transfer communications;
(6) Quality of service and data including availability, reliability, data security and integrity;
(7) Processing times;
(8) Providing a simulated operational and technical environment that reflects the operational environment;
(9) Assessment of Conformity or Suitability for Use of Constituents and Verification of Systems.

(b) The FDPS and EFPS Systems used by ATC units must comply with the Interoperability standards and use a protocol for electronic communication comprising message formats, their encoding for interchange and sequence rules used for the information exchanges between flight data processing systems that comply with the specifications prescribed in ICAO Manual on Detailed

Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols (Doc 9880), Part II, ICAO Manual of Air Traffic Services Data Link Applications (Doc–9694), and operational communication– between ATS unit computer systems defined in ICAO Doc 4444, Procedures for Air Navigation Services - Air Traffic Management, Appendix 6 - ATS Interfacility Data Communications (AIDC) Messages.

(c) The specifications and testing scheme of automatic ATS Interfacility Data exchange systems must, at least, consider, the following aspects:

(1) Each flight message transfer must have an identifier;
(2) An identification function must ensure that communications for flight message transfer can take place only between authorised entities;
(3) A connection management function must establish and release connections between entities ensuring that flight data transfer can be achieved only during the lifetime of a connection;
(4) A data transfer function must send and receive flight data messages between connected entities;
(5) A monitoring function must verify the continuity of service of a connection between entities for flight message transfer; and
(6) All functions exchanged of flight messages between entities must use Transmission Control Protocol as prescribed in paragraph (b).

VIII. Clocks.

Each control position must have a visible clock. However, for dedicated control position(s) used by assistant controllers, one clock may be installed between the executive and the assistant control positions. The UTC time must be used for this clock showing hours, minutes, and seconds with an accuracy within ±15 seconds per day.

IX. Aeronautical Ground Lighting (AGL) Control and Monitoring Equipment.

(a) The AGL Control and Monitoring System must enable the selection of the required display of lights and provide an indication of the lights displayed to the aerodrome control position.

(b) An indication, easily visible from the aerodrome control position(s), showing the actual serviceability status of AGL services (as opposed to the switch position), must be provided. The equipment must indicate when failure or abnormal operation of the AGL service selected for use falls

below levels required by the aerodrome certificate. These levels are outlined in GACAR Part 139.

(c) The serviceability status information required to be passed to pilots must be readily established from the indications visible from the aerodrome control position(s).

Note: GACAR Part 139 (Ref. ICAO Annex 14 - Volume I) describes the technical requirements for AGL control and monitoring equipment.

(d) Software related aspects of an AGL Control Monitoring System at ATC units must comply with international standards related to Software Safety Assurance in ATS Equipment.

Note: The IEC 61508 Part 3 and RTCA DO178-B/EUROCAE ED12-B are international software assurance standards and guidelines that can be used to provide evidence on compliance with Software Safety Assurance in ATS Equipment requirements. A statement or declaration by the manufacturer on the compliance with these standards in the software development and validation is an acceptable means of compliance.

X.Visual Signalling.

A signal lamp with interchangeable coloured lenses (white, red and green) and spare bulb must be provided at each conventional or remote aerodrome ATS tower and must be accessible to the air traffic controller or AFISO. The lamp must enable control of aerodrome traffic as laid down in ATSPM Part 1 required under GACAR Part 171. The light must be visible from all points of the manoeuvring area and from all points within the aerodrome visual circuit.

Note: Shining the lamp through tinted glass or blinds can affect the perceived colour of the signal.

XI. Emergency Services Alerting.

(a) An audible method of alerting airfield emergency services or fire station must be provided at conventional or remote aerodrome ATS Tower as a primary means of emergency call out. A standby means of alerting airfield emergency services, independent of the primary method, must be identified in accordance with GACAR Part 139 requirements.

(b) A means of communicating with other emergency services must be provided.

(c) Check-lists of actions to be carried out in the event of an emergency (one check-list for each category of emergency) must be provided. These are to be easily accessible to the air traffic

controllers or AFISOs likely to use them.

A.6 - AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

I. General.

(a) The purpose of an Automatic Terminal Information Service (ATIS) is to reduce Air Traffic Control (ATC) workload by means other than the controller's VHF air-ground communications frequency to convey current and routine meteorological and aerodrome information to aircraft. ATIS may be implemented by Voice-ATIS and data link (D-ATIS).
An aerodrome Voice-ATIS may be provided by the ATS provider, using either a dedicated VHF transmitter or a CVOR/DVOR transmitter. A D-ATIS may be provided by the ATS provider, in conjunction with a data link communication, using a VDL ground station network or by satellite.

(b) In the KSA ATIS is provided as an additional Flight Information Service in association with an Air Traffic Control Service authorized under GACAR Part 171.

(c) This appendix sets out the engineering requirements for Voice-ATIS and D-ATIS used within the Kingdom of Saudi Arabia in support of an Air Traffic Control Service. For the purpose of this section, ATIS is only considered to include the collation of meteorological and aerodrome data, the preparation of messages and the transmission of the messages.

(d) The Automatic Terminal Information Service (ATIS/D-ATIS) equipment and systems must provide complete, identified, accurate and uncorrupted voice / data communication of meteorological and other aeronautical information.

II. Interface to Voice / Data Recording Equipment.

(a) The equipment and systems used in the provision of a Voice-ATIS or D-ATIS must provide all the necessary signals and information to the Voice/Data Recording Equipment in compliance with the provision of Annex A1.1 to this Appendix.

(b) Appropriate material relating to the operation of the ATIS must be written for inclusion in the ATSPM required for ATS providers under GACAR Part 171.

III. Voice-ATIS and D-ATIS.

(a) The ATIS message must relate to a single aerodrome.

(b) The ATIS message must be updated immediately when a significant change occurs.

(c) The preparation and dissemination of the ATIS message must be the responsibility of the ATS provider authorized under GACAR Part 171.

(d) Individual ATIS messages must be identified by a letter designator from the ICAO spelling alphabet assigned consecutively in alphabetical order.

(e) Voice-ATIS must only be provided in association with an air traffic control service.

(f) Voice-ATIS must be provided at aerodromes where there is an operational requirement to reduce ATC VHF air-ground communications workload.

Note: The provision of a Voice-ATIS may be limited by the availability of discrete VHF frequencies which are in short supply.

(g) Voice-ATIS broadcasts must comprise one or more of the following:

(1) One broadcast for arriving aircraft;
(2) One broadcast for departing aircraft;
(3) One broadcast for arriving and departing aircraft;
(4) Two separate broadcasts for arriving and departing aircraft where the combined broadcast would be excessively long.

(h) Voice-ATIS must be provided on a discrete VHF frequency whenever practicable.

(i) When a discrete VHF frequency is not available, Voice-ATIS may be provided on the most appropriate terminal navigation aid.

(j) Voice-ATIS broadcasts, when provided, must be continuous and repetitive.

(k) Where D-ATIS is provided alongside the existing availability of Voice-ATIS, the content and format of the information must be identical.

(l) Where D-ATIS is provided alongside the existing availability of Voice-ATIS, when the ATIS requires updating, the Voice-ATIS and D-ATIS must be updated simultaneously.

(m) Where D-ATIS broadcast includes real time meteorological information, which is within the parameters of the significant change criteria reference of ICAO Annex 3, the content must be considered identical for the purpose of maintaining the same designator.

Note: It is likely that interface arrangements will need to be established between the ATS provider, operating the aerodrome Voice-ATIS, and the D-ATIS data link provider to ensure compliance with the requirements of ATIS Voice.

IV. Collation of Meteorological and Aerodrome Data.

(a) The meteorological data used in the preparation of ATIS messages must be sourced from a MET services provider authorized under GACAR Part 179.

(b) The meteorological data must be extracted from the local meteorological routine or special report.

(c) Where rapidly changing meteorological conditions preclude the inclusion of a weather report, the ATIS message must contain information that the relevant weather information will be given on initial contact with the Air Traffic Control Unit.

(d) The ATS provider must ensure that the accuracy and integrity of the data used in the preparation of the ATIS message is maintained at a level appropriate to the operational requirements.

V. Preparation of Messages.

(a) Where the Voice-ATIS broadcast messages are not prepared by the aerodrome ATC Unit, the organization responsible for this task must immediately make known the information contained in the current broadcast to the ATC Unit.

(b) Voice-ATIS broadcasts must be prepared in the English language.

(c) The message contents must contain the elements of information as defined under GACAR Part 171 in the order prescribed.

VI. Transmission of Messages Voice-ATIS CVOR/DVOR Transmitter.

The Designated Operational Coverage and frequency assignment terms and conditions must be consistent with both the CVOR/DVOR and Voice-ATIS operational requirements. Radio coverage problems may be found if the CVOR/DVOR is not located on or near the aerodrome providing the Voice-ATIS.

VII. Broadcast of Auto METAR.

(a) Broadcast of Auto METAR, utilizing an Automatic Terminal Information Service (ATIS) frequency, must be in conformity with the requirements prescribed in GACAR Part 179 and may be approved for use only at aerodromes where an ATIS facility has been approved and when the ATC Watch is closed. The Designated Operational Coverage of the ATIS frequency must be valid for the Auto METAR broadcast.

(b) The weather report (METAR) must be prefixed with the word ‘AUTO’ and only the METAR information must be included in the broadcast.

A.7– UHF RADIO EQUIPMENT AND SYSTEMS

I. General.

(a) This appendix sets out the engineering requirements for UHF radio equipment and systems at Base Stations and Land Mobile Stations established or used within the Kingdom of Saudi Arabia in support of Air Traffic Services Ground to Ground Communications at aerodromes.

(b) The provisions of this appendix apply to the equipment categories of fixed (Base Station), vehicle, portable and handheld (Land Mobile Station) comprising equipment types of transmitter, receiver (Base Station) and transceiver (Land Mobile Station).

(c) The provisions of this appendix apply to UHF radio equipment and systems operating on frequency assigned in the UHF Land Mobile Service allocation 450 MHz to 470 MHz, using Frequency Modulation (FM) with 12.5 kHz channel spacing, for analogue voice communications.

(d) The UHF radio equipment and systems must provide complete, identified, accurate and uncorrupted voice communications for Air Traffic Services Ground to Ground Communications.

(e) The equipment, systems, services and facilities must comply with the applicable international

standards, recommended practices and procedures for air navigation services.

(f) The equipment, systems, services and facilities must comply with the applicable Radio Regulations of the International Telecommunications Union.

(g) Two-way radiotelephony communication facilities must be provided for aerodrome (surface movement) control service for controlling vehicles on the manoeuvring area, except where communication by a system of visual signals is deemed to be adequate.

II. Radio Spectrum Management.

(a) The equipment and systems must be designed and constructed to operate within the Land Mobile Service allocation 450 MHz to 470 MHz with a channel spacing of 12.5 kHz using Frequency Modulation (FM) with ITU emission designator 11K0F3EJN using semi-duplex operation.

Note: The Base Station equipment uses duplex operation, and the Land Mobile Station equipment uses simplex operation.

(b) The equipment and systems must be installed, operated and maintained in compliance with the terms of specific location dependent or general frequency assignment(s) and the operational requirements of the Air Traffic Services Ground to Ground Communications being provided.

Note: All new Aeronautical Radio Stations must have been assessed as fit for purpose of the provision of air traffic services before a radio license can be issued.

(c) UHF Radio Equipment and Systems must comply with the International Standards.

III. Communications Availability.

The design, installation, operation and maintenance of equipment and systems must be such as to ensure an availability of communications appropriate for the air traffic services being provided.

IV. Radio System Design.

(a) Communications of a specified quality of service must be provided within the radio service area appropriate to the services being provided.

(b) The antennas must be installed such as to provide vertically polarized emissions.

V. Equipment Configuration.

The equipment configuration must be such as to ensure the availability of communications appropriate to the service being provided.

Note: The configuration of equipment includes associated antennas, cables, filters, and other equipment necessary for the operation of the equipment and systems.

Note: Main and Standby equipment may be operated as 'System A' and 'System B' where either may be considered as Main while in operational service and the other is considered as Standby, awaiting selection in the event of failure of the Main equipment or when the Main equipment is taken out of service for maintenance.

VI. Power Supply.

(a) For an Air Traffic Control Service, the power supply for the emergency equipment must be independent of that for the main equipment.

(b) Users must be provided with an indication of failure of the power supply to the emergency equipment. Each ATS provider authorized under GACAR Part 171 must ensure that instructions are provided in Part 2 of the ATS manual for user actions in the event of failure.

(c) For an Air Traffic Control Service, a primary and alternative power supply must be provided to increase the availability of power to equipment and systems in the event of an interruption to one of the power supplies. Change over between supplies should be on a 'no break' basis. The primary and alternative supplies should be independent of each other for a known period of time.

VII. Alarm / Status Indications.

(a) For an Air Traffic Control Service, the system must provide an indication of system failure that may have an effect on the service being provided, in a timely manner, so that actions can be taken to ensure the safe continued provision of an ATC Service or if necessary, the controlled withdrawal of the service.

(b) The Significance to the user of the indication of failure must be obvious from the indication given.

VIII. Interface to Voice/Data Recording Equipment.

(a) The equipment and systems at the Base Station must provide all the necessary signals and information to the Voice/Data Recording Equipment in compliance with the provisions of Annex A1.1 to this Appendix.

(b) Automatic recording facilities must be provided on communications channels used for the control of vehicles on the manoeuvring area.

IX. Unintentional or Continuous Transmissions.

The equipment and systems at Aeronautical Radio Stations must not fail in a manner such as to cause unintentional or continuous transmissions.

A.8– SATELLITE VOICE COMMUNICATION (SATVOICE) SYSTEM

Note. — Guidance material for the implementation of the aeronautical mobile satellite service is contained in the Manual on the Aeronautical Mobile Satellite (Route) Service (Doc 9925). Additional guidance for SATVOICE systems is contained in the Satellite Voice Operations Manual (Doc 10038), and the Performance-based Communication and Surveillance (PBCS) Manual (Doc 9869).

I. SATVOICE system characteristics.

(a) For ground-to-air calls, the SATVOICE system must be capable of contacting the aircraft and enabling the ground party/system to provide, as a minimum, the following:

(1) secure calling;
(2) priority level as defined in Table 1 below; and
(3) aircraft SATVOICE number, which is the aircraft address expressed as an 8-digit octal number.

(b) For ground-to-air calls, the SATVOICE system must be capable of locating the aircraft in the appropriate airspace regardless of the satellite and ground earth station (GES) to which the aircraft is logged on.

(c) For air-to-ground calls, the SATVOICE system must be capable of:

(1) contacting the aeronautical station via an assigned SATVOICE number, which is a unique 6-digit number or public switched telephone network (PSTN) number; and
(2) allowing the flight crew and/or aircraft system to specify the priority level for the call as defined in Table 1 below.

Table 1. Priority levels for SATVOICE calls (air-to-ground/ground-to-air)

Priority level	Application category
1 / EMG / Q15 Emergency (highest) Safety of flight	Distress and urgency. For use by flight crew, when appropriate.
2 / HGH / Q12 Operational high (second highest) Safety of flight	Flight safety. Typically assigned to calls between aircraft and ANSPs.
3 / LOW / Q10 Operational low (third highest) Safety of flight	Regularity of flight, meteorological, administrative. Typically assigned to calls between aircraft operators and their aircraft.
4 / PUB / Q9 Non-operational (lowest) Non safety	Public correspondence.

A.9– AERONAUTICAL MOBILE SERVICE — DATA LINK COMMUNICATIONS

I. General

Note. — Guidance material relating to CPDLC, ADS-C and related data link initiation capability (DLIC) can be found in the Global Operational Data Link (GOLD) Manual (Doc 10037).

II. DATA LINK INITIATION CAPABILITY (DLIC)

(a) Before entering an airspace where data link applications are used by an ATS unit, data link communications must be initiated between the aircraft and the ATS unit in order to register the aircraft and, when necessary, allow the start of a data link application. This must be initiated by the aircraft, either automatically or by the pilot, or by the ATS unit on address forwarding.

(b) The logon address associated with an ATS unit must be published in the Aeronautical Information Publications in accordance with Annex 15.

Note 1. — Jeddah FIR may have one or multiple logon addresses

Note 2.— Detailed specifications concerning aeronautical information publications presentation and contents are contained in the Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM, Doc 10066), Appendix 2.

III. AIRCRAFT INITIATION

On receipt of a valid data link initiation request from an aircraft approaching or within a data link service area, the ATS unit must accept the request and, if able to correlate it with a flight plan, must establish a connection with the aircraft.

IV. ATS UNIT FORWARDING

The ground system initially contacted by the aircraft must provide to the next ATS unit any relevant updated aircraft information in sufficient time to permit the establishment of data link communications.

V. FAILURE

(a) In the case of a data link initiation failure, the data link system must provide an indication of the failure to the appropriate ATS unit(s). The data link system must also provide an indication of the

failure to the flight crew when a data link initiation failure results from a logon initiated by the flight crew.

Note.— When the aircraft's logon request results from responding to a contact request by a transferring ATS unit, then both ATS units will receive the indication.

(b) The Air Traffic Service Provider must establish procedures to resolve, as soon as practicable, data link initiation failures. Procedures must include, as a minimum, verifying that the aircraft is initiating a data link request with the appropriate ATS unit (i.e., the aircraft is approaching or within the ATS unit's control area); and if so:

(1) when a flight plan is available, verify that the aircraft identification, aircraft registration, or aircraft address and other details contained in the data link initiation request correspond with details in the flight plan, and where differences are detected verify the correct information and then make the necessary changes; or
(2) when a flight plan is not available, create a flight plan with sufficient information in the flight data processing system, to achieve a successful data link initiation; then
(3) arrange for the re-initiation of data link.

(c) The aeronautical Telecommunication Services Provider must publish aeronautical information on, data link initiation failure procedures. These procedures must include, as a minimum, that the pilot:

(1) verify the correctness and consistency of the flight plan information available in the FMS or equipment from which data link is initiated, and where differences are detected make the necessary changes; and
(2) verify the correct address of the ATS unit; then
(3) re-initiate data link.

VI. COMPOSITION OF DATA LINK MESSAGES

(a) The text of messages must be composed in standard message format (e.g., CPDLC message set), in plain language or in abbreviations and codes. Plain language must be avoided when the length of the text can be reduced by using appropriate abbreviations and codes. Non-essential words and phrases, such as expressions of politeness, must not be used.

(b) The following characters and signs are allowed in the composition of messages:

Letters:	ABCDEFGHIJKLMNOPQRSTUVWXYZ (upper case only)
Figures:	1 2 3 4 5 6 7 8 9 0
Other signs:	- (hyphen) ? (questionmark) : (colon) ((open bracket)) (close bracket) . (full stop, period,ordecimalpoint) , (comma) ’ (apostrophe) = (double hyphen or equal sign) / (oblique) + (plus sign) and the space character.

(c) The Characters and signs other than those listed above must not be used in messages.

(d) The roman numerals must not be employed. If the originator of a message wishes the addressee to be informed that Roman figures are intended, the Arabic figure or figures must be written and preceded by the word ROMAN.

VII. Display of data link messages

(a) Ground and airborne systems must allow for messages to be appropriately displayed, printed when required, and stored in a manner that permits timely and convenient retrieval should such

action be necessary.

(b) Whenever textual presentation is required, the English language must be displayed as a minimum.

VIII. CPDLC PROCEDURES

Note.— The CPDLC message set referred to in this section can be found in ICAO PANS-ATM, Doc 44444 Appendix 5.

(a) In all communications the highest standard of discipline must be observed at all times.

(b) Consequences of human performance, which could affect the accurate reception and comprehension of messages, must be taken into consideration when composing a message.

Note.— Guidance material on human performance can be found in the Human Factors Training Manual (Doc 9683) and Human Factors Guidelines for Air Traffic Management (ATM) Systems (Doc 9758).

(c) Ground and airborne systems must provide controllers and pilots with the capability to review and validate any operational messages they send.

(d) Ground and airborne systems must provide controllers and pilots with the capability to review, validate and when applicable, acknowledge any operational messages they receive.

(e) The controller must be provided with the capability to respond to messages, including emergencies, to issue clearances, instructions and advisories, and to request and provide information, as appropriate.

(f) The pilot must be provided with the capability to respond to messages, to request clearances and information, to report information, and to declare or cancel an emergency.

(g) The pilot and the controller must be provided with the capability to exchange messages which include standard message elements, free text message elements or a combination of both.

(h) Unless specified by the Air traffic Service provider, voice read-back of CPDLC messages must not be required.

IX. Establishment of CPDLC

(a) The controller and the pilot must be informed when CPDLC has been successfully established.

(b) CPDLC must be established in sufficient time to ensure that the aircraft is communicating with the appropriate ATC unit.

(c) The controller and pilot must be informed when CPDLC is available for operational use, at initial establishment, as well as on resumption of CPDLC after a failure.

(d) The pilot must be able to identify the air traffic control unit providing the air traffic control service at any time while the service is being provided.

(e) When the airborne system detects that CPDLC is available for operational use, it must send the CPDLC downlink message element CURRENT DATA AUTHORITY.

X. AIRBORNE-INITIATED CPDLC

(a) When an ATC unit receives an unexpected request for CPDLC from an aircraft, the circumstances leading to the request must be obtained from the aircraft to determine further action.

(b) When the ATC unit rejects a request for CPDLC, it must provide the pilot with the reason for the rejection using an appropriate CPDLC message.

XI. ATC UNIT-INITIATED CPDLC

(a) An ATC unit must only establish CPDLC with an aircraft if the aircraft has no CPDLC link established, or when authorized by the ATC unit currently having CPDLC established with the aircraft.

(b) When a request for CPDLC is rejected by an aircraft, the reason for the rejection must be provided using CPDLC downlink message element NOT CURRENT DATA AUTHORITY or message element NOT AUTHORIZED NEXT DATA AUTHORITY, as appropriate. Local procedures must dictate whether the reason for rejection is presented to the controller. No other reasons for airborne rejection of ATC unit-initiation of CPDLC must be permitted.

XII. Exchange of operational CPDLC messages

(a) Controllers and pilots must construct CPDLC messages using standard message elements, free text message elements or a combination of both.

(b) When CPDLC is being used, and the intent of the message is included in the CPDLC message set contained in the PANS-ATM, Appendix 5, the associated standard message elements must be used.

(c) Except as provided by in section XVI (a) below, when a controller or pilot communicates via CPDLC, the response must be via CPDLC. When a controller or pilot communicates via voice, the response must be via voice.

(d) Whenever a correction to a message sent via CPDLC is deemed necessary or the contents of a message needs to be clarified, the controller or pilot must use the most appropriate means available for issuing the correct details or for providing clarification.

Note. — The following procedures may be applied by the controller, in terms of correcting clearances, instructions or information, or by a pilot, in terms of correcting a reply to an uplink message or correcting previously advised requests or information.

(e) When voice communications are used to correct a CPDLC message for which no operational response has yet been received, the controller's or pilot's transmission must be prefaced by the phrase: "DISREGARD CPDLC (message type) MESSAGE, BREAK" — followed by the correct clearance, instruction, information or request.

Note.— It is possible that, at the time the voice communicated clarification is transmitted, the CPDLC message being referred to has not yet reached the recipient, or has reached the recipient but has not been acted upon, or has reached the recipient and has been acted upon.

(f) When referring to and identifying the CPDLC message to be disregarded, caution should be exercised in its phrasing so as to avoid any ambiguity with the issuance of the accompanying corrected clearance, instruction, information or request.

Note. — For example, if SVA445, maintaining FL290, had been instructed via CPDLC to climb to FL350, and the controller needs to correct the clearance utilizing voice communications, the following phrase might be used: "Flight call sign" DISREGARD CPDLC CLIMB CLEARANCE MESSAGE, BREAK, CLIMB TO FL310.

(g) If a CPDLC message that requires an operational response is subsequently negotiated via voice, an appropriate CPDLC message closure response must be sent to ensure proper synchronization of the CPDLC dialogue. This could be achieved either by explicitly instructing the recipient of the message via voice to close the dialogue or by allowing the system to automatically close the dialogue.

(h) The composition of a CPDLC message must not exceed five message elements, only two of which may contain the route clearance variable.

(i) The use of long messages or messages with multiple clearance elements, multiple clearance request elements or messages with a combination of clearances and information must be avoided where possible.

Note. — Guidance material on the development of local operating procedures and CPDLC good operating technique can be found in the Human Factors Guidelines for Air Traffic Management (ATM) Systems (Doc 9758).

(j) CPDLC ground systems and airborne systems must be capable of using the CPDLC message alert attributes in order to draw attention to higher priority messages.

Note. — Message attributes dictate certain message handling requirements for the CPDLC user receiving a message. Each CPDLC message has two attributes: alert and response attributes. When a message contains multiple message elements, the highest precedence message element attribute type becomes the attribute type for the entire message.

(k) The alert attribute must delineate the type of alerting required upon message receipt. Alert types are presented in Table 1.

(l) The response attribute must delineate valid responses for a given message element. Response types are presented in Table 2 for uplink messages and Table 3 for downlink messages.

Table **1. Alert Attribute (Uplink and Downlink)**

Type	*Description*	*Precedence*
H	High	1
M	Medium	2
L	Low	3
N	No Alerting required	4

Table -2. Response Attribute (Uplink)

Type	*Response required*	*Valid responses*	*Precedence*
W/U	Yes	WILCO, UNABLE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR	1
A/N	Yes	AFFIRM, NEGATIVE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR	2
R	Yes	ROGER, UNABLE, STANDBY, NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, LOGICAL ACKNOWLEDGEMENT (only if required), ERROR	3

Type	*Response required*	*Valid responses*	*Precedence*
Y	Yes	Any CPDLC downlink message, LOGICAL ACKNOWLEDGEMENT (only if required)	4
N	No, unless logical acknowledgement required	LOGICAL ACKNOWLEDGEMENT (only if required), NOT CURRENT DATA AUTHORITY, NOT AUTHORIZED NEXT DATA AUTHORITY, ERROR	5

Table 3. Response Attribute (Downlink)

Type	*Response required*	*Valid responses*	*Precedence*
Y	Yes	Any CPDLC uplink message, LOGICAL ACKNOWLEDGEMENT (only if required)	1
N	No, unless logical acknowledgement required	LOGICAL ACKNOWLEDGEMENT (only if required), MESSAGE NOT SUPPORTED BY THIS ATC UNIT, ERROR	2

(a) When a multi-element message requires a response, the response must apply to all message elements.

Note. — For example, a multi-element message containing CLIMB TO FL310 MAINTAIN MACH.84, a WILCO response applies to, and indicates compliance with, both elements of the message.

(b) When a single message element clearance or any part of a multi-element clearance message cannot be complied with, the pilot must send an UNABLE response for the whole message.

(c) The controller must respond with an UNABLE message that applies to all elements of the request when no element(s) of a single or multi-element clearance request can be approved. The current clearance(s) must not be restated.

(d) When a multi-element clearance request can only be partially accommodated, the controller must respond with an UNABLE message applying to all the message elements of the request and, if appropriate, include a reason and/or information on when a clearance may be expected.

Note. — A separate CPDLC message (or messages) may subsequently be transmitted to respond to those elements that can be accommodated.

(e) When all elements of a single or multi-element clearance request can be accommodated, the controller must respond with clearances corresponding to each element of the request. This response must be a single uplink message.

Note. — For example, while messages containing multi-element clearance requests are to be avoided, a multi-element downlink message containing the indicated message elements:

REQUEST CLEARANCE YQM YYG YYT YQX TRACK X EINN EDDF REQUEST CLIMB TO FL350 REQUEST MACH 0.84

could be responded to with

CLEARED YQM YYG YYT YQX TRACK X EINN EDDF CLIMB TO FL350
REPORT MAINTAINING
CROSS YYG AT OR AFTER 1150 NO SPEED RESTRICTION.

(f) When a CPDLC message contains more than one message element and the response attribute for the message is Y, when utilized, the single response message must contain the corresponding number of replies in the same order.

Note. — For example, a multi-element uplink message containing:

CONFIRM SQUAWK WHEN YOU CAN ACCEPT FL410

could be responded to with

SQUAWKING 5525 WE CAN ACCEPT FL410 AT 1636Z.

(g) When a ground or airborne system generates the CPDLC message ERROR, the reason for the error must be included in the message.

(h) The appropriate ATS Authority must select those message elements contained in ICAO PANS-ATM (Doc 4444), Appendix 5 that support operations in their airspace. Should an ATS provider choose to select a subset of the message elements, and a received message does not belong to this subset, the ATC unit must respond by uplinking the message element MESSAGE NOT SUPPORTED BY THIS ATC UNIT.

Note. — Further processing of the received message is not required.

(i) Only the uplink messages appropriate to a particular control sector's operation must be provided to the controller.

Note. — The CPDLC message set contained in the PANS-ATM, Appendix 5 was developed to encompass different air traffic management environments.

(j) Information concerning CPDLC message elements subset utilized must be published in the Aeronautical Information Publications (AIPs).

XIII. TRANSFER OF CPDLC

Note. — Details on CPDLC transfer can be found in the Manual of Air Traffic Services Data Link Applications (Doc 9694).

(a) When CPDLC is transferred, the transfer of voice communications and CPDLC must commence concurrently.

(b) When an aircraft is transferred from an ATC unit where CPDLC is available to an ATC unit where CPDLC is not available, CPDLC termination must commence concurrent with the transfer of voice communications.

(c) When a transfer of CPDLC results in a change of data authority, and there are still messages for which the closure response has not been received (i.e., messages outstanding), the controller transferring the CPDLC must be informed.

(d) If the controller needs to transfer the aircraft without replying to any downlink message(s) outstanding, the system must have the capability to automatically send the appropriate closure response message(s). In such cases, the contents of any automatically sent closure response

message(s) must be promulgated in local instructions.

(e) When the controller decides to transfer the aircraft without receiving pilot responses to any uplink message(s) outstanding, the ground system must have the capability to automatically end the dialogue for each message prior to the transfer.

(f) The controller must revert to voice communications to clarify any ambiguity associated with the message(s) outstanding.

(g) When a transfer of CPDLC does not result in a change of data authority, and there are still messages outstanding, these messages must either be forwarded to the appropriate controller or must be closed in accordance with local instructions and, if necessary, letters of agreement.

XIV. Display of CPDLC messages

ATC units utilizing a CPDLC message contained in the PANS-ATM must display the associated text pertaining to that message as presented in the PANS-ATM, Appendix 5.

XV. Free text message elements

(a) The use of free text message elements by controllers or pilots must be avoided.

Note.— Whilst it is recognized that non-routine and emergency situations may necessitate the use of free text, particularly when voice communication has failed, the avoidance of utilizing free text messages is intended to reduce the possibility of misinterpretation and ambiguity.

(b) When the CPDLC message set contained in the PANS-ATM (Doc 4444) does not provide for specific circumstances, the ATS provider may use free text message elements. In such cases, the ATS provider, in consultation with operators and other ATS providers, if any, that may be concerned, must define display format, intended use and attributes for each free text message element and publish them with relevant procedures in the AIPs.

(c) Free text message elements must be stored for selection within the aircraft or ground system to facilitate their use.

XVI. Emergencies, hazards and equipment failure procedures

(a) When a CPDLC emergency message is received, the controller must acknowledge receipt of the message by the most efficient means available.

(b) When responding via CPDLC to all other emergency or urgency messages, uplink message ROGER must be used.

(c) When a CPDLC message requires a logical acknowledgement and/or an operational response, and such a response is not received, the pilot or controller, as appropriate, must be alerted.

XVII. FAILURE OF CPDLC

Note 1. — Action to be taken in the event of a data link initiation failure is covered in section V.Note 2. — Action to be taken in the event of the failure of a single CPDLC message is covered in 8.2.12.6.

(a) A CPDLC failure must be detected in a timely manner.

(b) The controller and pilot must be alerted to a failure of CPDLC as soon as a failure has been detected.

(c) When a controller or pilot is alerted that CPDLC has failed, and the controller or pilot needs to communicate prior to CPDLC being restored, the controller or pilot must revert to voice, if possible, and preface the information with the phrase:

XVIII. CPDLC FAILURE.

(a) Controllers having a requirement to transmit information concerning a complete CPDLC ground system failure to all stations likely to intercept should preface such a transmission by the general call ALL STATIONS CPDLC FAILURE, followed by the identification of the calling station.

Note. — No reply is expected to such general calls unless individual stations are subsequently called to acknowledge receipt.

(b) When CPDLC fails and communications revert to voice, all CPDLC messages outstanding must be considered not delivered and the entire dialogue involving the messages outstanding must be recommenced by voice.

(c) When CPDLC fails but is restored prior to a need to revert to voice communications, all messages outstanding must be considered not delivered and the entire dialogue involving the messages outstanding must be recommenced via CPDLC.

XIX. INTENTIONAL SHUTDOWN OF CPDLC.

(a) When a system shutdown of the communications network or the CPDLC ground system is planned, a NOTAM must be published to inform all affected parties of the shutdown period and if necessary, the details of the voice communication frequencies to be used.

(b) Aircraft currently in communication with the ATC unit must be informed by voice or CPDLC of any imminent loss of CPDLC service.

(c) The controller and pilot must be provided with the capability to abort CPDLC.

XX. FAILURE OF A SINGLE CPDLC MESSAGE.

(a) When a controller or pilot is alerted that a single CPDLC message has failed, the controller or pilot must take one of the following actions, as appropriate:

(1) via voice, confirm the actions that will be undertaken with respect to the related dialogue, prefacing the information with the phrase: CPDLC MESSAGE FAILURE;
(2) via CPDLC, reissue the CPDLC message that failed.

XXI. DISCONTINUATION OF THE USE OF CPDLC PILOT REQUESTS.

(a) When a controller requires all stations or a specific flight to avoid sending CPDLC requests for a limited period of time, the following phrase must be used:

((call sign) or ALL STATIONS) STOP SENDING CPDLC REQUESTS [UNTIL ADVISED] [(reason)]

Note. — Under these circumstances, CPDLC remains available for the pilot to, if necessary, respond to messages, report information, and declare and cancel an emergency.

(b) The resumption of the normal use of CPDLC must be advised by using the following phrase:

((call sign) or ALL STATIONS) RESUME NORMAL CPDLC OPERATIONS

(c) Where the testing of CPDLC with an aircraft could affect the air traffic services being provided to the aircraft, coordination must be effected prior to such testing.

APPENDIX B TO GACAR PART 173 – RADIO NAVIGATION SYSTEMS

B.1- GENERAL REQUIREMENTS FOR ILS

I. General.

(a) The ILS provides precision guidance signals to aircraft in the last stages of approach and landing (Localizer with frequency range 108.00 to 112.00 MHz and Glide path with frequency range 328.6 to 335.4 MHz. For this purpose, the equipment needs a high level of integrity, accuracy and reliability. Other auxiliary equipment is used to support the main equipment.

(b) Instrument Landing Systems are classified as Category I, Category II or Category III, in ascending order of accuracy, integrity and reliability.

(c) This appendix sets out the minimum requirements for all categories of ILS service.

(d) The equipment must provide a complete, identified, accurate and uncorrupted source of guidance information to aircraft, with levels of integrity and continuity of service which are consistent with the category of service provided.

(e) In addition to the requirements prescribed in this appendix, Instrument Landing Systems must comply with the Standards in ICAO Annex 10, Volume 1, Chapter 2 General Provisions for Radio Navigation Aids, and Chapter 3, Section 3.1 Specification for ILS.

(f) Abbreviated requirements for putting an ILS with an established mean time between outages (MTBO) into service are prescribed in Annex B1.1 of this appendix.

II. Serviceability Indicators.

Each ATS provider authorized under GACAR Part 171 and directly responsible for ILS operations (e.g., Approach Controllers) must be provided with:

(a) Visual indications showing the serviceability status of all elements of the ILS including power supplies. The visual indications may be combined and displayed in the monitoring panel or device with three status indications: Normal/Available, Reduced/Warning or unavailable/Alarm;

(b) An audible alarm indicating when the visual indications have changed state.

III. Failure of Status Communications.

(a) Failure of status communication between the ILS equipment and the remote status indicators must cause an immediate alarm at the remote indicators.

(b) For Category II and Category III any systems failure of the status communication must not cause an immediate ILS close-down. For Category I systems, it is acceptable to consider status communication failure as part of the Continuity of Service assessment.

(c) Following failure of the status communications, only aircraft on final ILS approach must be permitted to complete the approach. Except as stated in (d), the ILS must then be withdrawn from service in accordance with a documented procedure.

(d) For Category I systems failure of the status communication, ILS may be kept in operations with close monitoring of system at site level if there is an assurance that the ILS is providing guidance information to aircraft, with required levels of integrity and continuity of service. The Aeronautical Telecommunication Services Provider must issue NOTAM on failure of the communications.

(e) If the ILS is configured to close-down the system after a delay following status communications failure, the delay must be long enough for the actions in (c) to be completed.

(f) In the event of a status communication failure for Category I systems, a suitably trained ATSEP may be stationed at the ILS building(s) with a suitable means of communication to ATC. The equipment should then operate in local control, supervised by the system monitors. The monitors must not be overridden or inhibited. ATC must be advised without delay of any change in status of the ILS.

(g) A reciprocal ILS must not be put into service until the system with faulty status communications is positively disabled and cannot accidentally radiate.

IV. Category and Status Unit.

(a) In addition to the normal remote control and other indications, Category III facilities, if any, must be fitted with a unit that accepts signals from the ILS equipment, its monitors and the runway direction switch, to automatically provide ATC with indications of the operational category of the ILS.

Note: The precise method of calculation used by the Category and Status Unit will depend on the ILS equipment from which it derives its inputs.

(b) The unit must have an integrity of the same order as that of the ILS.

(c) Any change of calculated category must cause an audible alarm to ATC.

(d) The unit must have provision to limit the maximum category output to the display.

(e) If an ILS fault causes the calculated category to fall, when the fault is cleared, the category must remain at the lower value until upgraded manually by an authorized person using a reset button or similar.

(f) The unit must only automatically upgrade the category at initial ILS equipment switch- on or runway change.

V. Interlocking.

(a) Where systems are installed at opposite ends of the same runway they must be interlocked so that only one system may radiate at any one time.

(b) The interlocking system must be such that the non-operational system cannot be switched on using either the remote or local control switches.

(c) The interlocking system must be fail-safe. If the communication link between the systems fails, it must not be possible to make the non-operational system radiate using the local or remote front panel controls.

(d) The interlocking must be considered as part of the integrity and continuity of service assessment.

VI. Provision of Standby Equipment.

(a) Category III systems must have dual equipment so that the system is 'fail operational', regardless of proven MTBO. The non-operational transmitter must radiate into a dummy load and its critical parameters must be monitored.

(b) Other categories must have standby equipment with automatic changeover.

VII. Standby Battery Power.

(a) Category II and III systems, including the remote-control equipment, interlock and status displays must be provided with a standby battery power supply. In the event of a mains power failure, this must be capable of sustaining the normal ILS operation for a minimum of 20 minutes. The standby battery required for remote control equipment, interlock and status displays may be a connection to Uninterruptible Power Supply (UPS) capable to sustain the normal ILS operation for at least the same duration.

(b) Category I facilities must have standby batteries.

(c) Each ATS provider must have a procedure for managing the withdrawal and return of the ILS from/to operational service when standby batteries are or have been in use. Consideration must be given to the designed battery capacity and the fact that discharged batteries may take a significant time to recharge to full capacity following a failure.

VIII. Localizer Back Beam.

Facilities designed to radiate a back beam are not permitted.

IX. Offset Localizers.

(a) For facility performance Category I, the localizer antenna system must be located and adjusted in accordance with Annex 10, Volume I §3.1.3.10.1, unless site constraints dictate that the antenna be offset from the centre line of the runway;

(b) The offset localizer system must be located and adjusted in accordance with the offset ILS provisions of the Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS) (Doc 8168), Volume II, and the localizer standards must be referenced to the associated fictitious threshold point.

X. Field Measurements.

(a) Localizer Alignment.

(1) For CAT I, II and III, if any, systems, alignment measurements at threshold must be taken as soon as possible after commissioning and flight inspections.

(2) For CAT I, II and III, if any, systems alignment measurements at threshold must be made at monthly intervals.
(3) For CAT III systems, if any, which provide roll out or take off guidance, measurements of bends along the runway to ILS point E must be made at commissioning and at 6 monthly intervals. The commissioning and one check per year should be conducted with an appropriate antenna height consistent with that of an aircraft antenna e.g., 3 to 8 m above the runway. The second check may be made at 15 m above the runway.

(b) Localizer Displacement Sensitivity.

(1) Displacement Sensitivity measurements must be made:

(i) No closer than half the runway length from the localizer.
(ii) Between the half and the full sector width points, provided that a proportional relationship is established between that point and the full sector width.

(2) For CAT I Localizers using 14 or less radiating elements, field measurements may be made approximately 300 meters in front of the local transmitting aerial.
(3) Displacement Sensitivity measurements must be taken as soon as possible after commissioning, and flight inspections.
(4) Displacement Sensitivity measurements must be taken at monthly intervals.

(c) Ground Measurements of Displacement Sensitivity instead of Flight Inspection.

(1) It is permissible to make routine ground measurement of Displacement Sensitivity instead of Flight Inspection.
(2) At commissioning, the displacement sensitivity must be measured by flight inspection. If the ground and air measurements differ by more than 5% the disagreement must be investigated by the aeronautical telecommunication services provider.
(3) The flight inspection must still include semi-orbits from which linearity in the course sectors can be examined.
(4) When the aeronautical telecommunication services provider wishes to use the ground measurements as standard, it must consider the following information:

(i) Position of the ground measurement points; and
(ii) Details of the equipment to be used for this measurement.

(5) The localizer displacement sensitivity must be measured at a time as near as possible to that of the flight inspection. The result of the measurement is needed by the flight inspection service provider as part of the structure measurement calculations.
(6) The measurements may be made either in DDM or μA deflection current at the measurement points. For standardization these results must be converted into localizer full sector width, i.e., the theoretical angle between the points at which 0.155 DDM would occur.
(7) Each ILS maintenance instructions prepared by the aeronautical telecommunication services provider must show the method of calculating the width angle from the ground measurements.
(8) The normal tolerances for the various categories of ILS used for ground measurements must apply the applicable values specified under Appendix B of this Part, Annex 10 Volume I, and ICAO Doc. 8071.

(d) Localizer off Course Clearance. Off course clearance is measured by flight inspection and as such there is not a requirement to measure off course clearance on the ground. Operators may wish to establish a test point in the far field to assist in checking the localizer performance before requesting a flight inspection after engineering work.

(e) Field Test Equipment. In the event of an accident or incident each aeronautical telecommunication services provider must do all that is reasonable to ascertain that the ILS is operating correctly. For this reason, all aerodromes must have equipment suitable for making field measurements available within 12 hours.

(f) Glide path Measurements. Glide path field measurements are not mandatory but would be of great help in proving equipment stability. It is recommended that monthly field checks are made on null reference and sideband reference glide paths.

(g) Field Test Points. Points at which field measurements are made must be clearly and permanently marked. These marks must not present a hazard to aircraft and must be immune to disturbance by such operations as grass cutting and snow clearance.

XI. Critical Areas.

(a) Localizer and Glide path critical areas must be clearly marked and identified. The markings must be visible day and night and must help ensure that no person or vehicle may enter the areas without the permission of air traffic control during periods of ILS Operations.

(b) Where fencing is used to mark the critical areas, the aeronautical telecommunication services provider operator must ensure the ILS continues to operate correctly.

(c) Details of the Localizer and Glide path critical areas must be included in Part 2 of the ATSPM for the ATSU, together with any appropriate procedures.

XII. Sensitive Areas.

(a) Localizer and Glide path sensitive areas must be defined based on ICAO Annex 10 Volume I Standards and Recommended Practices and relevant material contained in ICAO Doc. 8071.

(b) Details of the Localizer and Glide path Sensitive Areas must be included in Part 2 of the ATSPM for the ATSU, together with any appropriate procedures.

Note: The ICAO Annex 10 Volume I, defines in Attachment C criteria for setting ILS Critical and Sensitive Areas (CSAs). The dimensions of ILS CSAs may be defined by the system operator or manufacturer and are required for positioning of hold points/positions, and supporting the provision of Air Traffic Services., etc.

XIII. Computer Simulation.

(a) Where computer simulation is used to define an ILS sensitive area, or to support a case for a system remaining operational during construction work, the following are required:

(1) Proof that the version of software being used is the latest issue, or recent written confirmation from the software manufacturer that the version being used has no known safety related problems;
(2) Proof that the person making the simulation has received formal training in the use of the simulation program;
(3) Evidence to support that the model is suitable for the intended simulation;
(4) Evidence to support the correlation of the modeling tool with far field measurement.

(b) Due to the difficulty of simulating lattice structures such as cranes, the President may require confirmatory flight and/or ground inspections during construction work.

XIV. Use of Decommissioning Equipment.

Decommissioned equipment may be installed subject to the following conditions:

(a) The equipment must be examined by the manufacturer's quality representative or by an agent designated by the manufacturer or by Aeronautical Telecommunication Services Provider. A written declaration must state:

(1) The equipment is in a satisfactory state for further service;
(2) There are no outstanding safety-related modifications or performance issues;
(3) The recorded performance is higher or equal to the required levels (Performance history);

(b) Glide path aerials must be brand new, or factory refurbished and re-tested to the original factory test specification;

(c) All aerial feeder cables must be renewed.

XV. Grass Height.

When reducing the grass height around the Localizer and Glide path the aeronautical telecommunication services provider must consider the potential effect of grass height on navigational and visual aids.

ANNEX B1.1 – ABBREVIATED METHOD OF PUTTING AN ILS WITH AN ESTABLISHED MEAN TIME BETWEEN OUTAGES (MTBO) INTO SERVICE

I. Eligibility Conditions.

(a) The manufacturer’s calculated MTBO must meet applicable ICAO Annex 10 SARPs with a defined confidence level.

(b) In service MTBO data must comply with applicable ICAO Annex 10 SARPs with a defined confidence level.

(c) The system(s) considered as part of the In Service MTBO assessment must be identical system(s)and cover the range of environmental conditions encountered in the KSA.

(d) The systems are installed and maintained to acceptable standards (e.g., manufacturer's installation and commissioning specifications).

(e) Each aeronautical telecommunication services provider must ensure that the organization making the installation has a good quality record and can provide evidence of staff competence.

II. Requirements.

if the eligibility conditions, specified under the previous section, are satisfied, each aeronautical telecommunication services provider must:

(a) carry out all the necessary tests. e.g., commissioning, site acceptance and flight inspection.

(b) run the ILS system continuously for 24 hours for CAT I and 300 Hours for CAT II/III, on either transmitter in the case of dual equipment.

(c) If there are no outages, put into service the ILS system at the appropriate Category.

(d) start continuous MTBO monitoring, initializing the figures for:

(1) CAT I Localizer and Glide path at 1250 hours
(2) CAT II/III Localizer at 5000 hours. (3) CAT II/III Glide Path at 2500 hours.

(e) continue to monitor MTBO using normal processes. A confidence level of 60% may be used.

Note: "Outage" in these calculations means a total unplanned loss of signal due to a fault. Automatic changeover to the standby transmitter, after a fixed delay in accordance with Annex 10 requirements, is not classed as a failure.

B.2 - ILS RADIO NOISE MONITORING

I. General.

This appendix sets out the minimum requirements for ILS equipment and systems. This appendix is based upon those relevant and applicable ICAO standards and Recommended Practices and it is applicable to all ILS localizers operated as facility performance Category II or Category III.

II. Equipment Requirements.

Note: Throughout this requirement, all references to signal voltages are the voltages measured at the aerial when terminated with 50 Ω. When calibrating the equipment, due allowance must be made for cable losses.

(a) Automatic Scanning must permit ability to bypass up to 5 channels.

(b) Frequency range must be for 108.00 - 112.00 MHz.

(c) Frequency tolerance must be ± 0.005%.

(d) Channel spacing must be 50 kHz.

(e) The 3dB bandwidth must be between ±10 and ±15 kHz. The exact figure must be stated as it is required for analysis calculations.

(f) Receiver sensitivity must be 2µV for 10dB (signal + noise)/noise ratio at 50% Mod AM or FM deviation 30% of IF bandwidth.

(g) The standard detector must be for amplitude modulation. For normal monitoring this detector must provide the output to the audio storage device.

(h) The minimum 3dB bandwidth of the receiver and recording equipment must be 300 to 3,400 Hz.

(i) The receiver must provide adequate immunity to interference from two-signal third order inter modulation products caused by signals outside the band being examined.

(j) The receiver must measure signal strengths in the range 2µV to 100µV.

(k) The receiver must be capable of detecting modulation when the signal strength is in the range 2µV to 1000µV.

(l) Interval between successive scans must be between 1 and 2 minutes when no modulation is being recorded. This figure must be quoted since it will be required for the analysis of data. In other cases, the total scan time will be determined by the recording time.

(m) Scanning dwell time on each channel.

(1) For signals greater than Threshold 1 but less than Threshold 2: The receiver must dwell on the channel long enough to allow the time, channel number and signal strength to be logged.
(2) For signals greater than Threshold 2: The receiver must dwell on the channel long enough to allow the time, channel number and signal strength to be logged, and for demodulated audio signals to be recorded.

(n) When a signal exceeds threshold 2, the demodulated audio signal must be recorded for a continuous period of approximately 20 seconds.

Note: To save recording space, if 10 successive scans have found the same channel with a signal exceeding Threshold 2, modulation recording of that channel may be terminated and only the signal strength need be logged.

(o) Channels to be examined at each scan must include all except the operational Localizer frequency or frequencies.

Note: If a continuous carrier is detected on one or more of the channels being examined, the scanning may step over those channels provided that the presence of the carrier on that channel has been recorded.

(p) If the equipment can also record interference events on the operational channel. Details must be provided of:

(1) The mask used to remove the ILS signal.
(2) The threshold levels used for the noise measurement.

(q) Threshold levels.

(1) Threshold 1 must be adjustable over the range 2µV to 10µV.
(2) Threshold 2 must be adjustable over the range 10 to 20µV.

(r) Aerial horizontal response must be omnidirectional.

(s) Aerial polarization must be horizontal.

(t) Channel occupancy data must be sent either directly to a printer or stored on computer disk or both.

(u) Modulation information must be stored on a suitable audio recording device.

Note: Suitable audio devices include such media as standard audio cassettes and solid-state digital storage.

(v) The results must be stored in a format which will facilitate further analysis.

III. Calibration.

(a) Documented calibration procedures must be applied to all equipment involved in the measurement of radio noise level. All equipment and standards used in the calibration process must have traceability to national or international standards.

(b) When any equipment used is claimed to be self-calibrating, the internal processes involved must be clearly defined. This involves showing how the equipment's internal standard is applied to each of the parameters which it can measure or generate. The internal standard must have traceability to national or international standards.

(c) Calibration intervals must be stated in the calibration records. Evidence must be available to support the quoted calibration intervals.

IV. Standard Settings.

For normal operation, threshold settings must be:

(a) Threshold 1 4.5µV

(b) Threshold 2 13µV

V. Data to be Recorded.

(a) For each scan across the frequency band, when any signal exceeds threshold 1, the following parameters must be recorded:

(1) The date and time.

(2) The frequency or channel number of each channel having a signal exceeding threshold 1. (3) The strength of all signals exceeding threshold 1.

Note: For signals greater than 100μV, the absolute signal strength need not be recorded. It is sufficient to state '>100μV'.

(b) Where the signal strength exceeds threshold 2 and modulation is present, the detected modulation must be recorded.

Note: Modulation is recorded to assist in identifying an offending transmission.

VI. Location of Measuring Equipment.

(a) *Horizontal position.*

(1) If a single measurement point is used for the complete airport, then the aerial must be located near the midpoint of the runway. If an alternative location in the approach area is used, the measurements must only apply to that particular approach.
(2) Measurements near the midpoint must only be made with equipment that is immune to blocking from the operational localizer.

(b) *Vertical position.*

(1) The aerial must be higher than any obstructions in the immediate vicinity but must not be an obstruction to aircraft.

VII. Measurement Interval and Duration of Measurement.

(a) The measurement must be made on each Cat II runway at intervals not exceeding one year.

(b) The total measurement period must be a minimum of 350 hours in any one year. The measurement need not be made in one continuous period.

VIII. Report.

(a) The report must show the total number of times that each channel has signals present with strengths:

(1) Exceeding threshold 1 but not threshold 2.
(2) Exceeding threshold 2.

(b) The present acceptance limit is an interference rate equivalent to < 2 x 10-5 events per second. An event being a signal > 13μV. The total rate must be calculated as an average over the total monitoring time. Submitted results must show the calculations used in producing the figures for the interference rate.

(c) Modulation recordings must be made available on request.

(d) When measurements show that the interference level exceeds limits, the aeronautical–telecommunication service provider must take the appropriate corrective measures and GACA must be advised immediately.

(e) Evidence of the required routine measurements must be available when requested by thePresident.

B.3 - ILS MONITORS

I. General.

(a) This appendix defines the monitor alarm limits and the method of testing those alarms.

(b) The equipment must not radiate guidance signals which are outside the standard operational tolerances as specified in Appendix B to this Part and ICAO Annex 10 Volume I.

II. Near Field Monitor.

(a) Localizers must have a minimum of one near field monitor measuring the course centerline.

(b) Glide paths must have a minimum of one near field monitor measuring either the glide path angle or the displacement sensitivity.

Note: Where multiple monitors are used, the signal from the near field monitor aerial may be split and fed into each set of monitors.

III. Far Field Monitor.

(a) Category II and III localizer systems must be fitted with a far field monitor which measures centerline accuracy and displacement sensitivity. The measurements of localizer alignment and displacement sensitivity must be conducted in accordance with the requirements of Section B.1-General Requirements for ILS, paragraphs X(a)(2), (b)(3), and (b)(4).

(b) The monitor must be installed near the relevant runway threshold.

(c) The far field monitor must provide alarms to a remote point but must not take executive action.

(d) A delay must be incorporated in the monitor to prevent false alarms due to aircraft movement on or in the vicinity of the runway.

(e) During the time when the ILS is being used to support low visibility procedures, the output of the far field monitor must be recorded, and time stamped. The minimum parameters to be recorded must be centerline DDM and displacement sensitivity.

(f) The far field monitor output should be recorded, and time stamped at all times when the ILS is operational.

IV. Monitor Correlation.

Any monitors on which the integrity assessment is based must correlate with changes in the far field. This correlation must be demonstrated for each new design of ILS transmitter, antenna or monitor system installed in the aerodrome.

V. Alarm and Warning Settings.

(a) Monitor alarm settings must not exceed the limits given in Table B.3-1. This requirement applies to all monitors on which the integrity of the ILS is based.

(b) On a system where several sets of monitors have been considered in the integrity assessment, the system must be adjusted to a point where sufficient alarms on those monitors are generated to cause a changeover/shutdown.

(c) If flight inspection or ground tests show that the change measured in the field exceeds the limits

given in Table B.3-1 with the transmitter set to the alarm condition, then the monitor system must be adjusted to tighter limits than those given in Table B.3-1.(d) Monitor limits must not be so tight that equipment instability can cause false shutdowns.

Note: On a glide path system operating with the correct nominal displacement sensitivity, an angle alarm tolerance of ±5.4% DDM corresponds to a change in angle of .075. The figure of 4% DDM (35 μA) has been chosen to allow for a system which may be operating near its lower limit of displacement sensitivity.

VI. Changeover and Shutdown Times.

(a) The maximum TOTAL time of false radiation must not exceed the number of seconds shown in

Table B.3-2.

Note: In the case of a common fault, e.g., the aerial system, in a system configured for immediate changeover, the quoted time is the total time from beginning of the fault until final shutdown of the system.

(b) For Category I and II systems, where immediate changeover is not provided, the delay from the time of shutdown of the main transmitter to the start of radiation from the standby transmitter must be 20 ± 2 seconds.

(c) For systems having this delay, the figures given in Table B.3-2 must apply separately to each transmitter of the system.

Table B.3-1 Normal Monitor Alarms

Parameter	Cat I	Cat II	Cat III
LOCALIZER			
Alignment at threshold	±1.5% ddm (15μA)	±1.1% ddm (11μA)	±0.9% ddm (8μA)
Displacement Sensitivity	±17% of nominal input. The ICAO Annex 10 standard that a localizer width angle must not exceed 6° is interpreted as an 'adjust and maintain' limit. The system alarms will still be set to ±17% of the nominal input. Field measurement is of nominal displacement sensitivity.		
	Localizer with no separate clearance system ±10% of nominal input. If clearance in the region between ±10° and ±35° is at any point <170 μA.		
Modulation Sum SDM	±4%		
	±20%of nominal input		
Clearance	Localizer with a separate clearance transmitter ±10% of the nominal clearance input if clearance in the region between ±10° and ±35° is at any point <170 μA		
Identification modulation	±5%		
Frequency Difference (Dual Frequency)	±3KHz		
RF Level Single Frequency	-3dB provided that coverage is satisfactory when the power is reduced to the alarm limit		
RF Level Dual Frequency	±1dB Unless tests have shown that a wider limit may be used.		
GLIDEPATH			
Alignment	-0.075 θ (5.5% DDM 47 μA) +0.10θ (7.3% DDM 63 μA) Field measurement of the nominal glide path angle.		
Displacement Sensitivity	±25% of nominal input Field measurement is of nominal displacement sensitivity.		
	Glide path with no separate clearance transmitter: ±20% of the nominal displacement sensitivity. If the 'fly up' signal at 0.3θ is <200 μA.		
Clearance	±20% of nominal input		
Modulation Sum SDM	±5%		

Parameter	Cat I	Cat II	Cat III
Frequency Difference (Dual Frequency)	±5 KHz		
RF Level **Single Frequency**	-3dB provided that coverage is satisfactory when the power is reduced to the alarm limit		
RF Level **Dual Frequency**	±1dB Unless tests have shown that a wider limit may be used.		
Phase **Advance and retard**	Sideband reference Sufficient alarms to cause shutdown. Glide path angle must not be less than 0.925θ Displacement sensitivity within limits above Fly-up signal at 0.3θ must not be less than 150 μA.		
	Null reference and Type M Sufficient alarms to cause shutdown. Glide path angle and displacement sensitivity within the limits above. DDM and field strength within flight inspection limits at 0.3θ.		

Table B.3-2 Changeover and Shutdown Times (in seconds)

	Cat I	Cat II	Cat III
Localizer	10	5	2
Glide Path	6	2	2

VII. Localizer Alarm Testing.

(a) *General.*

(1) At commissioning, or whenever a flight inspection has shown the system to be non-compliant with the limits in Appendix B.4 and no alarm has been shown by the monitors, the localizer alarms must be checked by ground or flight inspection.

(2) The alarm points of all individual monitor units must be measured at commissioning, using independent test equipment. The figures measured, and the monitor readings must be recorded as standard figures.

(b) *Method of simulating Localizer Alarms.*

(1) Alignment: alignment alarm must be tested by adjusting modulation balance.
(2) Displacement sensitivity alarm must be tested by adjusting sideband power.

(c) *Glide path Alarms Testing.*

(1) At commissioning, or whenever a flight inspection has shown the system to be non-compliant with the limits specified in Appendix B.4 and no alarm has been shown by the monitors, the glide path alarms must be re-flown and verified by flight inspection.
(2) Following any engineering work involving the aerial distribution unit, feeder cables, aerials or monitor-combining unit, the following glide path alarms must be verified by flight inspection:

(i) Angle low and width wide simultaneously;
(ii) Phase advance alarm; and
(iii) Phase retard alarm.

Note: If the monitor phase tests are not successful and transmitter adjustments are required, parts of the normal flight inspection will have to be repeated.

Note: On certain systems it is difficult to adjust the aerial phasing so that the system is just at the alarm point. For this reason, it is permissible to make the tests with the monitor near to or just beyond the alarm point. Provided that both the monitors and the flight inspection figures show reasonable symmetry, the behavior at the alarm points can be calculated.

(3) The alarm points of all individual monitor units must be measured at commissioning, using independent test equipment. The figures measured must be recorded as standard figures.

(d) Method of Simulating Glide path Alarms.

(1) *Alignment and Displacement Sensitivity.*

(i) The alignment and displacement sensitivity alarms must be checked in the following condition:

(A) Width wide and angle low;
(B) Width normal and angle high;
(C) Width normal and angle low;
(D) Width narrow and angle normal;
(E) Width wide and angle normal.

(ii) Alignment must be adjusted using modulation balance.
(iii) Displacement sensitivity must be adjusted using sideband power.

(2) *Phase.* For both advanced and retard alarms, the flight inspection must measure the glide path angle, displacement sensitivity, DDM and field strength at 0.32.
(3) *Null Reference.* Adjustment of Side Band Oscillator phase, which is the same as the relative phase between upper and lower aerials.
(4) *Sideband Reference.* The system aerial phaser must be adjusted until the monitors show sufficient alarms of any type to cause a shutdown.
Note: If the aerial phase control does not have sufficient range to reach the alarm condition, it is permissible to add adaptors or extender cables to give the required phase change.

(5) *Type M.* Adjustment of the relative phase between middle, upper and lower aerials, by adjustment of the middle antenna phaser.

VIII. Routine Monitor Maintenance.

(a) *General.*

(1) Checking of alarms must be repeated at intervals not exceeding 6 months.
(2) The alarm checking interval may be extended to 12 months if it can be demonstrated with a confidence of 95% that the monitors have a reliability of 0.95 or better.

Note: A failure is defined as a monitor whose ddm centering or alarm points are found to be more than 10% of the alarm value or 1 μA, whichever is the greater, from the standard values.

Note: This requires a large sample size (Minimum of 60 with no failures or 95 with one failure).

(3) Monitors used in the assessment need not all be on the same airport, but all must be of an identical type.

(4) All equipment monitor readings for all transmitters capable of operating into the aerial must be taken at monthly intervals or as prescribed by the equipment manufacturer or engineering authority.

(b) *Localizer*. On CAT III systems, all system monitor alarm checks must be made using independent test equipment.

(c) *Glide path*. Alarm checks must be made using independent test equipment and not by adjusting the transmitter.

B.4 - ILS FLIGHT INSPECTION REQUIREMENTS

I. General.

(a) This appendix defines the:

(1) Flight inspection interval;
(2) Limits to be applied to all parameters measured;
(3) Types of inspection.

(b) The ILS equipment must provide a complete, identified, accurate and uncorrupted source of guidance information to aircraft.

II. Flight Inspection Interval.

For ILS facilities, the prescribed interval between successive inspections is 180 days.

III. Tolerances.

(a) A tolerance of +20 days is applicable to the prescribed intervals. Each aeronautical telecommunication services provider must strive to ensure that flight inspection takes place as closely as possible to the prescribed intervals. If the previous inspection lasted more than one day, the interval must be calculated from the date when the inspection started.

(b) Flight inspections may be made up to 7 days earlier than the due date without affecting the due date for the next inspection. If an inspection is made more than 7 days before the due date, the date of

subsequent inspections must be advanced.

IV. Delays due to Adverse Weather.

(a) Occasionally, prolonged periods of adverse weather may prevent an inspection being

completed within the permitted tolerance. If this occurs, the system may continue in operation for a further 25 days provided that a reduced flight inspection has been made within the permitted tolerance interval.

(b) Reduced inspection requirements.

(1) Localizer: part orbit ± 35° at approximately 6 nautical miles for both transmitters.
(2) Glide path: Level slice starting at 10 nautical miles, at the height normally used for such a flight on the facility, for both transmitters.

V. Supplementary Flight Inspections.

(a) A supplementary flight inspection must be made 90 days ±20 days after a periodic flight inspection if at that inspection any parameter was found outside the flight inspection tolerances stated in Tables B.4-1, B.4-2 or B.4-3 below and subsequently adjusted.

(b) This requirement can be relaxed if ground measurement and equipment monitors confirm the changes seen during the periodic flight inspection. In this case it would be acceptable to carry out more frequent ground monitoring and inspection of the equipment monitor records.

(c) Only the parameters found out of tolerance need to be checked by the supplementary flight inspection.

(d) A supplementary flight inspection may be requested by the President at any time if the following conditions arise:

(1) A safety inspector considers that any aspect of maintenance is not being correctly carried out;
(2) An inspection of equipment monitor records shows any evidence of instability;
(3) Changes have been made within the safeguarded areas; and
(4) A periodic inspection has shown any unusual, though not necessarily out of tolerance, aberrations in the course structure.

VI. Field Monitors.

Commissioning flight inspections of localizers and glide paths must be made with all field monitors that can have a significant effect on the signal in space installed in their final positions.

Note: An engineering flight inspection may be necessary to establish the position of the glide path field monitor.

VII. Inspection after Engineering Work.

If the nature of the types of engineering work involving the aerial distribution unit, feeder cables, aerials or monitor-combining unit require re-inspection that the system must be flight checked before being returned to service.

VIII. Analysis of Flight Inspection Records.

(a) Each aeronautical telecommunication services provider must analyse the flight inspection records and inform GACA of any deficiencies in the performance of the navigation aids.

(b) With the agreement of the President, an aeronautical telecommunication services provider may delegate the task of examining the flight inspection records to a specialist organization. This may be the same organization that makes the flight inspection. The responsibility for addressing any deficiencies identified remains with aeronautical telecommunication services provider.

(c) Accurate technical and operational analysis of flight inspection records and reports can also serve as a mechanism to support trend analysis of the facility stability and performance.

IX. Flight Inspection Limits.

Flight inspection results must conform to the limits given in Tables B.4-1, B.4- 2 and B.4-3.

X. Parameters to be Measured.

Tables B.4-1, B.4- 2 and B.4-3give details of the parameters which must be measured at each type of flight inspection.

XI. Application of Designated Operational Coverage (DOC).

(a) The DOCs associated with the frequency assignments for ATS Communications Facilities and Radio Navigation and Landing Aids at aerodromes, must be published in the KSA AIP.

(b) Frequencies for En-route Navigation Facilities must have their DOCs published in the KSA AIP.

*Note: The requirements for validation of all instrument flight procedures are prescribed underGACAR Part 172.***Table B.4-1 Localizer Limits**

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Alignment Of nominal total angular width	Cat I ± 1.5% Cat II ± 1.0% Cat III ± 0.5%	Cat I ± 5.0% Cat II ± 2.1.% Cat III ± 1.4%	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Displacement **Sensitivity** Of the nominal displacement sensitivity	Cat I ± 5% Cat II ± 3% Cat III ± 3%	Cat I ± 17% Cat II ± 10% Cat III ± 10%	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Symmetry (either side of course line) of the measured displacement sensitivity	45% to 55%. In cases of disagreement with the ground figures, the ground measurements at threshold must be used for assessment		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Modulation Sum SDM sum of the modulation depths of the navigational tones	39% and 41%. Measured when approaching the facility, where the ddm is approximately zero	36% and 44% Measured when approaching the facility, where the ddm is approximately zero	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Off Course **Clearance**	Substantially linear increase from the front course line to an angle where the deflection current is 175 µA (0.18 ddm). From this angle to 10° on the same side, the deflection current must not fall below 175 µA (0.18 ddm) From ±10° to ±35° the deflection current must not fall below 150µA (0.155 ddm). It is desirable that the deflection current in the region between 10° and 35°should not be below 175 µA (0.18 ddm). Wherever possible, systems should be adjusted to achieve this.		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

<table>
<tr><th>Parameter</th><th>Commissioning</th><th>Annual / Routine</th><th>Transmitter to be checked</th></tr>
<tr><td rowspan="3">Coverage</td><td>Usable signals at edge of DOC,

±10° from the centerline

Usable signals at 17 NM,±10° to ±35° from the localizer centerline</td><td>Annual only.

Usable signals at edge of DOC on the localizer centerline</td><td>Commissioning 1 or 2

Annual 1 or 2

Routine None</td></tr>
<tr><td colspan="2">Usable signals between ±35° from the localizer centerline at or beyond 6NM</td><td>Commissioning 1 & 2

Annual 1 & 2

Routine 1 & 2</td></tr>
<tr><td colspan="2">Usable signals must be receivable to the distances specified, at and above a height of 2000 feet above the elevation of the threshold or 1000 feet above the elevation of highest point within the intermediate and final approach areas, whichever is the higher.

A usable signal is defined as a signal producing localizer flag current of not less than 275 μA and a DDM conforming to the off course clearance requirements.</td><td></td></tr>
</table>

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Course Structure	**Cat I** 30μA (0.031 DDM) Edge of DOC to point A, then decreasing at a linear rate to 15 μA (0.015 DDM) at point B. 15 μA (0.015 DDM) from point B to point C **Cat II / III** 30 μA (0.031 DDM) Edge of DOC to point A, then decreasing at a linear rate to 5 μA (0.005 DDM) at point B. 5 μA from point B to the ILS reference datum.		Commissioning 1 or 2 Annual 1 or 2 Routine None
	Cat I 30 μA (0.031 DDM) 8NM from the ILS reference datum to point A, then decreasing at a linear rate to 15 μA (0.015 DDM) at point B. 15 μA (0.015 DDM) from point B to point C **Cat II / III** 30 μA (0.031 DDM) 8NM from the ILS reference datum to point A, then decreasing at a linear rate to 5 μA (0.005 DDM) at point B. 5 μA from point B to the ILS reference datum. Course structure must have a probability of 95% or better of not exceeding the limits given below, when assessed over a 40 second interval. NOTE: Guidance on structure assessment is defined in Attachment C to ICAO Annex 10 Volume 1		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Identification	Clear and no perceptible interference to the basic localizer functions		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Power ratio Two frequency systems only	On the localizer centerline, the course signal must exceed the clearance signal by a minimum of: **Cat I /II** 10 dB. **Cat III** 16 dB	N/A	Commissioning 1 or 2 Annual None Routine None
Polarization	Only required at the commissioning of an aerial system which is new. Polarization error when the aircraft is in a roll attitude of 20° must be no greater than: Cat I 0.016 ddm. Cat II 0.008 ddm. Cat III 0.005 ddm.		As required

Table B.4-2 Glide Path Limits

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Alignment of the promulgated glidepath angle	Cat I ± 1.5% Cat II ± 1.0% Cat III ± 1.0%	Cat I ± 7.5% Cat II ± 7.5% Cat III ± 4.0%	Commissioning 1 or 2 Annual None Routine None
Displacement Sensitivity Of the nominal displacement sensitivity	Cat I ± 8% Cat II ± 6% Cat III ± 5%	Cat I ± 25% Cat II ± 20% Cat III ± 15%	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Symmetry of upper/lower half sector. Of the measured displacement sensitivity	Cat I 33% to 67%. Cat II 42% to 58%. Cat III 42% to 58%.		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2
Mod Sum SDM Sum of the depths of modulation of the navigational tones	78% -82% Measured when approaching the facility, where the ddm is approximately zero.	75% -85% Measured when approaching the facility, where the ddm is approximately zero.	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Below Path Clearance normal Operations Of the nominal displacement sensitivity	The clearance below path should be measured close to the edge of the Designated Operational Coverage (DOC). There must be a smooth increase in DDM from the glide path angle to an angle where 190 µA fly-up (0.22 DDM) is reached. This must occur at not less than 0.3θ Where this is achieved at an angle above 0.45θ, the fly-up must not fall below 190 µA (0.22 DDM) between this angle and 0.45θ or to such lower angle, down to 0.3θ, as required to safeguard the promulgated glide path intercept procedure. Where coverage between 0.45θ and 0.3θ is less than the specified datum, but sufficient current is present to remove the flag alarm, the fly-up must not fall below 190µA (0.22 DDM).		Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Below Path Clearance, Course only Note: This check is to ensure that 2 frequency M- Arrays have been correctly set up and that the clearance transmitter is not hiding a problem	**Cat I** Between the glidepath angle and 0.45Θ or to such lower angle, down to 0.3Θ, as required to safeguard the promulgated glidepath intercept procedure, the DDM must remain 150 Hz predominant wherever a useable signal is present. Nominal Glidepath angle and half sector width values should be similar to that measured with clearance present. **Cat II/III** Smooth increase in DDM from the glidepath angle to an angle where 150 µA fly-up (0.175 DDM) is reached. Between this angle and 0.45 or to such lower angle, down to 0.3, as required to safeguard the promulgated glidepath intercept procedure, the DDM must remain 150 Hz predominant wherever a usable signal is present. Nominal Glidepath angle and half sector width values should be similar to that measured with clearance present. *Note: With clearance signal removed, there is no requirement to meet any coverage (signal strength) specification. Only the value of DDM is being examined.*		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Clearance Below Path **(at ±8 azimuth)**	During the prescribed level flight, a minimum deflection current of 190 µA (0.22 DDM) must be achieved at 0.45Θ measured close to the edge of DOC.		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2
Clearance Above Path	Smooth increase in fly-down from the glidepath angle to an angle where the flydown is 190 µA (0.22 DDM). Between this angle and 1.75Θ, the fly-down must not fall below 150 µA (0.175 DDM).		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Coverage	Adequate coverage must exist to the edge of the DOC and down to 0.45Θ or a lower angle down to 0.3Θ, as required to safeguard the promulgated glidepath intercept procedure. Adequate coverage is defined as a receiver input exceeding the equivalent of a 40 μV source of EMF and a total impedance of 50 ohms resistive, together with sufficient current to remove the flag alarm.		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Course Structure	Course structure must have a probability of 95% or better of not exceeding the limits given below, when assessed over a 40 second interval. **Cat I** 30 µA (0.035 DDM) Edge of DOC to the ILS reference datum to point C. **Cat II** 30 µA (0.035 DDM) Edge of DOC to the ILS reference datum to point A, then decreasing at a linear rate to 20 µA (0.023 DDM) at point B.20 µA from point B to the ILS reference datum. **Cat III** 30 µA (0.035 DDM) Edge of DOC to the ILS reference datum to point A, then decreasing at a linear rate to 20 µA (0.023 DDM) at point B.20 µA from point B to the ILS reference datum. NOTE: Guidance on course structure assessment may be found in Attachment C to ICAO Annex 10 Volume 1.		Commissioning 1 or 2 Annual 1 or 2 Routine 1 or 2

Parameter	Commissioning	Annual / Routine	Transmitter to be checked
Biased Structure	The structure of the edges used to calculate the displacement sensitivity should have good correlation with the course structure.		Commissioning 1 or 2 Annual 1 or 2 Routine None

Table B.4-3 Marker Beacon Limits

Parameter	Commissioning/Annual/Routine	Transmitter
Coverage	The following distances must be measured whilst on the ILS glide path and localizer course line: Inner Marker 150 m ± 50 m Middle Marker 300 m ±100 m Outer Marker 600 m ±200 m	Commissioning 1&2 Annual 1 & 2 Routine 1 & 2
Field strength	No less than 1.5 millivolts per meter at the limits of coverage. Rising to at least 3 millivolts per meter.	Commissioning 1 & 2 Annual 1 & 2 Routine 1 & 2

B.5 – VHF MARKER BEACONS

I. General.

(a) There must be two marker beacons in each installation. A third marker beacon may be added whenever, in the opinion of the President an additional beacon is required because of operational procedures at a particular site.

(b) Except as provided in (c), the marker beacons must conform to the requirements prescribed in

ICAO Annex 10 Volume 1. When the installation comprises only two marker beacons, the requirements applicable to the middle marker and to the outer marker must be observed.

(c) Reserved.

(d) The marker beacons must produce radiation patterns to indicate predetermined distance from the threshold along the ILS glide path.

(e) When used as an alternative to part or all of the marker beacon component of the ILS, a DME must:

(i) provide distance information operationally equivalent to that furnished by marker beacon(s);
(ii) be published in accordance with the provisions of GACAR Part 175 and Annex 15;

(f) When used as an alternative for the middle marker, the DME must be frequency paired with the ILS localizer and sited so as to minimize the error in distance information.

II. Radio Frequency.

The marker beacons must operate at 75 MHz with a frequency tolerance of plus or minus 0.005 per cent and must utilize horizontal polarization.

III. Coverage.

(a) The marker beacon system must be adjusted to provide coverage over the following distances, measured on the ILS glide path and localizer course line:

(1) Inner marker (where installed): 150 m plus or minus 50 m (500 ft plus or minus 160 ft);
(2) Middle marker: 300 m plus or minus 100 m (1000 ft plus or minus 325 ft);
(3) Outer marker: 600 m plus or minus 200 m (2000 ft plus or minus 650 ft).

(b) The field strength at the limits of coverage must be 1.5 millivolts per meter (minus 82 dBW/m2). In addition, the field strength within the coverage area must rise to at least 3.0 millivolts per meter (minus 76 dBW/m2).

IV. Modulation.

(a) The modulation frequencies must be as follows:

(1) Inner marker 3 000 Hz;
(2) Middle marker: 1 300 Hz;
(3) Outer marker: 400 H.

(b) The frequency tolerance of the above frequencies must be plus or minus 2.5 per cent, and the total harmonic content of each of the frequencies must not exceed 15 per cent.

(c) The depth of modulation of the markers must be 95 per cent plus or minus 4 per cent.

V. Identification.

The carrier energy must not be interrupted. The audio frequency modulation must be keyed as follows.

(a) Inner marker. 6 dots per second continuously;

(b) Middle marker. A continuous series of alternate dots and dashes, the dashes keyed at the rate of 2 dashes per second, and the dots at the rate of 6 dots per second;

(c) Outer marker. 2 dashes per second continuously. These keying rates must be maintained to within plus or minus 15 per cent.

VI. Siting.

(a) The inner marker must be located so as to indicate, in low visibility conditions, the imminence of

arrival at the runway threshold.

(b) If the radiation pattern is vertical, the inner marker must be located between 75 m (250 ft) and450 m (1500 ft) from the threshold and at not more than 30 m (100 ft) from the extended centerline of the runway.

(c) If the radiation pattern is other than vertical, the equipment must be located so as to produce a field within the course sector and ILS glide path sector that is substantially similar to that produced by an antenna radiating a vertical pattern.

(d) The positions of marker beacons, or where applicable, the equivalent distance(s) indicated by the DME when used as an alternative to part or all of the marker beacon component of the ILS, must be published in accordance with the provisions of ICAO Annex 15 (Appendix 1).

(e) When so used, the DME must provide distance information operationally equivalent to that furnished by marker beacon(s).

(f) When used as an alternative for the middle marker, the DME must be frequency paired with theILS localizer and sited so as to minimize the error in distance information.

VII. Monitoring.

Suitable equipment must provide signals for the operation of an automatic monitor. The monitor must transmit a warning to a control point if either of the following conditions arise:

(a) Failure of the modulation or keying; or

(b) Reduction of power output to less than 50 per cent of normal.

B.6 - DISTANCE MEASURING EQUIPMENT (DME) TRANSPONDERS AND FLIGHT INSPECTION REQUIREMENTS

I. General.

(a) This appendix sets out the technical requirements for all Distance Measuring Equipment (DME) Transponders intended for use in the provision of an air traffic service in the KSA.

(b) The DME Transponder equipment must not radiate a signal which falls outside standard

operating tolerances or provides false information over its Designated Operational Coverage area (DOC).

II. System Requirements.

(a) Except as provided in (b), in addition to the requirements in this section, DME transponder systems must comply with the Standards and in ICAO Annex 10 Volume 1 Chapter 2 General Provisions for Radio Navigation Aids and Chapter 3 Section 3.5 Specification for UHF Distance Measuring Equipment (DME).

(b) Reserved.

(c) The equipment must only transmit on the frequency assigned.

(d) The identification signal must be suppressed when the DME is not available for operational service.

Note: The normal identity code may be radiated for short periods during maintenance or flight inspection as necessary.

(e) Standby power supplies must be provided commensurate with the service being supported.

(f) Indication of change of status of equipment must be given immediately by visual and audiblemeans to the ATC personnel providing the Approach Control or Aerodrome Control functions forpublished final approach procedures.

(g) The DME must be sited to keep the triangulation error at the point at which the distance is required to a minimum.

III. DME Flight Inspection Requirements.

(a) DME flight inspection must be performed to ensure that the DME provides an accurate and uncorrupted source of range information within the Designated Operational Coverage.

(b) The following parameters must be assessed for the prescribed transponders and be within limits:

(1) Accuracy. Table B.6-1 provides the accuracy requirements for the various uses of the DME.

(2) Coverage. Throughout the inspection while within the DOC the DME receiver input mustnot fall below –90 dBm.
(3) Identification. The identification signal must be clear throughout the flight inspection; additionally, where the identification signal is synchronized with other equipment, the correctness of the keying sequence must be checked.
(4) Performance. False unlocks and instances of interference must be identified on the Flight Inspection report and investigated by the aeronautical telecommunication services provider and the appropriate rectification carried out.
(5) Flight Inspection Interval. Periodicity must be in line with any associated equipment e.g., ILS, VOR or NDB facilities where applicable. Where there is no associated equipment, inspections must be made on Commissioning and in line with any flight inspection requirements of Instrument Flight Procedures supported by the equipment.

(c) Flight inspection service provider. All DME flight inspections must be made by a flight inspection service provider authorized under Appendix D to this part.

(d) Analysis of Flight Inspection Records.

(1) Each aeronautical telecommunication services provider must analyse the flight inspection records and resolve any deficiencies in the performance of the navigation aids.
(2) Analysis of flight inspection records can be delegated to a specialist organization. This may be the same organization that makes the flight inspection. The responsibility for addressing any deficiencies identified remains with the aeronautical telecommunication services provider.

Table B.6-1 DME Accuracy Requirements

Procedure Supported by the DME	Where and how measurement is made	Interval / Tolerance	Transponder
DME associated with precision approach	4NM – 1NM on approach	Comm ± 0.3 NM Routine ± 0.1 NM	Comm Both Routine one TXP

Procedure Supported by the DME	Where and how measurement is made	Interval / Tolerance	Transponder
DME associated with Instrument Approach Procedures (IAP) that are not precision approaches	4NM – 1NM on approach	Comm / Routine ± 0.1 NM	Comm Both Routine one TXP
IFP	On the procedure, spot check at ranges used	Comm ± 0.1 NM	One TXP
Missed Approach Procedure	On the procedure, spot check at ranges used	Comm / Routine ± 0.1 NM	One TXP
Direct Arrivals	On the procedure, spot check at ranges used. The orbit as required for DME general below, may be carried out at the appropriate radius.	Comm ± 0.1 NM	One TXP
Hold	On the procedure, spot check at ranges used.	Comm ± 0.1 NM	One TXP

Procedure Supported by the DME	Where and how measurement is made	Interval / Tolerance	Transponder
DME general	An orbit at a radius of 5 NM or greater at an elevation of 2º from the DME site.	Comm ± 0.1 NM	A complete orbit on one transponder. Followed by a minimum 20º overlap on the second transponder.
En-route	During radials flown on any associated facility	Comm / Routine ± 0.1 NM	One TXP

B.7 - REQUIREMENTS FOR ILS AND ILS/DME IDENTITY KEYING

I. General.

(a) This appendix prescribes the identity keying requirements for all categories of ILS including those systems with an associated DME.

(b) An operationally available ILS or DME must radiate an identity code permitting it and its operational status to be positively identified.

II. Keying Sequence.

(a) An associated ILS and DME must radiate identity codes which positively identify their association.

(b) When a DME is associated with an ILS, the identity keying of both systems must be synchronized. ICAO Annex 10 refers to this as 'associated' code.

(c) A complete keying sequence must occupy approximately 40 seconds.

Note: In the following descriptions the 40 second interval is represented by /4 and the number of times the Morse code is repeated in that interval is shown by the preceding figure. i.e., 1/4 means

that the Morse code identity occurs once in each 40 second interval.

III. Master Equipment.

The DME or the ILS may be used as the master identity keyer.

IV. System Operation.

(a) If at any time the master equipment fails, the slave equipment must revert to totally independent keying.

(b) If the master keyer is subsequently returned to service, the slave equipment must automatically return to normal slave operation, with no requirement for manual resetting at the slave equipment.

(c) When a localizer is acting as slave to a DME it must key 3/4. The DME keying must be synchronized to occur where there is an interval in the localizer keying. If the DME fails, thelocalizer must revert to 4/4 keying with no gap where the DME identity would have been.

(d) When a DME is slave to a localizer, it must key 1/4. If the localizer fails, the DME must continue to key 1/4. i.e., the DME must key itself at the correct rate for an independent DME.

(e) Regardless of which equipment is master or slave, a failure in one equipment must neither leave the associated equipment without identity nor cause it to close down.

V. Slave Monitor Information.

Note 1: If the slave equipment fails, there is no requirement for the master equipment to alter its keying sequence.

Note 2: Certain types of ILS and DME equipment, when used as master, have the facility to accept an input from the slave's status monitor. This signal can be used to alter the keying sequence of the master. If this capability exists, it may be used.

If this system is used, the master equipment must automatically return to associated keying when the slave equipment is returned to service.

VI. Independent Operation.

An ILS with no associated DME must always key 4/4, i.e., the Morse code must be repeated at regular intervals, not less than 6 times per minute.

VII. Use of Letter I Prefix.

If the DME identity code has an “I” prefix, the DME must continue to radiate this prefix if the associated localizer fails.

VIII. Equipment Out of Service.

Note: It is sometimes necessary to radiate signals from equipment which is not available for operational use. This can occur during commissioning tests or engineering investigations.

Whenever the equipment is not available for operational use, the identity keying must be suppressed.

Note: Radiation of continuous unkeyed tone is permitted.

Note: During commissioning and engineering flight inspections, the normal identity code may be radiated for short periods

B.8 - TACTICAL AIR NAVIGATION (TACAN).

I. General.

(a) This appendix prescribes the main requirements for tactical air navigation (TACAN).

(b) The TACAN equipment must not radiate a signal which falls outside standard operating tolerances or provide false information over its Designated Operational Coverage area (DOC).

II. System Requirements.

(a) The equipment must operate in the frequency range from 960 to 1215Mhz.

(b) The accuracy of a TACAN system must be within the following tolerance:

(1) Bearing.

(i) ± 1.5º from 0 to 130 nautical miles;
(ii) ± 2.5º above 130 nautical miles;

(2) Distance.

(i) ± 0.12NM+0.05% of the slant distance, from 0 to 65 nautical miles,
(ii) ± 0.17NM+0.05% of the slant, above 65 nautical miles.

(c) Each operational channel in the TACAN system must be defined by two frequencies (interrogation and reply frequencies), spaced 63 MHz apart (See Table B.8-1), and by the pulse code for the assigned channel (X or Y channel).

(d) TACAN must transmit on a preselected channel in accordance with mode channels operating frequencies.

(e) Each beacon must emit a Morse identify code signal which can be heard in the pilot headset. This code must consist of pulse pairs transmitted at a frequency of 1350 Hz.

(f) Each beacon must be identified by means o– its channel frequency, its pulse coding and its identity signal. –The channel code (operating mode), pulse code and replies delay must be as shown in the Table B.8-2.

Table B.8-1 Frequencies TACAN Ground Beacon Channels

X Channels		Y Channels
I = 1025 MHz + (CH-1)		I = 1025 MHz + (CH-1)
R = I - 63	1 < = CH < = 63	R = I + 63
R = I + 63	64 <= CH <= 126	R = I - 63
I = Interrogation Frequency (MHz) R = Reply Frequency (MHz) CH = Channel Number		

Table B.8-2 Nominal Pulse Code and Reply Delay

Channel Code	Nominal Interrogation Pulse Code (µS)	Transponder Reply Pulse Code (µS)	Transponder Nominal Reply Delay (µS)
X	12	12 ± 0.1	50
Y	36	30 ± 0.1	56

III. TACAN Flight Inspection Requirements.

(a) TACAN flight inspection must be performed to ensure that the TACAN provides an accurate and uncorrupted source of azimuth and range information within the Designated Operational Coverage.

(b) Throughout the inspection while within the DOC the TACAN receiver input must not fall below the value specified in the technical documentation.

(c) The identification signal must be clear throughout the flight inspection.

(d) Instances of interference must be identified on the Flight Inspection report and investigated by the aeronautical telecommunication services provider and the appropriate rectification carried out.

(e) Flight Inspection periodicity must be in line with any associated equipment e.g., VOR facility where applicable. Where there is no associated equipment, inspections must be made on Commissioning and in line with any flight inspection requirements of Instrument Flight Procedures supported by the equipment.

(f) All TACAN flight inspections must be made by a flight inspection service provider authorized under this part.

(g) The aeronautical telecommunication services provider must analyse the flight inspection records and resolve any deficiencies in the performance of the navigation aids. Analysis of flightinspection records can be delegated to a specialist organization. This may be the same organization that makes the flight inspection. The responsibility for addressing any deficiencies identified remains with aeronautical telecommunication services provider.

B.9 - REQUIREMENTS FOR CONVENTIONAL AND DOPPLER VHF OMNI-DIRECTIONAL RANGE (CVOR/DVOR) BEACONS

I. General.

This appendix prescribes the technical requirements for all Conventional and Doppler VHF Omni-Directional Range Beacons (CVOR/DVOR) intended for use in the provision of an air traffic service in the KSA.

II. System Requirements.

(a) Except as provided in (b), in addition to the requirements below, VOR beacon systems must comply with the Standards in ICAO Annex 10 Volume 1 Chapter 2 General Provisions for Radio Navigation Aids and Chapter 3 Section 3.3 Specification for VHF Omnidirectional Radio Range (VOR).

(b) Reserved.

(c) The equipment must only transmit on the frequency assigned.

(d) The Identification must be suppressed when the VOR is not available for operational purposes, e.g., under maintenance.

(e) With the exception of ATIS, no other voice communication channel must be transmitted via theVOR system.

(f) Standby power supplies must–be provided commensurate with the service being supported.

(g) Indication of change of status of equipment must be given without delay by visual and audible means to the ATC personnel providing Approach Control or Aerodrome Control functions that use the VOR for published final approach procedures.

B.10 - VHF OMNIDIRECTIONAL RANGE (VOR) FLIGHT INSPECTION REQUIREMENTS

I. General.

This appendix prescribes the following flight inspection requirements for each VOR:

(a) Parameters that must be measured;

(b) Profiles that must be flown to demonstrate the VOR is suitable to support Instrument Flight Procedures;

(c) Measurement methods that must be used;

(d) Flight inspection tolerance limits;

(e) Flight Inspection types and Interval.

II. Parameters to Be Measured.

During Commissioning and Routine inspection, the parameters in Table B.10-1 must be measured for all available transmitters and be within limits:

Table B.10-1 Parameters to be Measured

Parameter	Limits
Alignment	± 2°
Bends	± 3.5°
Roughness and Scalloping	± 3°
Coverage	90 microvolts per meter. At commissioning only, useable signals up to an elevation angle of 40 degrees.
Modulation 30Hz and 9960Hz	± 2%
Voice	Clear
Identification	Clear

Parameter	Limits
Polarization	± 2%

III. Measurement Method.

(a) A checkpoint must be selected during the commissioning inspection at a point in space where the signal is stable. This checkpoint must be used in establishing course alignment, 30 Hz Modulation Depth, 9960Hz Modulation Depth and Field Strength to be recorded on the Flight Inspection report.

(b) The mean alignment must be determined by flying a 360-degree orbit of the VOR. The altitude selected for the flight should place the aircraft in the main lobe of the VOR.

(c) Alignment must be recorded at the reference check point.

(d) Bends must be determined on all flown radials.

(e) Roughness and Scalloping must be determined on all flown radials.

(f) Field strength must be recorded at the reference check point.

(g) At commissioning useable signals must be established by two level flights, separated by approximately 90 degrees.

(h) The mean modulation depth must be determined by flying a 360-degree orbit of the VOR. Thealtitude selected for the flight should place the aircraft in the main lobe of the VOR.

(i) Modulation must be recorded at the reference check point.

(j)Thevertical polarization effect mustbe checked when flying a radialatadistance of 18.5 to 37 km (10 to 20 NM).

IV. Profiles to be Checked.

Table B.10-2 prescribes details of the profiles, which must be checked and the frequency of flight inspection for each profile.

Table B.10-2 Flight Inspection Profiles

Profile	Commissioning	Routine
	Transmitter to be checked	
Radials	1 or 2	1 or 2
Approach Procedures	1 & 2	1 & 2**
Cross check radials	1 or 2 *	None
Intersections	1 or 2 as required	None
Holds	1 and 2 as required	
** For routine inspection of dual transmitter Doppler VORs, where it can be demonstrated that the alignment error between the transmitters is small i.e. ≤ 0.5 degrees, then only one transmitter needs to be checked.		
* Flight inspection of cross-check radials is not required provided there is sufficient flight inspection data to support the use of those radials.		

V. Flight Inspection Interval.

The prescribed interval between successive inspections is 1 year. This interval may be extended to 5 years if the aeronautical telecommunication services provider can demonstrate that the system is stable and that multipath interference does not affect the guidance signals.

VI. Flight inspection Service Providers.

All VOR flight inspections must be made by a flight inspection service provider authorized under this part and having approval for VOR inspection.

VII. Analysis of Flight Inspection Records.

Each aeronautical telecommunication services provider must analyse the flight inspection records and inform GACA of any deficiencies in the performance of the navigation aids. With the agreement of the President, the aeronautical telecommunication services provider may delegate the task of

examining the flight inspection records to a specialist organization. This may be the same organization that makes the flight inspection. The responsibility for addressing any deficiencies identified remains with the aeronautical telecommunication services provider.

VIII. Associated VOR and DME.

(a) At location where for operational reasons, or because of air traffic control reasons such as air traffic density or proximity of routes, there is a need for a more precise navigation service than that provided by VOR, the aeronautical telecommunication services provider must install and maintain in operation a distance measuring equipment (DME) as a complement to VOR.

(b) Associated VOR and DME facilities must be collocated in accordance with the following:

(1) Coaxial collocation: the VOR and DME antennas are located on the same vertical axis; or
(2) Offset collocation.

(c) When associated with a VOR, DME/N coverage must be at least that of the VOR to the extent practicable.

(d) The characteristics of the “associated” signal must be as follows:

(1) The identification must be transmitted in the form of dots and dashes (International Morse Code) and must be synchronized with the VHF facility identification code;
(2) Each 40-second interval must be divided into four or more equal periods, with the transponder identification transmitted during one period only and the associated VHF identification, where this is provided, transmitted during the remaining periods.

B.11 - REQUIREMENTS FOR MF NON-DIRECTIONAL BEACONS

I. General.

(a) This appendix prescribes the technical requirements for MF Non-Directional Beacons (NDBs) intended for use in the provision of an air traffic service in the KSA.

(b) It applies to all NDBs including those associated with published Instrument Approach Procedures, also known as Locators, promulgated as NDB(L).

(c) The system must radiate a signal which complies with the standard operating parameters and provides correct guidance to users within its rated coverage.

II. System Requirements.

(a) Except as provided in (b), in addition to the requirements below, NDB systems must comply with the Standards in ICAO annex 10 Volume 1, Chapter 2, General Provisions for Radio Navigation Aids and Chapter 3 Section 3.4, Specification for non-directional radio beacon (NDB).

(b) Reserved.

(c) The equipment must only transmit on the frequency assigned. The assigned frequency must be maintained within ±0.01%.

(d) The power output must be adjusted to give a vertical field strength of 70 microvolts/meter atthe limit of the rated coverage and be maintained within tolerances of +2 dB and −3 dB.

(e) Modulation is by on/off keying of an amplitude modulating tone. Each NDB must be individually identified by a two or three letter international Morse code group as assigned and transmitted at a rate corresponding to approximately 7 words per minute. The complete identification must be transmitted at least 3 times in each 30 second period, equally spaced within that period.

(f) The facility Identification must be suppressed when the NDB is not available for operational purposes, e.g., under maintenance.

Note: The normal identity code may be radiated for short periods during maintenance or flight inspection as necessary.

(g) The frequency of the modulating tone for identification must be 400 Hz ±25 Hz.

(h) The carrier power of an NDB must not fall by more than 0.5 dB when the identification signal is being radiated.

(i) An executive site monitor must be provided to switch off the equipment in use and, if applicable, change over to the standby system in less than 1 minute if:

(1) There is a change in radiated carrier power of more than +2 dB or −3 dB to that required for

the rated coverage.
(2) A malfunction or failure of the means of self-monitoring of executive parameters occurs.

(j) A Non-Executive Alarm must be generated within three minutes, if the NDB fails to transmit the correct identification code.

(k) Indication of change of status of equipment must be given immediately by visual and audible means to the ATC personnel providing Approach Control or Aerodrome Control functions that use the NDB.

(l) NDB must be provided with suitable power supplies and means to ensure continuity of service appropriate to the needs of the service provided.

(m) An NDB ATSEP must regularly record the field strength of NDB, as measured at a remote location. Remote measurement of field strength can take place at any point where the NDB ground wave is consistently established.

III. Flight Inspection.

Note: See also Annex D.3.

(a) Commissioning flight inspections must be made by a flight inspection service provider authorized by the President under this part for flight inspection of NDBs.

(b) Annual flight inspections may be conducted by local pilots holding at least an ATPL certificate. The pilot must provide confirmation of the performance of the NDB as described in Table B.11-1 below. The aeronautical telecommunication services provider must formally record this confirmation.

(c) During commissioning and annual inspection, the appropriate parameters in the following table must be measured and be within limits. These checks need only be done on one transmitter.

(d) The bearing given by the ADF system must not be in error by more than plus or minus 5 degrees with a radio signal from any direction having a field strength of 70 microvolts per metre or more radiated from an LF/MF NDB or locator operating within the tolerances limits described in Table B.11-1 below and in the presence also of an unwanted signal from a direction 90 degrees from the wanted signal and:

(1) on the same frequency and 15 dB weaker; or
(2) plus or minus 2 kHz away and 4 dB weaker; or
(3) plus or minus 6 kHz or more away and 55 dB stronger.

Note. — The above bearing error is exclusive of aircraft magnetic compass error.

Table B.11-1 NDB Performance Requirements

Parameter	Limits	Periodicity and Measurement Method
Accuracy within the DOC	ADF needle oscillations <± 10°. See Note 1	**Commissioning** Orbit at the DOC or 15NM, whichever is the smaller at Minimum Safe Altitude.
Accuracy on Airways	ADF needle oscillations < ± 10°. See Note 1	**Commissioning** Following notified airways. Where an NDB supports many airways then one airway in each quadrant should be flown.
Accuracy in Holding Patterns	ADF needle oscillations < ± 5°. See Note 1	**Commissioning** Following notified Holding pattern
Accuracy on Instrument Approach Procedures	ADF needle oscillations < ± 5°. See Note 1	**Commissioning and Annual** Following Instrument Approach Procedure
Coverage	>70 microvolts per meter.	**Commissioning** Orbit at the DOC or 15NM, whichever is the smaller, at Minimum Safe Altitude.

Parameter	Limits	Periodicity and Measurement Method
Identification	Correctness, clarity and proper tone.	**Commissioning and Annual** Throughout the flight inspection.
Station passage	Reversal without excessive ADF needle swing around station passage. ADF needle oscillations <± 10° throughout the remainder of the radial. See Note 1	**Commissioning and Annual** Two radials 90 degrees apart. From 5NM to 5NM past the station.
Note 1: Periods of out of limits are acceptable as long as: (a) They are oscillatory in nature rather than one sided and do not exceed 8 seconds for the check of the DOC, Airways and Holding patterns and 4 seconds for Instrument Approach procedures, (b) The pilot reports that the usability of the NDB is acceptable and that the NDB satisfactorily supports the Airway/Holding Pattern/Approach Procedure.		

B.12 - REQUIREMENTS FOR INSTRUMENTED RUNWAY VISUAL RANGE (IRVR) SYSTEMS

I. General.

(a) The purpose of this appendix is to prescribe the performance criteria and safeguarding requirements for IRVR equipment installed in the kingdom of Saudi Arabia and intended for use in the provision of an air traffic service.

(b) These requirements ensure that consideration has been taken of those aspects that affect the safety of services provided and supported by an IRVR facility..

II. IRVR Requirements.

(a) The equipment must enable the provision of an accurate indication of the runway visual range to be available to the pilot during the take-off and landing phases of flight.

(b) Instrumented Runway Visual Range (IRVR) must be measured, over the range appropriate for the approach categorization, to a minimum accuracy of:

(1) ±10 Meters from 50 meters to 400 meters.
(2) ±25 Meters from 400 meters to 800 meters.
(3) ±10 per cent above 800 meters.

(c) All systems must meet these accuracy requirements over background luminance levels in the range 5 to 30,000 Cd. per m2.

(d) For calculating the IRVR value, 20 per cent of the peak beam on axis intensity of the runway light (rounded to the nearest 100 cd) must be assumed.

(e) The sensor output must be sampled at a minimum rate of once per second.

(f) The equipment must average the recorded extinction coefficient over a period of 1 minute, to effect smoothing of short-term atmospheric variations.

(g) The IRVR value presented to the user must be rounded down to the nearest increment specified in section VII below.

(h) When RVR is increasing, a hysteresis of 1.5 increments must be used to prevent unnecessary fluctuations in the displayed IRVR.

(i) The equipment integrity and reliability must be such that the number of safety-related failures must be no more than 10-5 per operating hour, unless otherwise indicated by a formal and documented hazard analysis.

III. Equipment Calibration.

The maintenance and calibration policy, and facilities necessary to maintain performance within the parameters stated in this document, must be documented and implemented.

IV. Equipment Interfaces.

(a) Technical justification that the safe operation of the equipment is not compromised by any non-passive interfaces installed in or connected to other equipment must be provided.

Note: The connection of the IRVR system to any existing approved equipment may require the reassessment of that other equipment.

(b) All interfaces between the IRVR system and other systems must be designed, constructed, installed and tested to an integrity standard appropriate for the more demanding applicable standard.

(c) The interfaces to the lighting systems must be fed with tell-back information only.

(d) Any tell-back indications from the runway lighting system which indicate that the lighting equipment has malfunctioned, or which prevent the status of the runway lighting from being established must render the IRVR information to be invalid.

(e) The IRVR system must be provided with a time source which must be synchronized to UTC within a tolerance of ± 5 seconds.

V. Monitoring.

(a) IRVR systems must be self-monitoring for correct operation.

(b) Any incorrect operation identified by the monitoring must render the IRVR information to be

invalid.

(c) Displays in operational positions must indicate the serviceability status of the system.

VI. Displays.

(a) Displays must present the RVR data in the manner described below:

(1) In an alphanumeric format with indication of trend over successive readings;
(2) Any changes in system status, including blanking of displayed data, or RVR value, must be presented at operational displays within 5 seconds of the change.

(b) Where the IRVR value is presented on a display system that is not dedicated to the function (i.e., where information from a variety of sources is displayed on a single display system), all operational ATC positions must display the IRVR data in the standard alphanumeric format.

(c) All displays must be provided with a method of testing the serviceability of the display and backed by procedures to ensure compliance with the stated criticality.

(d) Where data is transmitted beyond the aerodrome the ICAO station identification must be included.

(e) The data must be displayed with the following resolution:

(1) 25 meter intervals from 50 to 400 meters.
(2) 50 meter intervals from 400 to 800 meters.
(3) 100 meter intervals above 800 meters.

VII. Recording.

(a) IRVR records must be time stamped against UTC and retained for a minimum period of 30 days. Electronic, magnetic or optical recording devices may be used, but all records must be stored in a readily accessible format. Printed copies of these records must be available on request.

(b) The RVR value and status information must be recorded in the event of the following:

(1) Change in RVR or trend from any site.

(2) System self-test.
(3) On detection of change of serviceability status (including nature of the fault).
(4) Change of runway in use.
(5) Change in runway lighting intensity.

(c) Change in law used to calculate the given RVR value must be recorded.

(d) Transmittance, luminance Threshold (Et) and software version must be recorded.

VIII. Siting Criteria.

(a) Sensor measurements must be used to derive an RVR value that is representative of the pilot's perspective of the visibility along the runway.

(b) The location of IRVR sensors must be acceptable to the President.

(c) RVR measurements, if they are made, on a runway operating to CAT I must be made at one location representing the Touchdown TDZ area.

Note: Runway Visual Range (RVR) assessment using Human Observers may be permitted for runways currently operating to CAT I.

(d) IRVR measurements on a runway operating to CAT II must be made at two locations, representing the TDZ and midpoint (MID).

(e) IRVR measurements on a runway operating to CAT III, if any, must be made at three locations, representing TDZ, MID and STP.

Note: Particular attention should be paid to the design and location of the sensor heads to ensure an effective representation of the required coverage area.

(f) The sensor housing must not affect the accuracy of the atmospheric measurement.

Table B.12-1 Summary of IRVR System Requirements under Normal Operating Conditions

IRVR Assessment Site (LDA – Landing Distance Available)	Category I Runway	Category II Runway less than 2000m LDA	Category II Runway 2000m or more LDA	Category III All Runways
TDZ	Recommended	Required	Required	Required
MID		Required	Required	Required
STP			Recommended	Required

B.13 - REQUIREMENTS FOR THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

I. General.

(a) The purpose of this appendix is to prescribe the minimum performance requirements for ground-based elements of GNSS.

(b) The GNSS must provide position and time data to the aircraft and comply with the technical specifications of Appendix B to Annex 10, Volume I.

Note: Guidance material for the application of GNSS Standards and Recommended practices are defined in Attachment D to Annex 10, Volume I.

II. GNSS Elements.

(a) The GNSS navigation service must be provided using various combinations of the following elements installed on the ground, on satellites and/or on board the aircraft:

(1) Global Positioning System (GPS) that provides the Standard Positioning Service (SPS)
(2) Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA)
(3) Galileo that provides a single- and dual-frequency Open Service (OS)

(4) BeiDou Navigation Satellite System (BDS) that provides the BDS Open Service (BDS OS)
(5) Aircraft-based augmentation system (ABAS)
(6) Satellite-based augmentation system (SBAS)
(7) Ground-based augmentation system (GBAS)
(8) Ground-based regional augmentation system (GRAS)
(9) Aircraft GNSS receiver.

(b) Except as provided in (c), in addition to the requirements prescribed below, GNSS and ground-based GNSS elements and services must comply with the Standards in ICAO Annex 10, Volume I Chapters 3, Appendix B, and Attachment D.

(c) Reserved.

III. GNSS Elements Specifications - Ground-Based Augmentation System (GBAS).

Note: Except where specifically annotated, reference to approach with vertical guidance (APV) means APV-I and APV-II.

(a) *Performance*. GBAS combined with one or more of the other GNSS elements and a fault-free GNSS receiver must meet the requirements for system accuracy, continuity, availability and integrity for the intended operation.

Note: GBAS is intended to support all types of approach, landing, departure and surface operations and may support en-route and terminal operations. GBAS is intended to support en-route, terminal, non-precision approach, departure, and approach with vertical guidance. The following provisions are developed to support Category I precision approach, approach with vertical guidance, and a GBAS positioning service. In order to achieve interoperability and enable efficient spectrum utilization, it is intended that the data broadcast is the same for all operations.

(b) *Functions.* GBAS must perform the following functions:

(1) Provide locally relevant pseudo-range corrections;
(2) Provide GBAS-related data;
(3) Provide final approach segment data when supporting precision approach;
(4) Provide predicted ranging source availability data; and
(5) Provide integrity monitoring for GNSS ranging sources.

(c) *Coverage.*

(1) *Category I precision approach and approach with vertical guidance.* The GBAS coverage to support each Category I precision approach or approach with vertical guidance must be as follows, except where topographical features dictate, and operational requirements permit:

(i) Laterally, beginning at 140 m (450 ft) each side of the landing threshold point/fictitious threshold point (LTP/FTP) and projecting out ±35 degrees either side of the final approach path to 28 km (15 NM) and ±10 degrees either side of the final approach path to 37 km (20 NM); and
(ii) Vertically, within the lateral region, up to the greater of 7 degrees or 1.75 promulgated glide path angle (GPA) above the horizontal with an origin at the glide path interception point (GPIP) and 0.45 GPA above the horizontal or to such lower angle, down to 0.30 GPA, as required, to safeguard the promulgated glide path intercept procedure. This coverage applies between 30 m (100 ft) and 3 000 m (10 000 ft) height above threshold (HAT).

(2) *For Category I precision approach.*

(i) The data broadcast should extend down to 3.7 m (12 ft) above the runway surface.
(ii) The data broadcast should be omnidirectional when required to support the intended applications.

(d) *GBAS positioning service.* The GBAS positioning service area must be that area where the data broadcast can be received, and the positioning service meets the signal in space requirements and supports the corresponding approved operations.

(e) *Data broadcast characteristics.*

(1) Carrier frequency. The data broadcast radio frequencies used must be selected from the radio frequencies in the band 108 to 117.975 MHz. The lowest assignable frequency must be 108.025 MHz and the highest assignable frequency must be 117.950 MHz. The separation between assignable frequencies (channel spacing) must be 25 kHz.
(2) Access technique. A time division multiple access (TDMA) technique must be used with a fixed frame structure. The data broadcast must be assigned one to eight slots.
Note: Two slots are the nominal assignment. Some GBAS facilities that use multiple VHF

data broadcast (VDB) transmit antennas to improve VDB coverage may require assignment of more than two-time slots.

(3) Modulation. GBAS data must be transmitted as 3-bit symbols, modulating the data broadcast carrier by D8PSK, at a rate of 10 500 symbols per second.

(4) Data broadcast RF field strength and polarization.

Note: GBAS can provide a VHF data broadcast with either horizontal (GBAS/H) or elliptical (GBAS/E) polarization that employs both horizontal polarization (HPOL) and vertical polarization (VPOL) components. Aircraft using a VPOL component will not be able to conduct operations with GBAS/H equipment.

(f) *GBAS/H*.

(1) A horizontally polarized signal must be broadcast.

(2) The effective radiated power (ERP) must provide for a horizontally polarized signal with a minimum field strength of 215 microvolts per meter (–99 dBW/m2) and a maximum field strength of 0.350 volts per meter (–35 dBW/m2) within the GBAS coverage volume. The field strength must be measured as an average over the period of the synchronization and ambiguity resolution field of the burst. The RF phase offset between the HPOL and any VPOL components must be such that the minimum signal power defined in Annex 10 Volume I, Section 3.7.3.5 is achieved for HPOL users throughout the coverage volume.

(g) *GBAS/E*.

(1) An elliptically polarized signal should be broadcast whenever practical.

(2) When an elliptically polarized signal is broadcast, the horizontally polarized component must meet the ERP requirements in paragraph (f)(2), and the ERP must provide for a vertically polarized signal with a minimum field strength of 136 microvolts per meter (–103 dBW/m2) and a maximum field strength of 0.221 volts per meter (–39 dBW/m2) within the GBAS coverage volume. The field strength must be measured as an average over the period of the synchronization and ambiguity resolution field of the burst. The RF phase offset between the HPOL and VPOL components, must be such that the minimum signal power defined ICAO Annex 10 Volume I is achieved for HPOL and VPOL users throughout the coverage volume.

(h) Power transmitted in adjacent channels. The amount of power during transmission under all operating conditions when measured over a 25 kHz bandwidth centered on the adjacent channel must not exceed the values defined in ICAO Annex 10 Volume, I section 3.7.3.5.

(i) Unwanted emissions. Unwanted emissions, including spurious and out-of-band emissions, must be compliant with the levels defined in ICAO Annex 10 Volume I. The total power in any VDB harmonic or discrete signal must not be greater than –53 dBm.

(j) Navigation information. The navigation data transmitted by GBAS must include the following information:

(1) Pseudo-range corrections, reference time and integrity data;
(2) GBAS-related data;
(3) Final approach segment data when supporting precision approach; and
(4) Predicted ranging source availability data.

IV. Resistance to Interference.

GNSS must comply with performance requirements defined in ICAO Annex 10 Volume I in the presence of an interference environment.

APPENDIX C TO GACAR PART 173 - SURVEILLANCE EQUIPMENT AND SYSTEMS

C.1– RADAR SYSTEMS

I. General.

(a) This appendix prescribes requirements for primary, secondary and surface movement radar systems and associated equipment, including sensors, external monitor, markers, displays, video maps, and recording.

(b) Unless otherwise authorized by the President, all Surveillance systems intended for use in Air Traffic Management or at civil aerodromes in the Kingdom of Saudi Arabia must comply with the provision of this appendix.

(c) Each aeronautical telecommunication service provider must carry out a range of technical and operational assessments during the lifecycle of Surveillance equipment. The scope and degree of any assessment must cover, at least, the following aspects:

(1) The complexity of the proposed system.
(2) The experience and credentials of the equipment supplier.
(3) The safety classification of the system.
(4) The 'track record' of the equipment.
(5) The Operational Requirement.

II. Identification of Responsibilities.

(a) Each aeronautical telecommunication service provider must identify the technical and operational responsibilities for the Radar equipment and systems.

(b) Each aeronautical telecommunication service provider must designate an entity in charge of safety management system as an appropriate contact, through which GACA would channel requests for data and information.

III. Hazard Analyses.

Each aeronautical telecommunication service provider must produce figures (drawings and

graphics) of how the function of the radar equipment is to fit within the ATC environment. This will consider the effects resulting from a failure or loss of integrity of the equipment and its implications on the safety of the provision of Air Traffic Control services. Such figures would derive the critical components; determine the resultant failure modes and the results of such failures. From such figures, determine the following aspects:

(a) The required reliability and integrity of the system.

(b) Maintainability requirements; e.g. mean time to repair (MTTR).

(c) Degree of design assurance required.

(d) The accuracy and resolution requirements of the system.

(e) Coverage requirements.

(f) Data handling capacity.

(g) The Target Level of Safety (TLS) for the operational service.

IV. Frequency Allocation and Clearance to Transmit.

(a) Each aeronautical telecommunication service provider must submit to the Communications, Space & Technology Commission a request for frequency allocation or for clearance to transmit as follows:

(1) Primary. (Frequency)
(2) Secondary. (Clearance to transmit)

(b) Each aeronautical telecommunication service provider must coordinate the allocation of SSR codes and Primary frequency request with the ICAO MID Region Office.

V. Functional Description.

Each aeronautical telecommunication service provider must prepare a functional description that must explain the function of the radar equipment and must cover:

(a) System interconnections and interfaces to items outside the sub-systems.

(b) Performance requirements.

VI. Design Description.

Each aeronautical telecommunication service provider must prepare a design description that must explain how the discrete elements of the system carry out their function. At this stage the assessment will ensure that integrity of the data is maintained throughout the system. Such an assessment would cover an appraisal of both the hardware and software design and include:

(a) Decomposition of the design from functional description to module level. (This ensures the verification of functions).

(b) An evaluation of hardware reliability.

(c) An evaluation of failure modes: for example, overload situations, handling of no specified inputs etc.

(d) Description of how design decisions are derived from, or refer to, the initial Hazard Analysis.

VII. Testing Regime.

(a) Each aeronautical telecommunication service provider must ensure data integrity by testing of the system as individual packages and at various stages of integration. This assessment must cover:

(1) Testing of specified inputs for correct output.
(2) Testing of correct operation in fault conditions.
(3) Testing for correct handling of corrupt or non-specified data.
(4) Any testing philosophy used. For example boundary testing, path testing, branch testing etc.

Note: It will normally be necessary to evaluate the testing to the level of what tests were undertaken and assessing the results of such tests. The depth of required assessment will reflect the results of the Hazard Analysis.

(b) All these tests must be documented and used as evidence on the level of compliance of the system with the technical specifications.

VIII. Radar System Site Protection.

(a) Each radar system must be safeguarded with criteria which are derived from the following as a minimum:

(1) Operational Range.
(2) Base of Coverage.
(3) Operational Usage.
(4) Equipment Manufacturer's recommended clearances to prevent degradation in the system's performance.

(b) The criteria for safeguarding must include the following for all radar systems:

(1) A Sterile Zone around the antenna to permit clean, uninterrupted beam formation;

(i) Which must be precisely defined with respect to a clear reference point on the antenna system;
(ii) Which must be derived from the vertical and horizontal beam patterns of the antenna type;
(iii) Which must state both the vertical and horizontal extents of the Sterile Zone.

(2) A safeguarded slope must be defined around the system which must assure the system's performance such that it continues to support the operational requirement;

(i) Which must be precisely defined with respect to a clear reference point on the antenna system;
(ii) Which must define the gradient of the slope.
(iii) The criteria should also include consideration of the construction, shape, location, orientation and materials used in any application.

(c) Each aeronautical telecommunication service provider must identify the Sterile Zone and safeguard slope by diagram coverage with a detailed text description.

(d) The safeguard area must cover the airport boundary from ground level.

IX. Flight Trials.

(a) Prior to entering operational service, each aeronautical telecommunication service provide must arrange a flight trial to confirm that the radar achieves its Operational Requirements.

(b) The system performance as defined in the Operational Requirements must be confirmed using an aircraft 'target' and a general traffic study. As the system provides a large coverage volume, tests must be conducted to prove the basic volume, with detailed analysis in operationally significant areas. Such significant areas will include, as appropriate:

(1) Radar handover areas.
(2) Holding areas.
(3) Typical airway routes.
(4) Areas with clutter or reflection problems.
(5) Upper and lower bounds of operational cover.
(6) The approach.

(c) The flight trial must assess the radar sensor in all the configurations intended for operational use.

(d) The flight trial must determine the accuracy and resolution of the system.

(e) The flight trial must contain an appropriate series of maneuvers and transition levels to demonstrate the vertical lobe structure of the radar and this must include maneuvers at 1000, 2000, 4000, 6000, 10000, 20000 feet above the aerodrome reference point and as appropriate to the Operational Requirements.

(f) A 360-degree orbit at a suitable range must be carried out at a level equivalent to the base of required coverage.

(g) Target returns registered in each block of airspace must be recorded and analyzed in order to identify areas of anomalous replies.

X. Accuracy Assessment.

(a) The flight trial must assess the accuracy of the system in the areas of operational significance. The errors in the collection and recording of data must be calculated and justified. Note: This may include:

(1) The resolution error in any recording devices.
(2) The error in the equipment used to determine the aircraft position.

(b) The flight trial must produce at least five error profiles in each of the following areas:

(1) The Approach.
(2) Each Holding Area.
(3) Each radar handover area.

(c) In areas requiring separation standards the flight trial must demonstrate that the appropriate Target Level of Safety (TLS) can be achieved for the required separation standards.

XI. Accuracy Assessment for Radar Approach.

(a) The following accuracy assessment must be achieved for any radar intended for use for such procedures:

(1) Angular error must be less than ±1 degree.
(2) Range error must be less than ±55 + 0.05R meters where 'R' is the range of the respective range check point.

(b) For each Surveillance Radar Approach procedure intended, a minimum of 10 aircraft or helicopter tracked approaches must be carried out.

(c) Where 3 NM Surveillance Radar Approach is proposed, for each approach the target position must be recorded at threshold, 0.5 NM, 1 NM, 2 NM, 3 NM, 4 NM and 5 NM from touchdown and compared against the controller reported position.

(d) For Surveillance Radar approaches terminating at 5 NM or greater, for each approach the target position should be recorded at 0.5 NM, 1 NM, 2 NM, 3 NM, 4 NM and 5 NM from touchdown and compared against the controller reported position.

Note: To assist in the selection of appropriate range points these ranges can be ± 0.25 NM.

Note: The following is a suitable method for obtaining the aircraft position:

(1) Bearing by use of the odolite tracking of a suitably equipped aircraft using trained operators from an approved flight check organization.

(2) Range checking by use of visual reporting points.

(e) Assessment of Maps and Permanent Echoes (PE) as part of the flight trial the accuracy of the video maps and PE must be confirmed.

(f) In the case of the maps a number of significant map features must be chosen and a suitable reference must be determined for each feature.

(g) PE should be selected taking the following factors into account:

(1) There should be at least 3 PE, each separated by more than 60 degrees.
(2) Each PE should not extend over more than 2 degrees of bearing.
(3) Each identified PE should be at least 5 degrees away from other fixed clutter.
(4) Each identified PE should be at greater than one third the standard displayed range.

XII. Resolution Assessment.

(a) The flight trial must assess the resolution capability of the system in terms of the minimum separation standards as required in the Operational Requirements.

(b) The resolution capability of the system must be evaluated in both 'standard' areas and areas of clutter and reflections.

C.2 – RADAR SENSOR REQUIREMENTS

I. General.

(a) The radar sensor must provide a complete, accurate and uncorrupted source of radar data.

(b) Except as provided in (c), in addition to the requirements prescribed in this appendix, Secondary Surveillance Radar (SSR) systems, including Mode S and surveillance systems utilizing Mode S Extended Squitter must comply with the Standards and Recommended Practices (SARPs) in ICAO Annex 10, Volume IV Chapters 2, 3, 5, and and consider ICAO Aeronautical Surveillance Manual, Doc 9924 and Technical Provisions for Mode S Services and Extended Squitter, Doc 9871 in the planning and implementation of such systems.

(c) Reserved.

II. Site Requirements.

(a) After equipment installation, possible site effects and their impact on coverage must be assessed.

(b) Local site obstructions must be shown to be acceptable for the required coverage and operational requirements. This must be provided by a 360 degree representation giving the elevation (in degrees) of any obstruction versus bearing and a 'line of sight' coverage chart for several target heights based on these radar obstructions and using the Radar earth curvature.

(c) Access to the radar and associated equipment must be restricted such that the availability of the air traffic service is not compromised accidentally or intentionally.

(d) The aerial stability limits allocated to the tower must be justified. An analysis of the tower structure must show that limits are met at the stated operating wind speed, ice loading, hail, and sand storm. The assessment method chosen must be in accordance with the relevant standards and requirements in force.

(e) The aerial support structure must be constructed to survive the excesses of once in 50 years wind speed.

(f) The design and testing regime must demonstrate that the equipment operates as required in the chosen environment.

III. Transmitter Requirements.

(a) In accordance with ITU Radio Regulations, the following bands are allocated to primary radar services:

(1) 590 MHz to 598 MHz (50 cm) medium/long range radar services.
(2) 1215 MHz to 1365 MHz (23 cm) medium/long range radar services.
(3) 2700 MHz to 3100 MHz (10 cm) short/medium range radar services.
(4) 9000 MHz to 9200 MHz and 9300 MHz to 9500 MHz (3 cm) short range radar services.
(5) 15.4GHz to 15.7GHz (GMR) very short range radar services.
(6) 34.5GHz to 35.5GHz (ASMI) very short range radar services.

(b) In accordance with ITU Radio Regulations Appendix 2, the following transmitter tolerances must be applied:

(1) Frequency Band Stability Tolerance
(2) 90 MHz–1365 MHz within 500 ppm
(3) 2700 MHz–9500 MHz within 1250 ppm
(4) 15.4 GHz–35.5 GHz within 5000 ppm

(c) Details of transmitter frequency stability must be stated.

(d) A practical trial of ageing effects must show that the inspection intervals are consistent with the required stability.

(e) The frequency of the SSR transmitter must be 1030 MHz.

(f) The output transmitter carrier frequency must have a tolerance of ±0.2 MHz.

(g) The carrier frequencies of the control transmissions and each of the interrogation transmissions must not differ from each other by more than 0.2 MHz and the Polarization of the interrogation, control and reply transmissions must be predominantly vertical.

(h) For Primary radar, the level of any spurious component must be either 50dB down on the mean power in bandwidth or less than 100 mW, whichever results in the least spurious output.

(i) The bandwidth required must be justified.

(j) The equipment must generate the output pulse patterns to minimize the bandwidth required.

(k) The emission classification as defined in the ITU Radio Regulations Article 4 must be stated.

(l) For SSR, the spurious radiation of CW must not exceed -76 dBW.

(m) The existing electromagnetic environment in which the equipment is to operate must be assessed to ensure that the proposed equipment will comply with all requirements. Existing services have operating priority.

(n) All reasonable steps must be taken to reduce the effect of interference.

(o) For SSR the incorporation of side lobe suppression is required.

IV. Spurious Return Reduction.

(a) All spurious return reduction techniques must be defined and justified.

(b) For SSR, the response of SSR ground equipment to signals not within the receiver pass band must be at least 60dB below the normal sensitivity.

V. Accuracy: General.

(a) When used for surveillance radar approach (SRA) purpose (i.e. primary only), the accuracy must be better than 1 degree of bearing and 55 Meters, + 5% of target range.

(b) When used for radar separation, the intended minimum separation standard must be justified.

Note: Guidance on factors to be considered when determining the minimum radar separation to be employed can be found in ICAO Doc. 9426 ATS Planning Manual Part II, Section 2, Chapter 1 and Section 3, Chapter 2.

(c) To ensure that the equipment provided can support this requirement, the radar accuracy distribution must be defined and justified.

(d) The worst combination of error distributions must achieve the TLS.

Note: For the system configurations covered by this document the required TLS, expressed as the probability of horizontal overlap due to loss of accuracy, is generally accepted to be 7 x 10-7 per event (i.e. two adjacent targets) which uses the radar separation minimum. The TLS depends on the operational purpose of the system.

VI. Accuracy Determination.

(a) The radar systems that produce the radar data used for separation must be assessed.

(b) For a remote secondary surveillance radar (SSR) used in conjunction with a local primary the following errors must be assessed:

(1) Error in slant range correction, if applied.
(2) Error in prediction of position due to differing scan rates.
(3) Error due to the curvature of the earth when transferring the centre of one volume to another centre.

(4) Stability and accuracy of original plots.
(5) Tolerance error in detected position of site marker.
(6) Provision of SSR and/or Primary marker.
(7) Allowable error in combination box.
(8) The plot delay must be acceptable in respect of the Operational Requirement (OR). This assessment must consider both the mean delay and the distribution of the delay.

(c) The error in range and bearing between the following must be less than ± 2 degrees in azimuth and ± 3% of target range:

(1) The aircraft position reported by SSR and primary radar
(2) The reported SSR monitor position and the video map.
(3) The reported SSR monitor position and the known monitor position.

(d) The maximum time in store for the radar data must not exceed the time taken for 90 degrees of aerial rotation.

VII. Plot Extractor Effects.

(a) The algorithm chosen to determine the center and run time of the target must be defined and justified.

(b) The effect of the plot extractor on resolution and the accuracy error budget together with theoretical justification must be defined.

Note: This is not necessary where the intention is to use the SSR purely as an overlay for height separation purposes.

(c) The processing precision must be sufficient to meet the error budget for the system accuracy and resolution.

(d) If plot processing is used (i.e. to decrease the effect of garbling and reflection) any effect on detection must be defined and justified.

(e) The position of the radar relative to the coverage volume desired must be justified.

Note: If the radar head is not at the center of the desired cover the error may differ in each sector.

(f) The distribution of any misalignment errors between two sensors must be justified.

(g) Where two sensors are not co-sited (for example, assigned services) the analysis must include the position conversion error.

VIII. Radar System Beam Width.

(a) A system beam width plot ±10 degrees of bore-sight or 40 dB down on peak power, whichever the plot reaches first, must be developed.

(b) In systems that rely on multiple beam patterns, the plot must show the interaction of the beam patterns.

(c) In systems that have user adjustable beam width, methods recommended for the assessment of changes must be stated.

(d) Demonstration of the beam patterns must be carried out on a test range.

(e) The effect of beam width on accuracy, resolution, system loading and garbling must be defined and justified.

IX. Rotation Rate.

(a) The effect of rotation rate on system performance must be defined and justified.

(b) A primary radar providing the positional data for the following services must rotate at the following effective minimum turning rates:

(1) General TMA Zone and approach work, a rotation rate of 5 RPM.
(2) SRA to 2 NM, a rotation rate of 10 RPM.
(3) SRA to 1 NM, a rotation rate of 15 RPM.
(4) SRA to 0.5 NM, a rotation rate of 20 RPM.

X. Resolution.

For 3 NM separation the equipment must resolve two targets at 1 NM separation and for 5 NM separation the equipment must resolve two targets at 3NM, both to a probability of 95% or greater throughout the required azimuth and range as defined in the Operational Requirements.

Note: It is likely that any areas not meeting this figure are the result of the relative location of the

Radar Sensor to the traffic pattern. Such degradation can only be permitted if special rules are proposed for the separation of traffic for these areas.

XI. Coverage.

(a) The radars must have a theoretical coverage, in the areas of the Operational Requirements, which corresponds to 80% detection of the returns from a 1 m2 target. This increases to 90% for areas providing Surveillance Radar Approach procedures. For primary targets this theoretical cover must assume Swerling case 1 targets.

Note: This coverage requirement applies to both primary and SSR sensors if separation standards between primary, reinforced and SSR only plot positions are applied.

(b) Primary and SSR sensors must have their performance continuously monitored. An alarm must be raised when coverage cannot be met.

(c) Where the use of the primary radar system includes Surveillance Radar Approaches the coverage must be suitable for the termination distance.

XII. SSR Coverage.

(a) For services that use SSR for separation purposes a formal coverage specification must be constructed.

Note: Where the provision of the SSR service is for an overlay only service, to aid target identification, no formal coverage specification is required.

(b) The output power of SSR or primary radar must not exceed the approved level.

(c) For the secondary radar system details of the link power budget must be defined. This link budget must show that the system achieves coverage in both range and elevation.

(d) Where interrogation side lobe suppression (ISLS) is used, the amplitude of P2 must be between 0dB and +3dB above the nominal greatest side-lobe level. The amplitude of P2 must be greater than 9dB below the nominal level of P1 in the main beam.

(e) Where improved interrogation side-lobe suppression (IISLS) is used, in addition to the requirements of 3.8.2.4, the level of P1 must be within 3dB of P2.

(f) The control channel response must be greater than 3dB above the response of the interrogator channel outside the nominal bore-sight angle for receiver side-lobe suppression (RSLS).

(g) The pulse spacing must comply, where appropriate, with Section 3.1.1.4 and Section 3.1.2 of ICAO Annex 10, Vol. IV, and Chapter 3.

(h) The Reply Transmission Characteristics (SIGNALS-IN-SPACE) must comply, where appropriate, with Section 3.1.1.6 of ICAO Annex 10, Vol. IV, and Chapter 3.

(i) Interrogator and Control Transmission Characteristics must comply, where appropriate, with Section 3.1.1.7 of ICAO Annex 10, Vol. IV, and Chapter 3.

(j) Where the equipment uses reflection suppression, the effects of this on system performance must be defined and justified.

(k) The de-garble capacity and performance of SSR extractors for the amount of traffic and the separation standard required must be justified.

XIII. Data Handling Requirements.

(a) Operational requirements must consider the required processing load in terms of:

(1) The number of aircraft targets expected. This must be based on overall load and sector peaks. This load must include all targets within the coverage of the sensor.
(2) The worst case weather conditions.
(3) Any roads within the radar coverage.
(4) Any fixed clutter patterns.

(b) During operational trials the equipment must monitor the processor and memory loading distribution of each sub-system.

(c) The probability of 100% processing load in any sub-system should be less than 0.01.

(d) The data precision used must be consistent with the positioning performance required from the system.

(e) The system data must achieve the operationally required level of integrity.

(f) The equipment must contain error detection systems to ensure appropriate data integrity during operation.

Note: An integrity loss has the effect of reducing the accuracy of the presented information.

(g) To ensure that any radar data processing equipment connected to the sensor can correctly identify the source of the data, the chosen data transmission standard must support source identification.

(h) Identification codes must be unique.

Note: The allocation of identification codes is entirely at the discretion of the Applicant, with regard to the codes already in use in the system.

XIV. Radar Recording.

Any radar service used in first line Distress and Diversion must be fitted with radar recording equipment.

XV. Default Parameters.

All default values must be stated.

Note: Default settings control such items as filter settings, clutter level defaults, fixed arithmetic offsets, feedback loops etc.

Note: This does not apply to arithmetic constants fixed in the equipment design.

XVI. Monitoring Requirements.

(a) All radar systems must have methods available to determine the alignment.

(b) For an analogue primary radar the system must use appropriate video outputs to check the range/bearing error based on Permanent Echoes (PE). The controller or maintenance engineer must check such figures at suitable intervals.

(c) The system must identify at least three PE, each separated by more than 60 degrees. Each PE must be at a range greater than one third of the standard display range. In addition the separation of each PE from other permanent features must be at least 3 degrees in azimuth and ±0.5 nautical mile in

range.

(d) Where an analogue only channel is not provided and therefore PEs cannot be displayed, an active test target (MTI runway marker) must be used for alignment checking.

(e) The position of any active test target (MTI runway marker) must be as near to threshold as practical.

Note: For systems that use SSR in conjunction with primary, there are further options. First, that the SSR system has an independent site monitor. Second, that there is a procedure in place to determine the collimation error between the secondary and the primary data. This procedure can take the form of the ATC operator checking the errors on screen, or equipment that checks the error. Such a check could be part of the Plot Assignor/Combiner equipment.

(f) The SSR site transponder and monitoring system must monitor those radar parameters which affect detection, performance, accuracy or resolution.

XVII. Remote Control and Monitoring System (RCMS).

(a) Based on ICAO Annex 11 provisions, GACAR Part 171 requires that a procedure be in place that informs ATS units of the operational status of the equipment used for controlling takeoff, departure and approach to land. The system must report any failures that will put restrictions on the performance or abilities of the equipment. How the system achieves this must be defined and justified.

Note: An electronic system or a procedural reporting method from the maintenance department or to ATC can be used.

(b) If a failure of a sub-system occurs, the remote control and monitoring system or the manual reporting system must record a hard copy of the event. It must indicate, where possible, the cause of the event.

(c) The RCMS information required depends on the configuration, and the ATS provider’s intention to provide service in reduced redundancy. However, the following minimum information must be available:

(1) An indication of present operating configuration.
(2) An indication of unavailable sub-systems.

(d) The RCMS must enable the operator to select the correct course of action. The intended operating procedures must be submitted for approval.

(e) Any configuration changes undertaken by remote control must not conflict with local control.

XVIII. Reliability.

(a) The reliability of the radar sensor as appropriate to the Operational Requirements must be justified.

(b) The expected reliability either from theoretical analysis or a practical trial must be demonstrated. This reliability assessment must extend to the power supplies and landlines. The reliability analysis must be combined with a hazard analysis to produce a functionally based reliability analysis.

(c) The reliability assessment must state the method chosen and the chosen environment.

XIX Mean Time to Repair (MTTR).

(a) The mean time to repair must be specified and justifiably appropriate to the Operational Requirements.

(b) When operating in reduced redundancy the system provider must show that adequate safety mechanisms exist, including:

(1) Equipment identifies that no standby is available.
(2) Maintenance procedures identify the priority for repair that must occur.
(3) Operating procedures identify the smooth transition to another service type in the case of loss of remaining equipment.

(c) The documentation and skills/training necessary to achieve repair times must be defined.

(d) The maximum time taken to establish full operating conditions following a power supply interruption must be justified.

C.3 – TRANSPONDER PROTOCOLS

I. Requirements.

(a) Interrogation modes (ground to air) for Air Traffic Services must be performed on the modes described in Chapter 2 & 3 of Annex 10, Volume IV. The uses of those modes must be in accordance with the provisions of Annex 10, Volume IV, and Chapter 2.

(b) The ATS provider authorized under GACAR Part 171 must establish the procedures for the allotment of SSR codes in conformity with Regional Air Navigation agreements, taking into account other users of the system.

(c) Appropriate provisions must be made in ground decoding equipment to ensure immediate recognition of Mode A codes 7500, 7600 and 7700.

(d) Mode A code 2000 must be reserved to provide recognition of an aircraft which has not received any instructions from air traffic control units to operate the transponder.

Note: Mode A/C and Mode S transponders are those which conform to the characteristics prescribed in Annex 10 Volume IV, Chapter 3. The functional capabilities of Mode A/C transponders are an integral part of those of Mode S transponders.

II. Systems Having only Mode A and Mode C Capabilities.

(a) The carrier frequency of the interrogation and control transmissions must be 1 030 MHz. The frequency tolerance must be plus or minus 0.2 MHz.

(b) The carrier frequencies of the control transmission and of each of the interrogation pulse transmissions must not differ from each other by more than 0.2 MHz.

(c) The carrier frequency of the reply transmission must be 1 090 MHz.

(d) The frequency tolerance must be plus or minus 3 MHz.

(e) Polarization of the interrogation, control and reply transmissions must be predominantly vertical.

(f) The interrogation modes, control transmission and technical characteristics of transponders must comply with the provisions of Annex 10, Volume IV, Chapter 3.

(g) The two types of standard length communications protocols are Comm-A and Comm-B; messages using these protocols are transferred under the control of the interrogator. The technical characteristics of these communications protocols must comply with the provision of Annex 10, Volume 4, and Chapter (h) Comm-A messages must be sent directly to the transponder and must be completed within one transaction. A Comm-B message must be used to transfer information from air to ground and can be initiated either by the interrogator or the transponder. In the case of ground-initiated Comm-B transfers, the interrogator requests data to be read out from the transponder, which delivers the message in the same transaction. In the case of air-initiated Comm-B transfers, the transponder must announce the intention to transmit a message; in a subsequent transaction an interrogator will extract the message.

Note: In a non-selective air-initiated Comm-B protocol all transactions necessary can be controlled by any interrogator.

Note: In some areas of overlapping interrogator coverage there may be no means for coordinating interrogator activities via ground communications. Air-initiated Comm-B communications protocols require more than one transaction for completion. Provision is made to ensure that a Comm-B message is closed out only by the interrogator that actually transferred the message. This can be accomplished through the use of the multisite Comm-B communications protocols or through the use of the enhanced Comm-B communications protocols.

Note: The multisite and the non-selective communications protocols cannot be used simultaneously in a region of overlapping interrogator coverage unless the interrogators coordinate their communications activities via ground communications.

Note: The multisite communications protocol is independent of the multisite lockout protocol. That is, the multisite communications protocol may be used with the non-selective lockout protocol and vice versa. The choice of lockout and communications protocols to be used depends upon the network management technique being used.

Note: The broadcast Comm-B protocol can be used to make a message available to all active interrogators.

C.4 – SSR EXTERNAL MONITOR REQUIREMENTS

I. General.

(a) This appendix sets out the required functions, positioning and operating conditions of SSR external monitoring equipment.

(b) The external monitor must provide accurate reference information to test the transmission, reception and decoding characteristics of the SSR service in conjunction with the range and azimuth accuracy of the ground interrogator.

II. Functional Requirements.

(a) If the SSR service is to be used without a primary radar, an external site monitor must be provided.

(b) The external monitoring equipment must continuously monitor those radar parameters which affect detection performance, accuracy or resolution. This includes parameters such as the following:

(1) Target bearing.
(2) Target range.
(3) Peak power.
(4) Side Lobe Suppression.
(5) Pulse spacing.

III. Siting Requirements.

(a) The positioning of the SSR monitor will depend on the use of the equipment. Where the controller uses the monitor to assess collimation errors the monitor must be sited within the range that the ATS operators can view. The bearing chosen must correspond to an area of airspace commensurate with the operational situation; the position must not conflict with operationally sensitive areas.

Note: This does not imply that the controller should continuously check the position but merely that a suitable range setting must be available to the controller.

(b) Where an equipment sub-system, under the control of the user, uses the monitor to assess collimation errors, the monitor must be within the nominal coverage of the radar. If the monitor is at a

range greater than the normal range displayed to the controller, a reporting procedure must be in place.

(c) Where a sub-system, not under the control of the user, uses the monitor to assess collimation errors, the monitor must be within the nominal coverage of the radar. If the monitor position is outside the normal defined area displayed to the remote controller, a reporting procedure must be in place. This procedure must report alarms from the system provider to the service user. The originator of the service, not the remote user, must identify and notify the remote users of any collimation errors determined.

(d) The SSR monitor must be located at a range greater than 4 km from the radar head, unless otherwise justified.

(e) The monitor must be set up to report its true position in range. This allows easier coordination with other users. Where operational considerations make this undesirable, the monitor must not be visible from any other operational radar service.

Note: If this is not possible, a written agreement to the installation must be obtained from the owners of the affected systems.

(f) The Mode A code for the SSR Site Monitor must be 7777 unless specific approval is granted by the President for a different code.

C.5 – PRIMARY APPROACH RADAR MARKERS REQUIREMENTS

I. General.

When a primary airport radar is intended to be used for Surveillance Radar Approaches (SRA), a particular configuration of fixed returns or markers is required. This appendix sets out the requirements for siting of these markers.

II. Marker Requirements.

Any radar fitted with a processor to extract fixed clutter will not see passive targets, therefore, one of the following must be provided:

(a) A raw radar feed for calibration purposes. This feed must be independently aligned with the processed radar feed;

(b) An active test marker; or

(c) Areas of radar coverage which are inhibited from processing.

III. Required Marker Siting.

(a) There are no requirements for extra markers for an SRA with termination range of 3 NM or greater from threshold.

(b) For approach radar services providing SRA less than 5 NM but not less than 3 NM, bracket markers are not required. However, centerline markers, as described in 5.4.3 must be provided.

(c) There must be two non-permanent Centerline markers available. These must be located as follows:

(1) Within 2 degrees of the applicable approach centerline.
(2) Between 3 and 6 NM of the applicable touchdown point.

Note: For aerodromes with reciprocal approaches, one permanent marker on each approach path may be used.

(d) The Bracket Marker Siting must be as follows:

(1) There must be two permanent markers available that enable the identification of runway touchdown point. These permanent markers must be positioned equidistant from the runway centerline at the instrument touchdown point.
(2) The distance from the runway edge must be the minimum commensurate with runway operations but not closer than 15 meters from the runway edge.

(e) As this site is within the clear and graded area, the support structure must be frangible and less than 0.9 meters high above local ground level.

IV. Use of Markers.

(a) The sets of markers must allow the controller to confirm the correct position of the SRA approach line.

(b) The marker system must contain an active monitor that checks the primary radar performance.

Such primary radar monitors must evaluate:

(1) Primary radar spectrum.
(2) Primary radar power level.
(3) Primary radar beam width.

C.6 - RADAR DISPLAY REQUIREMENTS

I. General.

(a) This appendix sets out the technical requirements relating to those safety standards that are concerned with the approved use of radar displays by Air Traffic Control units operating under GACAR Part 171.

(b) This appendix applies to all display equipment used for the presentation of radar derived position and identification data used for the provision of air traffic services.

(c) The radar display system must preserve the accuracy, availability and integrity of the input data and reproduce it in an unambiguous and clear manner.

II. Display Characteristics.

The following must be assessed to determine suitability/appropriateness for the operational requirement:

(a) Screen area and corresponding displayed range.

(b) The number of display lines. The number of lines must be greater than 1000*1000.

(c) Linearity and screen astigmatism.

(d) Frame refresh rate. Frame refresh must be 75 Hz (or greater), non-interlaced.

(e) Selection of synthetic phosphor decay.

(f) Ability to display system status information.

(g) The chosen display brightness and luminance and their variation.

(h) The ambient lighting.

(i) The color set must be assessed as appropriate for the operational requirement. Some colors must be reserved for future requirements.

(j) A system must be in place that allows the color set to be calibrated.

(k) Color calibration checks must be carried out at intervals appropriate to the system stability.

III. Symbology.

(a) The symbology set selected must be assessed for suitability to the Operational Requirements.

Note: The on-screen positioning of menu selection and video map symbology is of particular importance.

(b) The equipment must not display any symbol indicating the position of particular filtered targets.

(c) The equipment must draw the attention of the controller by flashing the associate label if it detects one of the emergency codes listed below:

(1) 7700 : SOS
(2) 7600 : RT FAIL
(3) 7500 : HIJACK

(d) An audible alarm must also be sounded for the emergency codes listed in (c).

(e) The equipment must display both the emergency code and the previous call sign or code if unconverted.

(f) The symbol size must not vary with displayed range.

Note: Some features, map features for example, will be scaled according to their significance on the displayed ranges.

(g) Where the display automatically moves the labels to various positions (to prevent label overlapping) the equipment must provide leader lines.

(h) The display contrast control must not be made available to ATC staff.

IV. Design.

(a) The display specification must be related to the operational requirement both in functional and performance terms.

(b) Allowable error budgets for the display system must be calculated and justified.

(c) The following parameters must be specified and justified in relation to the Operational Requirements, technical specification and hazard analysis, as appropriate:

(1) Resolution.
(2) Accuracy.
(3) Precision.
(4) Max/Min ranges.
(5) Data load ('analogue' plus 'synthetic') and processing time. If the equipment is subjected to a high data load the operator must be given a warning of the data that is shed. For systems using remote SSR data for overlay, data discard should take place progressively from long range.
(6) MTBF.
(7) MTTR.
(8) Input type. Analogue, data formats, data transmission rates.
(9) Environmental performance.
(10) EMC performance.
(11) Quality standards applicable to equipment design, both hardware and software, must be stated.
(12) Correct identification of radar source by validating radar source code.
(13) Identification of appropriate data input faults. This information must be indicated within one radar scan interval.

V. Functional Parameters.

(a) The system must be capable of showing the source of all data that the controller has selected for display on the radar display.

(b) If a remote SSR data source is used the radar identification code must be decoded and displayed on the screen.

(c) Return to default settings must be achievable via the 'top level' menu.

(d) The region of the boundary where composite picture processing is being used must be indicated.

(e) The display must be capable of displaying QNH values.

(f) Any manual changes to this value must be validated by double entry.

(g) When it is possible to change the QNH remotely, the equipment must require the change to be drawn to the controller's attention and confirmed on all other displays.

(h) When the equipment can filter out targets by area, type or height, the equipment must be capable of displaying the parameters of such filters.

(i) Equipment must be fitted with a filter override allowing all targets to be displayed quickly.

(j) The brightness range, both overall and for individual screen elements, must be restricted to the range determined in the color assessment trial.

Note: It should not be possible to delete radar targets completely by use of this control.

(k) Target and map brightness must be independently variable.

(l) The equipment must have the following operator functions as minimum:

(1) Selection of display ranges.
(2) Display off center.
(3) Choice of maps.
(4) Range rings on/off.
(5) Choice of leader line length, SSR label block rotation and positioning.
(6) Prediction data, code/call sign selectivity.
(7) Choice of character size.
(8) Menu selection/positioning.
(9) Acceptance of error/alert messages.

(m) The equipment must be fitted with facilities to record the data and display settings in accordance with the provisions of Appendix C.10.

C.7 – AERODROME TRAFFIC MONITOR SAFETY REQUIREMENTS

I. General.

(a) This appendix applies to all surveillance sensor equipment providing data for an aerodrome ATS. The following requirements are applicable for the installation and use of equipment provided for the aerodrome traffic monitor. This appendix covers all systems using surveillance data from local or remote surveillance sensors or both.

(b) The Aerodrome Traffic Monitor equipment must be accepted by the President.

(c) An aerodrome traffic monitor must provide accurate and uncorrupted data suitable for all the functionalities that will be performed using the Aerodrome Traffic Monitor.

(d) An aerodrome traffic monitor may be provided at certain aerodromes to assist in achieving maximum runway utilisation and aerodrome capacity. The aerodrome traffic monitor must not be used as an ATS surveillance system to provide Approach Radar Services. The information derived from the aerodrome traffic monitor may be used to:

(1) determine the landing order, spacing and distance from touchdown of arriving aircraft;
(2) assist in applying longitudinal separation for departing aircraft and monitor the progress;
(3) enable the air traffic controller or AFISO to confirm that the initial track of a departing aircraft conforms with the clearance issued;
(4) provide information to aircraft on the position of other aircraft in the circuit or carrying out an instrument approach;
(5) following identification, validate SSR codes of departing aircraft and verify associated Mode C read-outs;
(6) for ATC TWR, monitor the progress of overflying aircraft identified by Approach Surveillance Control to ensure that they do not conflict with the tracks of arriving or departing aircraft;
(7) pass traffic information;
(8) for ATC TWR, assist in checking the flight path in the event of a missed approach; and
(9) assist in taking initial corrective action when there is a doubt in the sequencing between arriving aircraft.

(e) The use of aerodrome traffic monitor during the provision of ATS services must comply with the following:

(1) the air traffic controller or AFISO has undertaken specified training;
(2) for ATC TWR, the air traffic controller is only providing an Aerodrome Control Service and a separate Ground Control Service is being provided by another controller on a separate frequency; and
(3) the procedures are detailed in ATSPM Part 2 as required under GACAR Part 171.

(f) ATS Units where Aerodrome Control and Ground Movement Control are combined are exempt from the requirement of paragraph (e)(2) above, if the ATS service Provider certified under GACAR Part 171 can demonstrate through a safety risk assessment that the use of aerodrome traffic monitor is safe.

II. Performance Requirements.

(a) In normal operation the aerodrome traffic monitor must not display traffic more than 20 NM and not less than 10 NM from the runway touchdown zone.

(b) The radar position displayed must be within 0.5 NM of the true aircraft position.

(c) The radars used for display must detect targets down to at least 200 feet below the minimum sector altitude. In the runway approach zone the radar must detect targets down to 100 feet below the nominal glide angle to the terminating range.

III. Functional Requirements.

(a) The display must show the runway centerline.

(b) The video map must indicate the threshold position.

(c) The equipment must resolve two targets at 1 NM separation.

(d) The labels must not cross at 2 NM separation.

IV. Display.

(a) The screen size must be capable of displaying a circle of at least 6 inches (15 cm) diameter.

(b) The display must be readable in all ambient light conditions.

(c) The display must be readable over a range of viewing angles, both vertically and horizontally.

(d) Displays requiring viewing hoods must not be used.

Note: High intensity daylight viewing displays and/or brightness controls fitted to the equipment can achieve the same effect.

(e) Color must not be used for information coding.

Note: Displays may use color but only in conjunction with brightness and symbology to aid de-cluttering of screen information.

(f) The aerodrome traffic monitor equipment must be positioned so that the operational controller can easily note and act on the information shown.

(g) At a unit where the controller has clearly defined and fairly narrow tasks to perform the orientation must be such that the runway on the aerodrome traffic monitor is aligned with the view of the runway from the control position.

C.8 – ERGONOMIC ASPECTS OF RADAR DISPLAY SYSTEMS

I. General.

(a) All radar systems require an input device to enable the operator to configure the display as required. This interface clearly affects the efficiency of the operator and can affect the safety of operation. An assessment must be carried out to confirm the adequacy of the chosen design.

(b) This appendix prescribes rules concerning specifying and testing the adequacy of the Human Machine Interface (HMI). It applies to all displays used for presenting air traffic service's (ATS) radar data at aerodromes.

II. The Specification of the Radar Display HMI.

(a) The specific operational requirement for the equipment must be defined.

(b) A formal ergonomic evaluation must be carried out to ensure that the safety of the ATS is not compromised.

(c) The input device must give immediate confirmation of selection.

Note: This does not mean that the equipment must carry out the function selected immediately.

(d) The selection time must correlate with the priority level.

Note: This is defined as the time between first confirmation of activation and function available.

(e) The system must indicate its indeterminate state during the time between confirmation of activation and function available.

(f) All input must be prohibited, except cancellation, during this wait period.

III. Input Devices Technical Requirements.

(a) The input devices must not mislead or hinder the operator or be capable of unintended action.

(b) All menus must be appropriately positioned.

(c) Equipment must locate each medium priority function not lower than the third page of any menu.

(d) Each page must have an available selection to return up one level, return to top level and exit.

C.9 – VIDEO MAP GENERATION EQUIPMENT REQUIREMENTS

I. General.

(a) All radar display systems have a method of providing the controller with reference information. This allows a controller to determine the relationship between aircraft position and ground or airspace positions.

(b) Although such systems can take various configurations, the procedures surrounding the systems will all take the same form. This appendix applies to all radar display equipment providing data for ATS providers authorized under GACAR Part 171.

(c) This appendix covers all equipment used to produce or display information making up the fixed radar video map. This includes overhead projection, etched plates, independent video map generators or on-system video maps.

(d) This appendix also covers the following areas:

(1) Procedures for the update control of video map data.
(2) Responsibilities for the update of video map data.
(3) Requirements for the coordinate system used for transfer of data.

(e) The video map generation equipment must provide complete and accurate reference data for ATS.

II. Procedure for Production and Update of Video Maps.

(a) Video map generation must be subject to formal configuration management.

(b) Each map or generation of map must be given a unique identifying label. The map as displayed on the equipment must display this label. In addition, documentation must use this label to show the origin and contents of the information used on the map.

(c) A suitably qualified engineer must carry out this function.

(d) The individual elements to be included on the map must be identified and documented in the Operational Requirement.

(e) The definition of such elements must be in terms of ATS requirements. These elements must include the following:

(1) Visual reporting points.
(2) Adjacent airfields.
(3) Adjacent areas of flying activity. For example, hang gliding sites, parachuting sites, etc.
(4) Danger areas, prohibited areas etc.
(5) Limits of controlled airspace.
(6) Runway extended centerlines.
(7) Map north marker.

Note: For certain ATS units additional points may be required.

(f) The identified features must be referenced to defined geodetic coordinates. In addition, the procedure must state the geodetic system used to define these geographical locations.

(g) The procedure must define the conversion of the geographical coordinates to the system geometry. It must also state the algorithms or processes used to convert this data.

(h) Provisions must be made to check the displayed data for accuracy and completeness.

(i) The original production or change request must be compared with the resulting map information. This must include a procedure for checking the absolute accuracy of the displayed maps. The ATS provider must carry out the verification.

(j) The final user must evaluate the whole map prior to introduction to service.

(k) A procedure must exist to ensure that the map always contains all operationally significant information.

III. Responsibilities for Control of Video Maps.

The video map documentation must identify all posts responsible for the control of the video maps.

IV. Tolerances on Video Map features.

(a) For a display used for SRA, all features used in the SRA zone must be accurate to within 5% of range scale +55 meters (180 feet) in range and within 1 degree measured from the airfield reference point.

(b) For raster scan display systems, all features must be accurate to within the resolution of the display.

(c) For all other features accuracy must be within 450 meters (0.25 NM).

V. Evaluation of Video Maps.

(a) At least three features of new video maps must have the accuracy assessed as part of the flight trial for the equipment. The tolerance on this accuracy must be better than 900 meters (0.5 NM).

(b) The accuracy assessment must ensure that the features shown correspond identically to those displayed at adjacent ATC units.

(c) New SRA maps must be assessed for bearing and range error at 6 NM, 5 NM, 3 NM, 2 NM, 1 NM and 0.5 NM as appropriate to the intended SRA termination range. The assessment must be by use of an aircraft with independent positioning equipment on board an aircraft or fixed ground mounted reflection sources.

(d) Methods independent of the original source must be used for proof of changes which are independent of the original source.

VI. Mapping Coordinate System.

The video maps must be in WGS84 format.

C.10 – RADAR RECORDING EQUIPMENT REQUIREMENTS

I. General.

(a) The use of radar recording equipment falls into three areas:

(1) The provision of data for post accident or post incident investigation.
(2) To provide location data in the event of search and rescue.
(3) For use in testing the performance of the radar sensor, processor and display system.

(b) This appendix applies to all radar sensor equipment providing data for ATS and where radar recording equipment is required.

(c) Surveillance data used as an aid to Air Traffic Services must be recorded to comply with the ICAO Standard in Annex 11, section 6.4.1. This includes Primary Radar, SSR, Automatic Dependent Surveillance (ADS), Multilateration and Surface Movement Radar (SMR).

II. System Performance.

(a) The data recording system used must not degrade the performance of the radar display and processing system.

Note: Degradation includes any effect on the data integrity, the update rate, plot delay or plot handling capacity.

(b) Radar recording equipment must have an accurate time source fitted.

(c) This time source must be synchronized with the main station time source and thus to Universal Time (Coordinated)(UTC time).

(d) The radar recording time source must be synchronized with the main station time source to a

tolerance of within ± 5 seconds.

(e) The radar recording equipment must record primary, secondary and surface movement radar data.

Note: This applies whether the data is analogue or plot extracted.

(f) The radar recorder must record the following data where received from the radar sensor:

(1) The plot position relative to a known datum.
(2) Mode A, C and S data, where appropriate.
(3) Type of plot, for example PRI only, SSR only, combined or assigned.
(4) Time of plot.
(5) Radar source.
(6) The recorder must incorporate features to ensure continuity between recordings.

(g) The device used for radar recording must not be capable of erasing any recorded data.

(h) Erasure equipment should be separate from the recording apparatus.

(i) The error rate of the recording equipment must be defined and justified.

Note: The recording system may use any suitable recording medium that meets the storage time and data interval time specified in this document.

(j) The following operating procedures must be in place at sites where radar recorders are mandatory:

(1) The recorded data must be kept for a minimum of sixty days after the end of the recording, or longer periods as directed.
(2) Suitable storage precautions must be taken for the prevention of the deterioration, theft, damage or tampering with the stored data.
(3) Suitable measures must ensure that:

(i) No recording is erased within 60 days.
(ii) All access to the stored data is recorded.
(iii) Authority under which any recorded radar data leaves the site for replay or duplication is recorded.
(iv) The identity of the person or organization taking charge of the recorded radar data is

recorded.

Note: ATS providers under GACAR Part 171 are required to document and implement operating procedures as well.

III. Playback Functions and Facilities.

(a) The radar recording and radio telephone (RTF) recording equipment must be integrated to allow synchronized play-back.

(b) Radar recording and play-back equipment must be integrated into the display equipment.

(c) The data recorded must allow the replay equipment to replicate the overall data presented to the controller. This includes the following:

(1) Map in use.
(2) Range in use.
(3) Display brightness.
(4) Error messages.
(5) Display windows.
(6) System settings, character size.
(7) Range offsets in use.
(8) Display orientation.

(d) Equipment must be provided to allow replay and duplication of recorded data. Duplicate copies must be marked clearly to this effect.

(e) The use of replay and duplication functions must not cause a break in the recording

(f) The play-back equipment must be capable of producing hard copy of the recorded aircraft tracks.

(g) Provisions should be included that enable the replay of recorded radar data near to the control position within a short interval of an event occurring. Actual times may vary with the event and a strategy should be devised to ensure that an appropriate response can be made.

Note: To enable, for example, the use of recorded data for search and rescue purposes.

C.11 – SURVEILLANCE SYSTEMS FOR AERODROME SURFACE SURVEILLANCE REQUIREMENTS

I. General.

(a) This appendix defines requirements for surveillance systems used for aerodrome surface surveillance such as Surface Movement Guidance and Control System (SMGCS) and Advanced Surface Movement Guidance and Control System (A-SMGCS). Each System must provide clear and unambiguous surveillance data to aid the guidance, movement and control of airport surface traffic.

(b) The surveillance sensors providing data for aerodrome surface surveillance systems may comprise of a single non-co-operative sensor such as a Surface Movement Radar (SMR) or a combination of a non-co-operative and multiple co-operative sensors.

(c) The requirements in this section:

(1) are specially concerning the performance of the surveillance systems and sensors, processing and display of surveillance data, where SMR or other form of surveillance sensors form part of the SMGC or A-SMGCS system at an aerodrome.
(2) apply to all co-operative and non-co-operative surveillance sensors providing data for an aerodrome surface surveillance system. Where possible, special requirements applicable for SMR and co-operative sensors have been identified separately.

II. General Requirements.

(a) Where surveillance data from SMR and/or other surveillance sensors are required to support the surface movement surveillance of an aerodrome, the required performance criteria must be identified based up on the following factors:

(1) The minimum visibility conditions the aerodrome normally operates;
(2) The traffic density and complexity of the movements;
(3) The design and layout of the aerodrome.

(b) The aerodrome surface surveillance system must be designed to be capable of expansion to accommodate complex operations, larger coverage area and various sizes of aircraft and vehicles that may operate in the aerodrome in future.

III. Coverage of aerodrome surface surveillance.

(a) The areas of aerodrome surface for which surveillance coverage using SMR or other sensor equipment must be defined. The horizontal coverage of the surveillance sensor(s) must extend over the required area of coverage.

(b) The vertical coverage must be suitable for monitoring all traffic on the aerodrome surface and during aircraft final approach and initial climb.

(c) Where the surveillance sensors are providing partial coverage of the aerodrome surface, other means of surveillance must be in place to monitor traffic on the areas not monitored by surveillance sensor equipment.

IV. Detectability under Adverse Weather.

The Surveillance sensor(s) must be capable of detecting all surface traffic in the required area of coverage under the worst weather conditions including lowest visibility under which the aerodrome operations must continue.

Note: All surface traffic should mean all aircraft and vehicles for a non-co-operative sensor and all co-operative traffic for other means of surveillance such as MLAT and ADS-B.

V. Mixed Equipage Environment.

Where both co-operative and non-co-operative traffic operate in the defined coverage area, sensors must be implemented to detect both co-operative and non-co-operative targets throughout the coverage.

VI. Resolution, accuracy and update rate.

(a) The horizontal resolution of the surveillance sensor equipment must be determined by a safety assessment for the specific aerodrome.

(b) The accuracy requirement for surface surveillance systems must be determined by a safety risk assessment for the specific aerodrome.

(c) The update rate must be at least once per second. The setting of this rate must be decided taking to account the speed of movements between aircraft and vehicles and their dimensions.

VII. Requirements Specific to Surface Movement Radar.

(a) Where Surface Movement Radar (SMR) is used for aerodrome surface surveillance, SMR must, to the extent possible, enable the detection and display of the movement of all aircraft and vehicles on the manoeuvring area in a clear and unambiguous manner.

Note: GACAR Part 139 §139.915 requires that surface movement radar for the manoeuvring area must be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m. In addition, Surface movement radar for the manoeuvring area must be provided at an aerodrome when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

(b) Aircraft and vehicle position indications may be displayed in symbolic or non-symbolic form. Where labels are available for display, the capability must be provided for inclusion of aircraft and vehicle identification by manual or automated means. .

(c) The probability of detection for SMR must be at least 90% for all target sizes expected on the required coverage area.

(d) The Performance Requirements for SMR must comply with the following requirements:

(1) The display must be usable in a daylight environment.
(2) The equipment must display ranges between 1 NM and 6 NM and have range offset controls.
(3) The equipment must suppress information from non- operational areas.
(4) The display size must allow discrimination between targets spaced at one quarter of the minimum visual feature size. The display may use colours to aid discrimination between moving and stationary targets and between true data and overlaid information (maps, etc.) however the use of colour for information coding is not allowed.
(5) The coverage must extend over a range and azimuth sufficient to cover the manoeuvring area
(6) The vertical coverage must be suitable for monitoring all airport traffic on the ground.
(7) The system must be capable of detecting targets as necessary within the coverage as defined in the operational requirements.
(8) Any radar shadowing must be mapped and verified.
(9) Operational use must take account of both dynamic and static shadowing.
(10) The information update rate must be appropriate to the speed of airport traffic and the minimum visual feature size.
(11) The equipment must present the data to the controller within a period equivalent to one quarter of the revolution rate of the aerial.

(12) The radar must achieve the required performance in the worst weather in which routine operations are likely to continue.

(e) The orientation of the picture in relation to the view from the display must be such that the runway on the SMR is aligned with the view of the runway from the control position.

Note: Typical performance requirements for a SMR can be found in ICAO Doc 9476 Appendix F. However, it should be noted that the required performance from a SMR depends on whether the SMR is used as part of a simple SMGCS or an A-SMGCS in which the requirements may be more stringent.

VIII. Requirements Specific to MLAT implementations.

(a) Where multilateration (MLAT) sensors are used in aid of aerodrome surface surveillance, the loss of any one MLAT receiver or interrogator must not cause a loss of the required coverage.

(b) The MLAT antennas must be mounted on strategic locations where each antenna has a clear line of sight to transponder antennas of aircraft or vehicles.

Note: In addition to the requirements listed above, general requirements described in Appendix C, Section C.14 for MLAT systems must apply to the MLAT systems used for surface surveillance.

IX. Requirements Specific to ADS-B implementations.

(a) Where ADS-B receivers are used in aid of aerodrome surface surveillance, the loss of any one ADS-B receiver must not cause a loss of the required coverage.

(b) The ADS-B receiver antenna/s must be mounted on strategic locations where each antenna has a clear line of sight to transponder antennas of aircraft or vehicles.

X. SMGCS Requirements.

(a) The Surface Movement Guidance and Control (SMGC) System comprises the following elements:

(1) Visual and non-visual aids that must comply with GACAR Part 139 requirements.
(2) Radiotelephony communication
(3) Operating procedures
(4) Control and information facilities.

(b) Where surveillance sensor/s form part of an SMGCS, a local safety risk assessment must determine the safety impact in the event of failure of any element of the surveillance system

(c) A local safety risk assessment must also justify the suitability of the functional and performance requirements of the surveillance system used as part of SMGCS.

(d) All elements of the SMGC must be located at the SMR control position

Note: General requirements and guidance on Surface Movement Guidance and Control Systems are given in ICAO Doc 9476 – Manual of Surface Movement Guidance and Control Systems.

XI. A-SMGCS Requirements.

(a) The Surveillance sensors used for A-SMGCS must have a vertical coverage up to an altitude to detect missed approaches and where appropriate, low-level helicopter operations.

(b) The surveillance sensors providing data to the A-SMGCS must detect aircraft from a suitable distance that aircraft approaching to all active runways can be integrated to the ground movements detected and displayed on the A-SMGCS.
(c) The distance from which it is required to detect approaching aircraft must be identified.

(d) The surveillance sensors must detect any obstacles, and vehicles in the required coverage area and any designated protected areas.

(e) The A-SMGCS must be referenced to the World Geodetic System (WGS-84).

(f) An A-SMGCS must be designed and operated with due consideration to all of its functional domains. A local safety risk assessment must determine the safety impact in the event of failure of any element of the system and confirm the suitability of the functional and performance requirements to the local operational context.

(g) The performance of the surveillance sensors must be monitored. The alerts must be provided to the users of the system in the following situations;

(1) Complete failure of a sensor;
(2) Failure of one or more sensors resulting in reduced vertical or horizontal coverage;
(3) System malfunction resulting in degraded performance and below the minimum required performance criteria

Note: ICAO Document 9830 Advanced Surface Movement and Guidance Control Systems manual contains performance requirements for surveillance, guidance, and control functions for a typical A-SMGCS system. EUROCONTROL has also published an operational Concept and Requirements document for A-SMGCS Level 1 and Level 2 Implementations.

XII. Display Requirements for A-SMGCS.

(a) The A-SMGCS must provide identification and labelling to all aircraft and vehicles on the manoeuvring area, and on other movement areas as required.

(b) The response time to issue alerts, alarms, or automatically generated instructions must be suitable such that necessary precautions can be applied to avoid conflicts taking to account:

(1) The minimum separations between aerodrome movements (aircraft and vehicles);
(2) The separations between movements from obstacles (ex: buildings, hangers etc.).

(c) All critical elements of the system must be provided with timely audio and visual indications of failure.

(d) Upon re-starting, the system recovery time must be less than 3 minutes. Upon re-starting, the system must restore the information on current traffic and system performance.

(e) The interfaces/ Input devices of an A-SMGCS for the Air Traffic Controllers must be functionally simple such that a minimum number of input actions are required.

(f) The display and all the indicators must be viewable in all ambient light levels in the aerodrome control tower environment.

(g) The processing system must have sufficient capacity to handle and process the surveillance data at the maximum movement rate at the relevant airfield.

(h) The allowable error in the reported position must be consistent with the requirements set by the guidance and control functions.

(i) The A-SMGCS recording, replay, and retention must comply with the recording requirements of surface movement control system specified under section XIII.

XIII. Recording and replay system.

(a) The Surface Movement control systems including SMR displays and A-SMGCS displays must be recorded where the information presented on these displays is used by the air traffic controllers to provide guidance, information or instructions either by visual or non-visual means that would lead to any movement action of an aircraft or vehicle receiving the service.

(b) The surveillance data recording system must not degrade or otherwise adversely affect the performance of the surveillance processing and display systems used for the provision of Air Traffic Services (ATS).

(c) The surveillance data recording system and power supply configuration must ensure the continued availability of the recording process, without interruption, whenever the ATS Unit is using surveillance data as an aid to air traffic services

(d) The surveillance recording and replay system must be capable of supporting the time-synchronised replay of voice and surveillance data used by that ATS Unit for the provision of air traffic services.

C.12 – AIRPORT REMOTE RADAR FEEDS REQUIREMENTS

I. General.

(a) For the provision of particular radar data, for example, secondary surveillance radar (SSR), it may be appropriate to use shared data sources. This data is termed 'onward routed radar data'. Such data can be used, for example, to provide additional coverage. The equipment used to convey this remote data from source to destination is termed a radar data link.

(b) This appendix details the aspects that must be considered before installing a radar data link system.

(c) These requirements apply to the following data elements:

(1) Target identification.
(2) Target position.
(3) Target type (where appropriate, for example vehicles, 'angels' etc.).
(4) System configuration information. This includes, as appropriate:
(5) Selected polarization.

(6) Radar channel selected.
(7) Pulse length selected.
(8) Radar antenna tilt.
(9) Radar monitoring and fault indication.

(d) The remote radar feed must provide complete and uncorrupted data so that the safety of the air traffic service utilizing it is not compromised.

II. Radar Data Links General Requirements.

The suitability of the link must be assessed against the operational requirement and must include the following aspects:

(a) Link integrity and interference.

(b) Link data rate and capacity.

(c) Link distortion and effect on accuracy.

(d) Link delay.

(e) Link reliability.

(f) Data resolution on link.

III. Availability, Integrity and Interference.

(a) The availability of the equipment must be defined and justifiable for the air traffic service being provided.

(b) Where radio links are used, the 'line of sight' path of the link must be safeguarded.

(c) The possibility of integrity errors arising during any reformatting by the encoder or conversion of the data at a data link interface must be determined.

(d) The effects of pick-up of false signals including radio frequency interference, magnetic and electrostatic fields must be determined.

(e) Error detection and correction algorithms must be used to check for data corruption.

(f) The system must provide warning indications for line loss and system status.

(g) Procedures must be in place that require the remote supplier to supply details to the recipient of any optimization or planned outages of the source radar system that may affect the supplied data. Any changes must be assessed formally to determine the effect on the Operational Requirement.

IV. Data Link Format, Rate and Capacity.

(a) Correct operation of all data transformations must be tested under all data formats used.

(b) The system must be capable of detecting an overload situation on the link. The system must provide information that allows the display or other system to advise the controller of this situation.

(c) The link bandwidth must be determined and shown that it has sufficient capability of transmitting the data required to satisfy the Operational Requirement.

V. Link Distortion and Effect on Accuracy.

(a) The offset drift and dynamic range of the link must be compatible with the data level.

(b) The worst case data delay through the system must be defined and be justified as being acceptable.

C.13– AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST REQUIREMENTS

I. General.

(a) This appendix defines the minimum technical requirements for a 1090 MHz Extended Squitter (1090 ES) Ground Station, which is part of an Automatic Dependent Surveillance – Broadcast (ADS-B) system providing airspace situational awareness to air traffic controllers and other users in non-radar airspaces (NRA).

(b) In addition to the requirements below, Automatic Dependent Surveillance – Broadcast (ADS-B) systems and Traffic Information Service- Broadcast, must comply with the Standards and Recommended Practices (SARPs) in ICAO Annex 10, Volume IV, Chapters 3 and 5.

II. Basic System Requirements.

(a) The 1090 ES Ground Station is part of a system that provides airspace and airport surface situational awareness to aircraft pilots, air traffic controllers and other users.

(b) Automatic Dependent Surveillance – Broadcast (ADS-B) must be a means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive identification, position, velocity and additional data in a broadcast mode via a data link.

(c) The ADS-B service must collect position, velocity and status information from systems and sensors on the aircraft and broadcasts this information to other targets and Ground Stations. The Traffic Information Service - Broadcast service, if any, must collect aircraft position information from radar sources and broadcasts it to aircraft.

(d) The ADS-B must be automatic with no external stimulus. It must be dependent and relies on on-board navigation sources and on-board broadcast transmission systems to provide surveillance information to other users. The aircraft originating the broadcast will have no knowledge of which users are receiving its broadcast; any user, either aircraft or ground based, within range of this broadcast, may choose to process the received ADS-B surveillance information.

(e) The ADS-B application must be designed to enhance the following air traffic services-

(1) Air Traffic Control Service and Flight Information Service principally for air traffic control separation services, transfer of responsibility for control, air traffic control clearances and flight information services.
(2) Alerting services, principally for notification of rescue coordination centers and plotting of aircraft in a state of emergency.

III. Functional Requirements.

(a) The 1090 ES Ground Station must provide at least the following functions:

(1) 1090 ES Reception and Decoding: Reception of 1090 MHz RF and extraction of Extended Squitter messages broadcast by ADS-B Out transponders.
(2) Report Assembly: Compilation of ADS-B reports to be forwarded to third party client ground systems (e.g. ADS-B servers, SDPD, etc.).
(3) UTC Time Synchronization: UTC time synchronization of the 1090 ES Ground Station for output report time stamping.

(4) Ground Station Management and Status Reporting: Station management, monitoring and control functions, and service status, including Built In Test Equipment (BITE).

(b) The 1090 ES Ground Station must ensure autonomous, reliable and accurate UTC time stamping of the generated ASTERIX reports. For this purpose the 1090 ES Ground Station must include a sufficiently reliable and accurate UTC time reference source, or alternatively it must be able to interface to an external standard UTC time source of equivalent quality. The internal or external time source supplies all the data necessary for the establishment of the UTC times of reception of position and velocity information.

(c) The 1090 ES Ground Station must operate unattended and autonomously, except for maintenance and testing activities. It must provide a monitoring, maintenance and control function allowing a local or remote operator to:

(1) Monitor the 1090 ES Ground Station status, and the status of each subsystem and service, including BITE and end-to-end system checks;
(2) Perform maintenance, configuration, and control actions

(d) The 1090 ES Ground Station must provide protection against unauthorized access to the system maintenance and control functions.

(e) The 1090 ES Ground Station must provide control facilities to allow the commanding changes of mode or state for the Ground Station or a service, as well as software configuration changes of subsystems and services. Addresses and communication protocols must also be configurable.

(f) The 1090 ES Ground Station must include a status reporting function, which is able to report the status of the Ground Station and its services to client systems both periodically and on an event driven basis over a ground network. These status reports will use the ASTERIX Category 023 message format.

(g) The 1090 ES Ground Station includes a Built In Test Equipment (BITE) capability, such that there is a continuous monitoring of the operating status of the equipment, which is achieved by the monitoring and analysis of critical system parameters at all relevant system levels.

IV. Additional Requirements.

(a) The power supply requirements may vary depending upon application and location. The following provisions are provided as guidance to be considered by the implementing authority. It

must be noted that it may not be necessary to include each of the following as requirements, but only those that pertain to the power supply being used. Consideration must also be given to the use of Uninterruptible Power Supplies (UPS), with appropriate monitoring as necessary, to meet Operational Availability requirements.

(b) The receiver must be protected from interference from out-of-band signals such as DME.

Table C.13- 1 shows receiver out-of-band rejection characteristics that are extensively used. It shows the 1090 ES Ground Station ADS-B message signal level required to provide a 90% Successful Message Reception rate at various frequency offsets from 1090 MHz.

Table C.13-1 Out of Band Characteristics

Frequency Offset from 1090 MHz	Minimum Input Level Above Specified Receiver Sensitivity (90% SMR)
±5.5 MHz	3 dB
±10.0 MHz	20 dB
±15.0 MHz	40 dB
±25.0 MHz	60 dB

(c) Alternative out-of-band rejection characteristics may be used provided that the performance requirements are met. For example the characteristics shown in Table C.13-2 may be suitable for a receiver that is used for both ADS-B and multilateration.

Table C.13-2 Alternative Out of Band Characteristics

Frequency Offset from 1090 MHz	Minimum Input Level Above Specified Receiver Sensitivity (90% SMR)
±12.5 MHz	3 dB
±19.0 MHz	20 dB
±29.0 MHz	40 dB
±46.0 MHz	60 dB

V. Equipment Classes.

The 1090 ES Ground Station equipment must be classified according to the unit's range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in ICAO Annex 10 Chapter 5:

(a) Class A extended squitter airborne systems support an interactive capability incorporating both an extended squitter transmission capability (i.e. ADS-B OUT) with a complementary extended squitter reception capability (i.e. ADS-B IN) in support of onboard ADS-B applications;

(b) Class B extended squitter systems provide a transmission only (i.e. ADS-B OUT without an extended squitter reception capability) for use on aircraft, surface vehicles, or fixed obstructions; and

(c) Class C extended squitter systems have only a reception capability and thus have no transmission requirements.

VI. Antenna.

(a) The antenna pattern must be nominally omnidirectional in the horizontal plane.

(b) The antenna gain must be 0 dB with respect to isotropic.

(c) The antenna must receive signals on the nominal operating frequency of 1090 MHz.

C.14– MULTILATERATION SYSTEMS REQUIREMENTS

I. General.

(a) Multilateration is a form of co-operative and independent surveillance system like SSR. Multilateration (MLAT) systems use the time difference of arrival (TDOA) of the existing 1090 MHz transmissions from aircraft, between several ground receivers to determine the position of the aircraft. An MLAT system can be active, passive or both.

(b) In addition to the requirements below, all Multilateration systems must comply with the Standards of ICAO Annex 10, Volume IV Chapter 6.

II. Performance requirements

(a) MLAT systems used for air traffic surveillance must have performance to meet the Required Surveillance Performance defined for the operational services supported.

(b) Where the MLAT system is used as a replacement to radar, the MLAT system must meet at least the same performance criteria met by the radar system subject to replacement.

III. Active MLAT System Transmitter Requirements

(a) The interrogator capability must be identified and justified with respect to the current and planned aircraft equipage requirements.

(b) The Aeronautical Telecommunication provider must take measures to minimise the effect of active MLAT operation on the 1030/1090 MHz radio frequency environment.

(c) The Interrogations from multilateration systems must not set “lockout” on any targets.

(d) The Interrogation rate must be configured to meet the operational requirement.

(e) All interrogation types used by the MLAT system must be defined.

(f) All active MLAT systems must transmit in accordance with CST requirements and conditions specified in the relevant Interrogator Approval certificate;

(g) The ICAO regional agreements for the coordinated allocation and use of Mode S interrogator codes must apply to all active MLAT systems which have a Mode S interrogator for which at least one of the following conditions is satisfied:

(1) the interrogator relies, at least partly, on Mode S all-call interrogations and replies for Mode S targets acquisition; or
(2) the interrogator locks out acquired Mode S targets in reply to Mode S all call interrogations, permanently or intermittently, in part or totality of its coverage; or
(3) the interrogator uses multisite communications protocols for data link applications.

(h) An active MLAT systems must not use Mode S all-call interrogations.

IV. ADS-B capable MLAT systems

(a) MLAT systems capable of receiving ADS-B messages using Mode S Extended Squitter must comply with the system characteristics stated in ICAO Annex 10, Volume IV, Chapter 5;

(b) Where an Air Traffic Services Provider certified under GACAR Part 171 intends to use ADS-B positional data or other data items transmitted in ADS-B messages, such data items must be identified with their intended use.

(c) The ability to de-code ADS-B messages must be demonstrated as part of commissioning trials. These requirements are identified in Appendix C, section C.13 of this Part.

(d) Where the MLAT system is implemented to detect ADS-B targets, the requirements mentioned in in Appendix C, section C.13 of this Part for ADS-B ground systems must apply to the MLAT ground system capable of receiving ADS-B messages.

V. Receiver Synchronisation

(a) The receiver synchronisation method must be defined and justified as appropriate to the operational requirement. The synchronisation method must incorporate sufficient degree of redundancy.

(b) For transponder synchronised systems, the loss of one transponder must not cause the loss of the entire MLAT system due to synchronisation failure.

VI. Receiver Geographical Distribution

(a) The geographic distribution of sensor locations must be such that the required probability of detection and coverage can be obtained at all levels where the service will be provided.

(b) The system must be installed and optimised such that the loss of data from any single receiver or interrogator does not cause a loss of the required coverage.

(c) The sensor antennas must be sited such that at least 4 sensors to have clear line-of-sight simultaneously to the target in the operationally significant coverage area.

VII. Link Performance

a) The data transmission links used between the sensors and the central processing system must be identified along with entities that have operational responsibility.

Note: Various communication links including RF links, satellite links, copper wire links and fibre optics may be used for communications between sensors and the central processing system within the same MLAT system.

b) The data link requirements listed in Appendix A, A.4 of this Part must be applicable to all data transmission links used in the MLAT system.

c) The suitability of the data transmission links chosen must be justified in terms of reliability, availability, continuity and integrity.

d) Where such data transmission links are operated by third parties, ANSPs must have appropriate service level agreements in place for repair, maintenance, accessibility and the performance of the links.

VIII. Redundant Sensor Configuration

(a) The system must comprise of at least one additional sensor to the minimum number of sensors required for obtaining a 2D or 3D solution throughout the required coverage area.

Note: This additional sensor may be used at all times for improved accuracy, although its use will be essential for deriving position information during a failure of a single sensor.

(b) The impact on coverage and accuracy in failure of each individual sensor must be determined through n-1 analysis and must be demonstrated as acceptable to continue the intended operation.

Note: 'n' is the total number of sensors. This has to be demonstrated via modeling and simulation and during performance assessment trials.

(c) In the case of more than one sensor failure, the suitability of the system to continue operation must be decided based upon the achievable coverage and the accuracy levels. The operational strategy in such situations must be defined including operational procedures.

(d) The procedures in such situations must be clearly documented and the controllers must be fully trained to handle such event.

IX. MLAT Performance Monitoring

(a) The MLAT system must use at least one Remote Field Monitor (SSR site monitor) for on-going system integrity and end-to-end performance monitoring.

(b) The performance monitoring mechanisms must be clearly defined with the parameters subject to monitoring by all monitoring mechanisms.

Note: These must include any in-built status monitoring and external monitoring mechanisms.

(c) The system must be capable of indicating to controllers when the MLAT system performance is suitable for operational use and when the system performance does not permit its use for providing the intended service.

Note: These may include visual and audible means or both.

(d) The system must indicate to the controllers when the system is operating under redundant conditions, if this is deemed necessary.

(e) The system must be capable of indicating to the engineering staff the current operational status of the sensor network and any failures.

(f)Where one or more RFMs are also used for time synchronisation purposes, the impact of the loss of those RFMs to the time synchronisation function as well as to the system status monitoring function must be assessed and indicated in design assurance documentation.

X. Sensor Siting Requirements

(a) The structure upon which the receivers/transmitters, antennas are mounted must be of sufficient stability to withstand all expected weather conditions in the operational environment, especially with respect to maximum wind speed.

(b) The maximum wind speed, temperature and humidity conditions expected in the operational environment must be identified.

Note: Typical values for maximum wind speeds during a 3 second period for operation to be no less than 80 knots and 120 knots for survival of the outdoor equipment.

XI. System Interfaces

The output of the MLAT system must be a digital data output, using standard communication protocols (e.g., ASTERIX).

XII. MLAT Output and Processing

(a) The data output rate must be identified and the MLAT system must use the data output method that gives the highest quality and positional accuracy of data.

(b) The processing and tracking system must be capable of handling the data received by the MLAT receivers and outputting the data at the required rate.

Note: MLAT system may receive a large amount of data depending on the amount of data transmissions occurring on the 1090 MHz frequency at any given time, however the required data rate may be much slower than this (e.g., 4s in a busy terminal environment) depending on the application. Hence the system has to accommodate a processing mechanism that delivers data of best quality and accuracy at the required rate.

XIII. Power Supply

The stability of the power supply to the system must be consistent with the availability and continuity of service requirements.

XIV. Low Level Coverage

The coverage and the probably of detection in the low levels of altitude must meet the performance requirements necessary for the intended application in the lower levels of the defined coverage area.

Note: MLAT system coverage and probability of detection can significantly vary across vertical levels. The probability of detection may be lower than the required criteria at lower altitudes.

XV. MLAT Performance

(a) Probability of Detection: The Pd should be at least 97% for the MLAT system.

(b) False Targets: The Number of false targets during any update must be less than 1%.

C.15– REMOTE AERODOME ATS OR LOCAL DIGITAL AERODROME TOWER

I. General.

(a) The development and deployment of remote aerodrome ATS or local digital aerodrome tower technology can enable the following types of operations:

(1) Replication of new or current on-site aerodrome conventional tower ‘single mode’ visual control room including non-Air Traffic Service (ATS) surveillance-derived information. Examples of these include permanent or temporary mapping such as Work in Progress or surface markings.
(2) ‘Replication Plus’ – enhancement of ‘replicated’ displays by means of overlays and integration of ATS surveillance derived information, e.g., Secondary Surveillance Radar (SSR) or ADS-B data.
(3) Single or multiple mode of operations for the provision of remote aerodrome air traffic services (ATS) as defined under GACAR Part 171, Appendix E.

(b) Each proposed remote aerodrome ATS or local digital aerodrome tower installation, regardless of operating mode is to satisfy the requirements for the introduction of a new ATS system or for a change to an existing ATS system as specified in GACAR Part 170 §170.62 and §173.19 of this part.

II. Replication of current on-site ‘single mode’ remote or local Aerodrome ATS facilities.

(a) For the purposes of single mode and enhanced mode operations, the overlaid information must be split into 2 categories - surveillance and non-surveillance overlays. The ‘basic’ single mode operation, non-surveillance based visual overlays on the visual presentation are, subject to specific acceptance granted by the President. These overlays can be permanent or temporary and could come in the form of:

(1) Aerodrome maps;
(2) Information markers e.g., surface markings, hazardous areas or WIP;
(3) Status information e.g., Rescue and Fire Fighting Service (RFFS) Category.

III. 'Replication Plus' – use of air traffic surveillance data in remote aerodrome ATS or local digital tower environment.

(a) For the purposes of remote aerodrome ATS or local digital aerodrome towers, the overlaid information must be split into 2 categories - surveillance and non-surveillance overlays. The requirements of 'basic' system in a single mode of operation with Surveillance Derived Data and non-surveillance overlays.

(b) The Surveillance-Derived Data includes but is not limited to:

(1) Use of infrared cameras.
(2) Dedicated means to facilitate the detection, recognition, identification (e.g., based on surveillance data or on flight plan correlation) and tracking (e.g. labels directly in the visual presentation) of aircraft.
(3) Dedicated means to facilitate the detection and tracking (e.g., labels directly in the visual presentation) of vehicles on the manoeuvring area.
(4) Dedicated means to facilitate the detection and tracking of obstructions/objects on the manoeuvring area (e.g., mobile and fix objects).
(5) Functionalities to assist the judging of the aircraft's position or altitude (depth of vision for the ATCO/AFISO).
(6) Safety Net functions based on surveillance derived data.

IV. Data Sources and Applicable Performance Requirements

(a) The Sources of the surveillance data displayed on the remote aerodrome ATS or local digital aerodrome tower Out-Of the Window (OTW) displays or any form of surveillance display such as an Air Traffic Monitor, Surface Movement Radar (SMR) display, Advanced Surface Movement Guidance and Control Systems (A-SMGCS) type display in the remote aerodrome ATS or local digital aerodrome tower could take one of these forms. The data may feed from one or more of these sources:

(1) Data obtained from video camera sensors/infrared (e.g., Laser Range Finder technology) installed in the remote aerodrome tower itself or from sensors mounted at strategic locations;
(2) Surveillance data integrated comes from conventional surveillance feeds such as SSR, Wide area Multilateration (WAM), Automatic dependent surveillance – broadcast (ADS–B) sensors etc.

(b) Where the surveillance data are derived (identification and position) from the video camera

sensors (visual or infrared), the camera sensors must be considered as an ATS surveillance sensor.

(c) Where visual or infrared camera sensors are used for deriving and displaying surveillance data for ground and airborne traffic, equivalent performance requirements expected of a conventional technology such as SMR/Multilateration (MLAT) for surface applications must apply.

(d) The performance requirements that apply to surveillance sensors used for surface surveillance can be found in Appendix C of this part.

Note 1: The Minimum Aviation System Performance specifications for A-SMGCS levels 1 and 2 are stated in EUROCAE ED-87.

Note 2: The Minimum Operational Performance Specification for Mode S Multilateration Systems for use in A-SMGCS can be found in EUROCAE ED-117.

Note 3: EUROCAE Document ED-240-Revision B, 'Minimum Aviation System Performance Standard for Remote Tower Optical Systems' provides guidance in developing these requirements and in verifying compliance.

(e) The visual presentation screens together with aerodrome ambient sound reproduction (if used) must be recorded. Where surveillance information is overlaid and/or integrated (in 'enhanced equipage') the recording of the screens must be performed.

V. Data Transmission

(a) The requirements of Appendix C of this part related for Surveillance Data Transmission, must apply to the data transmission links used to send data from the surveillance sensors to the surveillance equipment in the remote tower centre.

(b) The latency of the transmitted surveillance data from the aerodrome-based sensors or from any onward routed surveillance data feed must be measured and verified.

(c) The position accuracy at the time of applicability of the received surveillance data must be verified by comparison with the position data displayed on the remote tower centre and by verifying with the actual position of a target.

VI. Air Traffic Management

(a) Any form of surveillance data represented on the OTW displays must not replace the ATM

surveillance display equipment used in an aerodrome ATS environment.

(b) In the event of the loss of the ATM display, it may be possible to utilise the limited surveillance data represented on the OTW displays to help effectively manage the traffic situation in a contingency period.

Note: The requirements of Appendix C of this part must apply to any ATM used in a remote tower environment.

VII. SMR/SMGCS or A-SMGCS

(a) Where an aerodrome has an A-SMGCS or an SMR based surface surveillance display, the integration of surveillance data on to the OTW displays of the Remote Tower must not replace the A-SMGCS or the surface surveillance display based on SMR or other type of surveillance technology.

(b) In addition to the requirements below, all Multilateration systems must comply with the Appendix C, Section C.11 of this part and the applicable SARPs of Annex 10, Volume IV Chapter 6.

(c) In the event of failure of A-SMGCS or any type of surface surveillance display used, the surveillance derived data displayed on the OTW displays in the remote tower Centre, must not be used as a substitute for the surface surveillance displays. However, it may be possible to utilize the limited surveillance data represented on the OTW displays to help effectively manage the traffic situation in a contingency period.

VIII. OTW Replicated Remote Tower Displays

(a) In the event where the OTW replicated view through the remote tower video sensors is lost, the surveillance data derived through any sensor type must not be used alone in substitute of the functions for which an Air Traffic Monitor, A-SMGCS or SMR display is used. The data may however be used in a contingency situation as a supporting aid to enhance safety and awareness.

(b) Where surveillance derived data is used on the OTW displays of the remote or local digital tower, the functions and the purposes for which they are intended to be used must be clearly identified.

IX. Detection and Tracking of Moving Targets

(a) Any surveillance sensors used for detection and tracking of objects must have algorithms to successfully separate targets and other moving objects such as flocks of birds.

(b) Moving objects that are not aircraft or vehicles must not be normally displayed unless visible via camera sensors on the remote or local digital tower OTW displays.

(c) The history trail dots must not be displayed on OTW displays.

(d) Display of and access to additional surveillance data is optional when selected by ATCO or AFISO as required.

X. Safety Nets and Alerting Functions

(a) In remote tower Centre where SMR/A-SMGCS is used for surface traffic monitoring, the safety nets on the OTW displays must be enabled.

(b) The sensors used for position calculation must have equivalent performance required of surveillance sensors used for surface surveillance applications.

(c) In the absence of an SMR/SMGCS or an A-SMGCS the use of safety nets alerts may be allowed provided that the accuracy, precision of the data and the rate of nuisance alert levels in the integrated remote or local digital tower system, is acceptable. Each integrated system and its associated safety nets functionalities is considered by on a case-by-case basis depending on the system capability.

XI. Display of Surveillance Data at remote tower Centre - OTW Displays

The surveillance data to be displayed in the labels on the remote tower Centre displays must be limited.

XII. Establishment of Remote Tower Centre (RTC) – multiple single mode applications

(a) Where a module is utilized as part of a RTC and could be selected for a variety of aerodromes, once a specific aerodrome location is selected, it must be locked in that location so that it cannot accidentally be switched to another location during operations.

(b) Where one location at an RTC has received approval to use specific enhancements and another location does not have the same approvals, these additional enhancements must be capable of being locked out during the period of operation for the other location.

(c) Each aeronautical telecommunications provider must coordinate with the certified ATS provider to ensure that the operational requirements for single and multiple mode operations for the provision of remote aerodrome ATS defined under GACAR Part 171, Appendix E are met.

XIII. Remote Aerodrome Meteorological Observing Service (RAMOS)

(a) In order to gain approval to use RAMOS, the assurance that accurate, timely and complete aerodrome meteorological observations can be provided at the remote tower centre must be demonstrated.

(b) The Aeronautical Telecommunications Provider must ensure that the quality of meteorological information supplied by the RAMOS complies with regulatory requirements defined under GACAR Parts 171 & 179.

(c) When using a RAMOS, the Aeronautical Telecommunications Provider must consider any potential differences in the processes, procedures or techniques for observing, reporting, recording and disseminating observations both ‘within’ and beyond the aerodrome. Particular consideration must be given to the following areas:

(1) The aerodrome meteorological observations reported (e.g. precipitation type and intensity) can be checked from OTW displays.
(2) The ATS personnel can check the aerodrome meteorological observations by calling the aerodrome meteorological office or station.
(3) The ATS personnel have access to the Automated Weather Observing System (AWOS) through dedicated displays or systems;
(4) The meteorological reports must be managed in accordance with applicable requirements and working arrangements defined between the ATS Unit and aerodrome meteorological Office or station.
(5) Different means are used to receive and check the contents of a special report of meteorological conditions (SPECI) and aerodrome warnings which are issued to provide operators, aerodrome services and others with concise information on meteorological conditions that could adversely affect the aerodrome’s facilities and services, and aircraft on the

ground, including parked aircraft.
(6) A review of Met training for ATS personnel will be needed to ensure that training syllabi and competency checks are updated where necessary to reflect any differences in the provision of a RAMOS.

(d) There are some differences in the requirements for the 'out of the window' view required for ATS provision and that required for checks on Met conditions. The camera(s) specification detailed in section XV below is for the provision of an ATS service. If camera(s) are to be used for checking and validation of aeronautical meteorological observations additional consideration must be given to the suitability, number, and location of cameras to be used. Particular consideration must be given to the following areas:

(1) During the hours of darkness cameras may not be able to distinguish the amount and type of cloud present, or the type and intensity of precipitation. Evidence must be provided to ensure that cloud observations can be checked during the hours of darkness using remote technology. For example, use Infra-Red cameras specifically at night.
(2) Cameras must be in a position, and at a height, that enables them to supply ATCOs/AFISOs with views which are representative of the aerodrome and its vicinity Additional cameras may be required to obtain the necessary view(s), for example in low visibility.
(3) Automated sensors used to measure certain meteorological elements (typically visibility, present weather and cloud) must be considered to be an aid to an ATCO/AFISO rather than a direct source of information. Such sensors can measure each of these elements but are limited by the spatial coverage of the sensor and the capability to resolve certain weather phenomena. Subject to the outcome of the assessment of the suitability of cameras for remote check and validation. The aeronautical telecommunication provider must consider whether additional sensors will be required to provide mitigation for any limitations in the camera view and/or the limited spatial coverage of certain Met sensors.

(e) Contingency arrangements for remote aerodrome ATS must cover use, check and validation of aeronautical meteorological reports.

(f) The use of RAMOS will require a period of testing to ensure parity with the service currently provided at the aerodrome. The test period must include the widest possible range of conditions, specifically the more hazardous weather conditions (e.g., sandstorms etc.). The testing plan must be conducted over a period of three months (to include winter and known period of low visibility).

XIV. Aerodrome Wildlife Management

At aerodromes where wildlife management is involving the ATS Unit, careful consideration will be necessary to determine how the ATS Unit will contribute from the remote tower centre.

XV. Aerodrome Surface Inspections

At aerodromes where the remote aerodrome ATS is provided, the concerned ATS Unit must establish arrangements with the aerodrome operator to authorize and monitor the surface inspections in the manoeuvering area.

XVI. Remote Tower Optical Systems

(a) The optical systems used must specify System Performance Requirements including Detection and Range Recognition Range Performance, Video latency, Video Update Rate, Video Failure Detection time, Point Tilt Zoom (PTZ) Function Control Latency, PTZ Function Movement Speed, and Time Synchronisation.

Note: EUROCAE Document ED-240A-Revision B, 'Minimum Aviation System Performance Standard for Remote Tower Optical Systems' provides guidance in developing these requirements and in verifying compliance.

(b) The visual presentation screens together with aerodrome ambient sound reproduction (if used) must be recorded. Where surveillance information is overlaid and/or integrated (in 'enhanced equipage') the recording of the screens must be performed.

XVII. Visual Presentation Equipment Interoperability.

Electro-optical equipment (cameras) and the associated visual presentation equipment (screens) are considered as systems and procedures for air traffic services.

XVIII. Change Management.

(a) When considering remote aerodrome ATS project, the aeronautical telecommunication services provider and the ATS provider must consider the impact and implications on people, equipment, and procedures as a whole. The Human Factors (HF) must include the whole organisation, how it interacts internally and externally and how those interactions would be affected by a change. At least the following considerations must be covered:

(1) Proposals must take into account those services/activities (other than ATS provision to aircraft) affected by the physical removal of the ATS staff from the aerodrome;
(2) Provision and assurance of aeronautical Meteorological (Met) services;
(3) Physical security of the on-site equipment;
(4) Cyber security measures;

(b) Should any non-ATS services be retained on-site at the aerodrome, pre-existing procedures must be reviewed to reflect any differences arising from operating the service (e.g. MET) onsite whilst the ATS service is provided remotely.

(c) While the requirements of this part apply to the provision of remoted communications, surveillance systems and the status of CNS facilities, the safety rationale for aerodrome remote ATS implementation must address the following:

(1) Voice and Data: fidelity of signals, protection from interference and back-up facilities and procedures established in the event of loss/corruption of signals
(2) Lights and pyrotechnic signal provision: replication, control by ATS Staff and where the systems are located, and AIP publication so that pilots are aware where to look for such signals;
(3) Failure modes and mitigation of system failure(s);
(4) Continuity of service: Availability of contingency facilities and how ATS personnel might exercise traffic management at the time of system failure, arrangements to monitor aircraft and vehicle movements when one or all of the systems fail, and transition from working system(s) to failed system(s).
(5) Any physical restrictions on the quality or quantity of the images transmitted due to, for example, bandwidth; a lower bandwidth may not be capable of transmitting ‘higher’ video update rates. Irrespective of the video update rate, the associated human factors (HF) impacts and mitigations must be considered.
(6) Reproduction of the audio environment and ambient sound;
(7) The interdependence and reliability assurance requirements must be considered and potential failures must be highlighted and mitigation provided where appropriate. The latency of different systems must be considered together.
(8) Provision of remote aerodrome ATS must be carefully considered and appropriate training provided to involved staff. Examples include:

(i) Management of ground movements;
(ii) Management of traffic with the area of responsibility;

(iii) Interaction with aerodrome Met office or station.
(iv) Interaction with aerodrome operator and services;
(v) General aerodrome work in progress;
(vi) Emergency services.

(9) ATS personnel ongoing familiarity with on-site services/personnel. Following any move of ATS staff to a remote tower Centre, the relationships with on-site aerodrome staff and services must be developed and maintained.
(10) Camera specifications:

(i) The design must address the camera tower strength/frangibility, stability and wind loading requirements associated with the aerodrome operation.
(ii) Camera tower security.
(iii) Camera tower safeguarding.
(iv) Camera tower height and infringement of obstacle limitation surfaces (OLS) defined under GACAR Part 139.(v) Camera resilience - weather; birds; age; replacement/maintenance (including cleaning) schedule(s).

(11) Maintenance arrangements considering priorities for each facility must be produced and robust contingency measures established.
(12) Recording. The recording of the Visual Presentation Screens and aerodrome ambient audio must be performed. Where the overlay and/or integration of surveillance data is used (in Replication Plus mode) the recording of the screens must comply with the requirements for At-The-Glass (ATG) Surveillance data.

(d) When planning the remote aerodrome ATS, the level of change and technology being introduced to the controlling environment and the relationship with the human operator must be considered.

(e) Any related safety assurance documents must be completed and submitted in accordance with GACAR Part 5.

XIX. Transition Plan.

A transition plan which describes how the operation will be conducted from a new remote tower centre or migrate from the conventional tower to the remote site must be developed and submitted to the President for acceptance.

APPENDIX D TO GACAR PART 173 – FLIGHT INSPECTION SERVICE PROVIDERS

I. General.

(a) This appendix prescribes requirements applicable to flight inspection service providers and their equipment.

(b) This appendix is divided into two parts as follows:

(1) Flight inspection service providers – Authorization Procedures.
(2) Annexes prescribing specific flight inspection requirements for specific types of navigational aids.

Note: Additional flight inspection requirements for certain navigation aids are prescribed in Appendices B.4 and B.6 to this part.

(c) Each flight inspection service provider authorized under this part must be capable of using flight inspection techniques to measure accurately the signals in space radiated by those navigational aids which they are approved to inspect.

II. Application Procedure.

(a) Any request for the authorization of flight inspection service provider must be submitted by the aeronautical telecommunication services provider authorized under this part with the required information in a coherent documentary form.

(b) The flight inspection service provider may propose an aircraft or system which is new in concept or not in common use for flight inspection. In such a case, the President may seek advice from other Civil Aviation Authorities and may also initiate a general consultation with the industry. If a new system or aircraft is proposed or the flight inspection service provider does not have a demonstrable history of flight inspection, then practical demonstrations of capability are necessary. The tests will be in two parts and the flight inspection service provider may be required to perform either or both parts:

(1) A demonstration of position fixing accuracy. This will be evaluated on an established test range. The precise details of this trial cannot be defined until details of the flight inspection

service provider's system are known.
(2) A demonstration of overall system performance. For this trial the flight inspection service provider will make a simulated commissioning inspection of the selected navigational aid. The trial may require several similar flight profiles to be flown to demonstrate the repeatability of measured results.

(c) Each flight inspection service provider must provide the President with a build state document of the measuring equipment, a complete and formalized list of the current issues of all relevant documentation and a manual describing the entire operation. If the flight inspection service provider proposes to make any changes to a flight inspection system, operation, or organization, the President must approve these changes before the organization is permitted to make any further flight inspections.

(d) Where authorization for ILS inspection is granted under this appendix it may be limited to the flight inspection of specific categories of ILS.

(e) For all flight inspection service providers, the President may require that a practical demonstration of ability is given.

III. Organization and Quality.

Any organization intending to perform flight inspection of navigation aids must demonstrate that it is competent, having regard to any relevant previous conduct and experience, equipment, organization, staffing maintenance and other arrangements, to produce accurate and adequate flight inspection results in relation to ATS safety aspects.

IV. Manual.

A manual must be provided by each flight inspection service provider to detail the overall flight inspection service provider and its intended operation. The following aspects must be included (or referenced to other documents) in the Manual or provided in a coherent documentary system.

V. Manual Contents.

The manual must include the following contents-

(a) Scope of flight inspection tasks.

(b) Types of navigational aids to be inspected. (For ILS the organization must state the categories of ILS to be calibrated.)

(c) Organizational Chart & technical details.

(d) Personnel responsibilities, terms of reference and authority to act.

(e) Procedures for notifying of major organizational changes.

(f) Procedures for notifying the President of the latest state of the flight inspection program.

(g) Procedures for notifying the aeronautical telecommunication services provider of proposed equipment changes and modifications or change of aircraft type.

(h) Details of the aircraft which the organization wishes to use for flight inspection.

(i) Functional description, technical specification and manufacturer's type number for all major items of the flight inspection system. This must include details of the equipment used for calibrating the aircraft flight inspection platform system.

(j) Location, characteristics and type of all measurement aerials on the aircraft.

(k) Technical description of any parts of the system which the applicant has designed or built.

(l) The design authority for all equipment must be stated.

(m) Procedures for inspection of equipment.

(n) Details of all uses of software and firmware in the measurement system. Also details of software and firmware support.

(o) Details of a log or record system for faults and maintenance of the measuring system.

(p) Documentation Control. List of documents held and produced.

(q) Details of initial and recurrent training and checking requirements and programs for flight

inspection personnel.

(r) Details of any internal and external auditing system e.g., auditing of the organization by any other organization not associated with the production of inspection results.

(s) Details of the quality management system.

(t) Details of any formal or implicit approvals which the organization has received from other foreign civil aviation authorities including a list of any navigation aids which the organization regularly inspects under such a formal or implicit approval. This will include:

(1) Type of navigation aid.
(2) Location of navigation aid.
(3) Category of navigation aid (if applicable).

(u) Flight inspection operating instructions for the inspector and flight crew.

(v) A typical detailed technical flight inspection report.

(w) A typical or test sample structure measurement for those navigational aids where structure measurements form part of a normal flight inspection.

(x) A statement showing to 95% confidence level, the measurement uncertainty which the organization claims to achieve for each of the measurable parameters.

(y) Details of statistical methods or interpolative techniques which may be applied.

(z) Details of any operating certificates held in respect of the aircraft operations.

(aa) Procedures for the control of sub-contractors.

(bb) A statement of compliance with the flight inspection requirements of this appendix.

VI. Aircraft.

(a) The aircraft used must be appropriate for the purpose of flight inspection and must be operated in a way which ensures accurate measurement of all parameters.

(b) The aircraft must be a multi-engine type capable of safe flight within the intended operational envelope with one engine inoperative, fully equipped and instrumented for night and instrument flight. Auto-pilot capability and FMS are recommended.

(c) The aircraft must be managed by two flying crew members.

(d) A crosswind limit must be set which will allow measurement accuracies to be within the limits required. This limit must be shown in the operating instructions.

(e) The aircraft must have a stable electrical system with sufficient capacity to operate the additional electronic and recording equipment.

(f) Where applicable, measures must be taken to reduce propeller modulation to an acceptably low level.

VII. Equipment.

(a) The purpose of the navigation aid flight inspection is to verify that all parameters of the navigation aid meet the requirements specified in Annex 10 and any other specific requirements of this part. Therefore, the equipment fitted in the aircraft must be capable of measuring all these parameters accurately and with repeatability.

(b) The navigation aid measuring equipment must not interfere with the operation or accuracy of the aircraft’s normal navigation and general avionics equipment.

(c) The flight inspection measurements must be adequately protected against the prevailing Electro Magnetic environment effects internal or external to the aircraft. Abnormal interference effects must be clearly identified on the inspection report results.

(d) The inspection system must have the facility for listening to the identity modulation of the navigation aid being inspected.

(e) The flight inspection system must include equipment which can determine and record the aircraft's position in space relative to a fixed reference point. The accuracy in the aircraft's positioning system must comply with the requirements of GACAR Part 91.

(f) The flight inspection system must include equipment which can record the measured parameters of the navigation aid being inspected.

(g) All recordings must be marked so that they can be correlated with the aircraft's position at the time of the measurement.

(h) Aerials must be positioned in such a manner that they are not obscured from the signal during any normal inspection flight profiles.

(i) The aerials to be used for tracked structure measurements must be positioned with due regard to the tracking reference on the aircraft. If the aerials and the reference are not in close proximity, this error must be addressed in the measurement uncertainty calculations and in setting the operational crosswind limit. Alternatively, the errors may be corrected using information from the aircraft's attitude sensors and data concerning movement of the aerial's phase centre.

VIII. Measurement Uncertainty.

(a) The measurement uncertainty for any parameter must be very small compared with the operational limits for that parameter.

(b) The measurement uncertainty to 95% probability must be calculated for each of the parameters to be measured. The method of calculation and any assumptions made must be clearly shown.

(c) Many measurements are a combination of receiver output and aircraft position. In these cases, the figure required is the sum of all the errors involved in the measurement, including aircraft position.

(d) For measurements which can only be derived from recordings, the accuracy and resolution of the recording equipment must be included in calculating the expected measurement uncertainty.

(e) When modifications are made which will affect the uncertainty of measurement of any parameter, new calculations must be submitted.

(f) The uncertainties stated in (e) must be maintained under the specified environmental conditions specific for a flight inspection procedure. The operator must define the environmental conditions

(temperature range, humidity range, system calibration etc.).

(g) Details of measurement uncertainty with respect to temperature must be available for all the measuring equipment. This may be in the form of test results made by the operator, or manufacturer's specifications. If manufacturer's specifications are quoted, the flight inspection service provider must be prepared to produce manufacturer's test results as evidence.

(h) If the measuring equipment requires any warm-up or cooling time, this must be clearly indicated in the operating instructions.

(i) The accuracy of marking must be commensurate with the accuracy required in the final figure. Specific requirements are given in the appropriate annex to this appendix.

IX. Inspection Procedures and Standards.

(a) All measuring equipment used for flight inspection must be calibrated to defined standards.

(b) Clearly defined inspection procedures must be applied to all equipment involved in the measurement of parameters in the appropriate annex to this appendix. All equipment and standards used in the inspection process must have traceability to KSA or international standards.

(c) When any equipment used is claimed to be self-calibrating, the internal processes involved must be clearly defined. This involves showing how the equipment's internal standard is applied to each of the parameters which it can measure or generate. The internal standard must have traceability to KSA or international standards.

(d) Details of inspection intervals required must be contained in the inspection records. The flight inspection service provider must be prepared to produce evidence in support of the quoted inspection intervals.

X. Operating Instructions.

(a) The flight inspection report must clearly and accurately document the measured performance of a navigational aid.

(b) This documentation must include concise details of:

(1) The flight profile to be used for each individual measurement;
(2) Pre-flight inspection of measuring equipment;
(3) Siting of any necessary ground tracking or position fixing equipment.
(4) Scheduled maintenance and inspection of the measuring equipment.
(5) Operation of the measuring equipment;
(6) Production of the flight inspection report;
(7) Certification; and
(8) The method of calculating any results which are not directly output by the measuring equipment.

XI. Personnel Training and Qualification Requirements.

(a) All personnel concerned with the flight inspection must be adequately trained and qualified for their job functions.

(b) The flight inspection service provider must show that all personnel concerned with the flight inspection are adequately trained and qualified for their job functions.

(c) The flight inspection service provider must have a procedure for ensuring the competence of its personnel. This procedure must have provision for regular assessment of competence.

(d) Particularly for the inspection of precision approach aids, the flight crew's familiarity with each location to be inspected is considered to be of importance. The flight inspection service provider's procedures and instructions must include details of training and familiarization which will apply to the flight crew.

XII. Flight Inspection Report.

(a) The flight inspection report must clearly and accurately document the measured performance of a navigational aid.

(b) All flight inspection results must be documented to a report format acceptable to the President. The minimum information to be provided on the report must be:

(1) Station name and facility designation.
(2) Category of operation.
(3) Date of inspection.

(4) Serial number of report.
(5) Type of inspection.
(6) Aircraft registration.
(7) Manufacturer and type of system being inspected.
(8) Wind and any pertinent meteorological conditions.
(9) Names and functions of all personnel involved in the inspection.
(10) Results of all measurements made.
(11) Method of making each measurement (where alternatives are available). These may be referenced to the operating instructions.
(12) Details of associated attachments (recordings, etc.).
(13) Details of extra flights made necessary by system adjustments.
(14) An assessment by the aircraft captain of the navigational aid's performance.
(15) Comments by the navigation aid inspector/equipment operator.
(16) Details of any immediately notifiable deficiencies.
(17) Statement of conformance/non-conformance.
(18) Navigation aid inspector's signature.
(19) Pilot's signature.
(20) Signature of the individual who is legally responsible (if different from (18) or (19)).

XIII. Records and Graphs.

(a) Records and graphs must be produced in a manner which ensures that system parameters may accurately be deduced from them.

(b) If recordings or graphs are used to derive figures for the inspection report, the scales must be commensurate with the permitted measurement uncertainty limits.

Note: If the recordings or graphs are only used to show that results are within designated tolerances, they may be presented on a reduced scale.

(c) The data from which these recordings and graphs are made must be stored with sufficient accuracy that expanded scale plots can be provided on demand.

(d) For flights where parameters are evaluated by comparison of the received signal and the output of a tracking device, only the final result need be presented for a normal inspection unless other data has been requested by the aeronautical telecommunication services provider. Position data and raw signal data must be recorded or stored and provided on demand.

(e) The minimum identification on each record and graph must be:

(1) Serial number.
(2) Date.
(3) Description of type of flight.
(4) Name of airport.
(5) Designation of facility being inspected.

(f) The flight inspection service provider must provide for approval, details of the arrangements to be made for archiving data from flight inspection results.

ANNEX D.1 TO APPENDIX D - INSTRUMENT LANDING SYSTEMS

D.1.1 Aircraft.

(a) Manual flight control using only the mandatory navigation instruments is not considered sufficiently accurate for inspection of the following types of ILS:

(1) Category III systems.
(2) Category II systems.
(3) Category I systems, which the operator wishes to use for auto land in good visibility.

(b) For inspection of the above systems the aircraft must be fitted with equipment which will provide repeatable following of the required path. Systems considered suitable to this purpose include telemetry of the ground-based tracking system’s output to a separate instrument in the aircraft, or an autopilot. If an autopilot is used GACA must be satisfied that it is capable of safe operation down to 50 feet above the threshold elevation.

D.1.3 Equipment.

(a) The ILS/DME inspection system must be capable of measuring and recording the following parameters:

(1) Localizer Field strength.
(2) Localizer Modulation Sum (SDM).
(3) Localizer Difference in Depth of Modulation (DDM).
(4) Glide path Field strength.

(5) Glide path Modulation Sum (SDM).
(6) Glide path Difference in Depth of Modulation (DDM).
(7) Marker Beacon Field strength.
(8) Marker Beacon Fly-through Time.
(9) DME Field strength.
(10) DME Distance.
(11) Radio Altimeter height.

(b) The recording equipment must be capable of recording any of the ILS parameters listed in paragraph (a). The equipment must measure and record beam structure by comparison of tracking data and the ILS signal, from a distance of at least 4 NM from the runway threshold.

(c) It must be possible to annotate the recordings with comments and any other necessary information at the time of making the recording.

(d) For beam bend measurements, the total time constant of the measuring and recording equipment must be 92.6/V seconds where V is the aircraft velocity in kilometres per hour.

(e) If digital sampling/storage is used, the sampling rate must be compatible with this time constant but never less than 4 samples per second for all parameters which are continuously measured.

(f) The equipment must be capable of recording a minimum of 4 parameters simultaneously.

D.1.5 Measurement Uncertainty.

Maximum permitted measurement uncertainty at 95% confidence level is prescribed as follows:

Note: Throughout the following tables, the figure of 2dB for field strength is the permitted uncertainty for repeatability of measurement. It is not a requirement for absolute field strength measurement.

(a) *Localizer.* As per Table D.1-1 below.

Table D.1-1 Localizer Measurement Uncertainty Limits

	Cat I	Cat II	Cat III
Alignment (average) (related to threshold)	2.0m	1.0m	0.7m
Displacement sensitivity (of the actual figure)	4%	4%	2.5%
Field strength (relative)	2dB	2dB	2dB
Off course clearance	3%	3%	3%
Course/clearance ratio	1dB	1dB	1dB
Course structure Outer limits of coverage to ILS Point A	6μA	6μA	6μA
Course structure ILS Point A to threshold	3μA	1μA	1μA
Modulation sum (absolute mod depth)	1.6%	1.6%	1.6%
Polarization	1.5μA	1.0μA	1.0μA
Modulation balance (CSB)	1.0μA	1.0μA	1.0μA

(b) *Glide path.* As per Table D.1-2 below.

Table D.1-2 Glide Path Measurement Uncertainty Limits

	Cat I	Cat II	Cat III
Angle (of the glide path angle)	0.5%	0.3%	0.3%
Displacement sensitivity (of the actual figure)	2.5%	2.0%	1.5%
Field strength (relative)	2dB	2dB	2dB
Clearance (of the actual figure)	3%	3%	3%
Course structure	3μA	2μA	2μA
Modulation sum	2%	2%	2%

	Cat I	Cat II	Cat III
Modulation balance (CSB)	1.0μA	1.0μA	1.0μA

(c) *Marker Beacon.*

(1) Field strength (relative) 2dB

(2) Distance 10 meters

(d) *Associated DME.*

(1) Field strength (relative) 2dB
(2) Distance 60 meters at threshold and point A

(e) *Uncertainty of Position Marking of Flight Inspection Data.*

(1) Approach Toward a Facility

(i) ±0.1 NM for markings at each nautical mile.
(ii) ±0.1 NM for marking at ILS point A.
(iii) ±0.05 NM for marking at ILS point B.
(iv) ±0.1° for marking glide path slice at 1.75 x (glide path angle).
(v) ±20 meters for marking the threshold crossing.

(2) Orbital Flights

(i) ±1.5 Degree.

Note: A marking accuracy of ±1.5° applies to clearance and coverage inspection, it is not sufficient for measuring displacement sensitivity.

D.1.7 Records and Graphs.

Where chart recordings are used for parameter evaluation, they must have sufficient resolution for this purpose. The minimum requirements are given below.

(a) *Structure Stability Recordings (deviation current).*

(1) Localizer. Minimum sensitivity of 1 mm per µA.
(2) Glide path. Minimum sensitivity of 0.5 mm per µA.

(b) *Structure Measurements (corrected recordings).*

(1) Localizer. Minimum sensitivity of 1mm per µA.
(2) Glide path. Minimum sensitivity of 0.5mm per µA for the initial part of the recording. For Category II & III systems, it must be possible to show the signal characteristic down to threshold crossing. This may require reduced sensitivity depending on available chart width.

(c) *Other Measurements.*

Many other recordings will need sensitivity changes during the recording to obtain optimum resolution at all times. The chart produced must be capable of displaying at least 450 µA of deflection current without saturation. Sufficient different sensitivities of display must be available to allow signal characteristics to be measured accurately.

(d) *Position Annotation.*

Records and graphs must be annotated to show the position of the aircraft at the time of making the measurement. The minimum requirements are given below. Required accuracies of annotation are given in paragraph D.1.5(d).

(1) Approaches Towards a Facility. Every nautical mile (referenced to 0 NM at the threshold), ILS points A, B & C, Threshold.
(2) Glide path Level Flight (on localizer Centre line). Every nautical mile (referenced to 0 NM at the threshold.
(3) Orbital Flights. Every 5 degrees.

ANNEX D.2 TO APPENDIX D - VHF OMNIDIRECTIONAL RADIO RANGE

D.2.1 Equipment.

(a) The VOR inspection system must be capable of measuring and recording the following parameters:

(1) Alignment Accuracy;
(2) Field strength;
(3) 30Hz Modulation depth; and
(4) 9960Hz Modulation depth.

(b) It must be possible to annotate the recordings with comments and any other necessary information at the time of making the recording.

(c) During orbital flights the system must be capable of measuring and recording every 5 degrees.

D.2.3 Measurement Uncertainty.

Maximum permitted measurement uncertainty at 95% confidence level is given in Table D.2-11 below:Maximum permitted measurement uncertainty at 95% confidence level is given in Table D.2-11 below:

Table D.2-1 VOR Measurement Uncertainty Limits

Parameter	Measurement
Alignment	0.4 degrees
Field Strength	3dB
Modulation 30Hz and 9960Hz	0.4%

D.2.5 Records and Graphs.

(a) Where chart recordings are used for parameter evaluation, they must have sufficient resolution for this purpose.

(b) Records and graphs must be annotated to show the position of the aircraft at the time of making the measurement.

ANNEX D.3 TO APPENDIX D - NON-DIRECTIONAL BEACON (NDB)

D.3.1 Equipment.

(a) The NDB inspection system must be capable of measuring and recording the following parameters:

(1) Accuracy;
(2) Field strength.

(b) It must be possible to annotate the recordings with comments and any other necessary information at the time of making the recording.

(c) During orbital flights the system must be capable of measuring and recording every 5 degrees.

D.3.3 Measurement Uncertainty.

Maximum permitted measurement uncertainty at 95% confidence level is given in Table D.3-1 below:

Table D.3-1 NDB Measurement Uncertainty Limits

Parameter	Measurement
Accuracy	1.0
Field Strength	3dB

D.3.5 Records and Graphs.

(a) Where chart recordings are used for parameter evaluation, they must have sufficient resolution for this purpose.

(b) Records and graphs must be annotated to show the position of the aircraft at the time of making the measurement.

APPENDIX E TO GACAR PART 173 – SOFTWARE SAFETY ASSURANCE IN ANS EQUIPMENT

I. General.

(a) This appendix prescribes requirements applicable to Software Safety Assurance within the framework the safety management system of a certified aeronautical telecommunication services provider, and as part of its risk assessment and mitigation activities with regard to changes, to manage properly software related aspects of a change.

(b) The assessment of an effective application of the documented software assurance processes may necessitate a technical evaluation of the evidence and arguments produced for the software assurance by the President when reviewing a notified change. In this context, the aeronautical telecommunication services provider must ensure access to the configuration management system for the President, which may need to verify:

(1) the consistency of all the evidence; and
(2) the fact that all the evidence is derived from a known version of the software (i.e. all evidence and arguments are actually available and can be traced without ambiguity to the executable version).

(c) The aeronautical telecommunication provider must:

(1) anticipate the possibility for on-site audits or inspections by the President; and
(2) when evidence and arguments are developed by contracted organisations, include the corresponding rights of the President to assess said organisations during onsite audits or inspections.

II. Software Assurance.

(a) This section does not prescribe how the assurance evidence is to be produced or its adequacy argued. International software assurance standards and guidelines, such as IEC 61508 Part 3 and RTCA DO178-B/EUROCAE ED12-B, when used in conjunction with the below requirements may provide an effective way to produce timely and technically valid evidence that can then be used to argue that the software assurance objectives are satisfied.

(b) When a change to a functional system includes the introduction of new software or modifications to existing software, the aeronautical telecommunication services provider must ensure the existence of documented software assurance processes necessary to produce evidence and arguments that demonstrate that the software behaves as intended (software requirements), with a level of confidence consistent with the needs of the required application.

(c) The aeronautical telecommunication services provider must use feedback of software experience to confirm that the software assurance processes are effective and, when used, the allocated software assurance levels (SWALs) and the rigour of the assurances are appropriate. For that purpose, the effects from software malfunctions (i.e., the inability of a programme to perform a required function correctly) or failures (i.e. the inability of a programme to perform a required function) reported according to the relevant requirements on reporting and assessment of service occurrences must be assessed in comparison with the effects identified for the system concerned as per the service specification demonstration.

(d) The software assurance processes must provide evidence and arguments that they, as a minimum, demonstrate the following:

(1) The software requirements correctly state what is required by the software, in order to meet the service and safety support requirements, as identified by the safety support assessment. For that purpose, the software requirements must:

(i) be correct, complete and compliant with the upper-level requirements; and

(ii) specify the functional behaviour, in nominal and downgraded modes, timing performances, capacity, accuracy, resource usage on the target hardware, robustness to abnormal operating conditions and overload tolerance, as appropriate, of the software.

(2) The traceability is addressed in respect of all software requirements as follows:

(i) Each software requirement must be traced to the same level of design at which its satisfaction is demonstrated.

(ii) Each software requirement allocated to a component must either be traced to an upper level requirement or its need must be justified and assessed that it does not affect the satisfaction of the safety support requirements allocated to the component.

(3) The software implementation does not contain functions that adversely affect the satisfaction of the service specification.
(4) The functional behaviour, timing performances, capacity, accuracy, resource usage on the target hardware, robustness to abnormal operating conditions and overload tolerance, of the implemented software comply with the software requirements.
(5) The software verification is correct and complete and is performed by analysis and/or testing and/or equivalent means, as agreed with the President.

(e) The evidence and arguments produced by the software assurance processes must be derived from:

(1) a known executable version of the software;
(2) a known range of configuration data; and
(3) a known set of software items and descriptions, including specifications, that have been used in the production of that version, or can be justified as applicable to that version.

(f) The software assurance processes must determine the rigour to which the evidence and arguments are produced.

(g) The software assurance processes must include the necessary activities to ensure that the software life cycle data can be shown to be under configuration control throughout the software life cycle, including the possible evolutions due to changes or problems' corrections. They must include, as a minimum:

(1) configuration identification, traceability and status accounting activities, including archiving procedures;
(2) problem reporting, tracking and corrective actions management; and
(3) retrieval and release procedures.

(h) The software assurance processes must also cover the particularities of specific types of software such as commercial-off-the-shelf (COTS), non-developmental software and previously developed software where generic assurance processes cannot be applied. The software assurance processes must include other means to give sufficient confidence that the software meets the service and safety support requirements. If sufficient assurance cannot be provided, complementary mitigation means aiming at decreasing the impact of specific failure modes of this type of software, must be applied. This may include but is not limited to:

(1) software and/or system architectural considerations;
(2) existing service level experience; and
(3) monitoring.

III. Software assurance levels.

(a) The assurance required by Section II Para. (c) above can be provided with different levels of confidence depending on the rigour to which the evidence and arguments are produced. For the provision of air traffic services (ATS), the use of the SWAL concept can be helpful to provide an explicit link between the criticality of the software and the rigour of the assurance. However, considering that the safety support assessment must be based on the evidence and arguments generated by the software assurance processes and that the safety support assessment is supporting a safety risk assessment, it is foreseen that, in many changes, the software assurance evidence and arguments must have to demonstrate a certain level of confidence and therefore will have to show compliance with the SWAL allocated by the aeronautical telecommunication services provider.

(b) The use of multiple SWALs must also allow the possibility of managing several criticalities of the different software components within the system (with partitioning or other architectural strategies) by the same set of software assurance processes. When the software assurance processes employ several SWALs, they must define for each SWAL the rigour of the assurances to achieve compliance with the objectives set out in Section II above. As a minimum:

(1) the rigour must increase as the criticality of the service supported by the software solution increases; and
(2) the variation in rigour of the evidence and arguments per SWAL must include a classification of the activities and objectives according to the following criteria:

(i) required to be achieved with independence, i.e., the verification process activities are performed by a person (or persons) other than the developer of the item being verified;

(ii) required to be achieved; and

(iii) not required.

IV. Software assurance levels allocation.

The process to allocate a SWAL to a software consistently with its foreseen criticality, as identified

by the safety support assessment and requirements, must consider the following elements:

(a) The SWAL allocation must relate the rigour of the software assurances to the foreseen criticality of the software.

(b) The allocated SWAL must be commensurate with the worst credible effect that software malfunctions (i.e., the inability of a programme to perform a required function correctly) or failures (i.e. the inability of a programme to perform a required function) may cause, as assessed by the aeronautical telecommunication services provider.

(c) The software components that cannot be shown to be independent of one another must be allocated to the SWAL of the most critical of the dependent components. In this context, the term ‘software components’ is understood to be a building block that can be fitted or connected together with other reusable blocks of software to combine and create a custom software application, and ‘independent software components’ are those software components which are not rendered inoperative by the same failure condition.

(d) The allocated SWALs must be consistent with the levels defined in the software assurance processes.

(e) The aeronautical telecommunication services provider is responsible for the definition of the software assurance processes. In this definition of processes, the service provider may consider the guidance material contained in existing industrial standards for the software assurance considerations of software.
It should be considered that not all standards address all aspects required and the service provider may need to define additional software assurance processes. The guidance material typically includes:

(1) objectives of the software life cycle processes;
(2) activities for satisfaction of those objectives;
(3) descriptions of the evidence, in the form of software life cycle data, that indicates that the objectives have been satisfied;
(4) variations according to the SWAL, to accommodate the different levels of rigour of the software assurances; and
(5) particular aspects (e.g., previously developed software) that may be applicable to certain applications.

(f) The most recent updates of the following industrial standards must be used as reference for ANS software safety assurance.

Document title	Reference
Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems	EUROCAE ED109A/ RTCA DO278A
Guidelines for ANS Software Safety Assurance	EUROCAE ED-153
Standards for Processing Aeronautical Data (only for AIS providers)	EUROCAE ED-76A/ RTCA DO-200B
Functional safety of electrical/electronic/ programmable electronic safety-related systems – Part 3: Software requirements	IEC 61508 – Part 3
Software Considerations in Airborne Systems and Equipment Certification	EUROCAE ED-12C/ RTCA DO-178C

Note: EUROCAE ED-109A/RTCA DO-278A and EUROCAE ED-12C/RTCA DO-178C make reference to some external documents (supplements), which are integral part of the standard for the use of some particular technologies and development techniques. The supplements are the following:

(1) Formal Methods Supplement to ED-12C and ED-109A (EUROCAE ED-216/RTCA DO-333)
(2) Object-Oriented Technology and related Techniques Supplement to ED-12C and ED-109A (EUROCAE ED-217/RTCA DO-332)
(3) Model-Based Development and Verification Supplement to ED-12C and ED-109A (EUROCAE ED-218/RTCA DO-331)
(4) When tools are used during the software development lifecycle, EUROCAE ED-215/RTCA DO330 'Software Tool Qualification Considerations' may be considered in addition to EUROCAE ED12C RTCA/DO-178C and EUROCAE ED-109A/RTCA DO-278A.

(g) The definition of the software assurance processes may be based on one of these industrial standards, without combining provisions from different standards as far as the consistency and validation of each of the industrial standards have only been performed at individual level by each specific standardisation group.

(h) The use of assurance level concepts, e.g., design assurance levels (DALs), software assurance levels (SWALs), hardware assurance levels (HWALs), can be helpful in generating an appropriate and sufficient body of evidence to help establish the required confidence in the argument.

(i) The term ‘software assurance level (SWAL)’ is understood to be the level of rigour of the software assurances throughout the software lifecycle. In this context, the software life cycle is understood to be:

(1) an ordered collection of processes determined by an organisation to be sufficient and adequate to produce a software item;
(2) the period of the time that begins with the decision to produce or modify a software item and ends when the item is retired from service.

V. System safety support requirements.

(a) The complete behaviour of a system is limited to the scope of the change. Safety support requirements only apply to the parts of a system affected by the change. In other words, if parts of a system can be isolated from each other and only some parts are affected by the change, then these are the only parts that are of concern and so will have safety support requirements attached to them.

(b) The following list contains examples, not exhaustive, of safety support requirements that specify:

(1) for equipment, the complete behaviour, in terms of functions, accuracy, timing, order, format, capacity, resource usage, robustness to abnormal conditions, overload tolerance, availability, reliability, confidence and integrity;
(2) for people, their performance in terms of tasks (e.g., accuracy, response times, acceptable workload, resilience to distraction, self-awareness, adaptability, reliability, confidence, skills, and knowledge in relation to their tasks);
(3) for procedures, the circumstances for their enactment, the resources needed to perform the procedure (i.e., people and equipment), the sequence of actions to be performed and the timing and accuracy of the actions; and
(4) interactions between all parts of the system.