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GHANA CIVIL AVIATION

(AIR NAVIGATION SERVICES)

DIRECTIVES

PART 23:- SUBPART 6

REQUIREMENTS FOR AERONAUTICAL TELECOMMUNICATION SERVICE PROVISION

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INTRODUCTION

In Subpart 6 of Part 23 prescribes the additional requirements for the Air Navigation Service Provider (ANSPs) providing Aeronautical Telecommunication (Aerotel) Services.

Whereas the preceding Subparts (i.e. 23.1, 23.2, 23.3, 23.4 and 23.5) deal with specifications and technical details of Aeronautical telecommunication systems mainly based on Standards and Recommended Practices (SARP) in the ICAO Annexes 10, Volume I – V), this subpart focuses on pertinent additional requirements that and procedures that service provider involved in the installation, operations and maintenance of Communication, Navigation and Surveillance / Air Traffic Management (CNS/ATM) ~~should~~shall put in place to enhance safety in its operations.

The term CNS Service Provider, Aerotel service provider and/or Service provider are used interchangeably to refer the entity authorized and approved by the Authority to provide aeronautical telecommunications within the territory that the Republic of Ghana has jurisdiction to provide Air Navigation Services.

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23 REQUIREMENTS FOR AERONAUTICAL SERVICE PROVISION

23.6 GENERAL

23.6.1 APPLICABILITY

23.6.1.1 This Subpart prescribes the requirements of the Republic of Ghana for:

(a) Provision of Aeronautical telecommunication (Aerotel) services and conditions under which those services shall be provided.
(b) Persons and entities involved in the installation, operation and maintenance of aeronautical telecommunication systems and facilities.
(c) Communication, Navigation and Surveillance (CNS) Service providers and practitioners.
(d) Air Navigation Service Providers (ANSP) and /or their Designates;
(e) Aviation Meteorological Service Providers;
(f) Aviation Training Organization (ATO);
(g) Airport Operators; and
(h) All other Air Navigation Service related operations.

23.6.2 DEFINITIONS

23.6.2.1 For the purpose of this Subpart, the definitions in Part 1 of Ghana Civil Aviation (ANS) Directives shall apply.

23.6.3 APPROVAL OF AERONAUTICAL TELECOMMUNICATION (AEROTEL) SERVICES

23.6.3.1 No person shall provide an aeronautical telecommunication services or operate an aeronautical facility except under the authority of, and in accordance with the provisions of, an approval granted by the Authority.

23.6.3.2 Aeronautical Telecommunication service means:

(a) Aeronautical broadcasting service described in Subpart 23.2.7;

(b) Aeronautical fixed service (AFS) described in Subpart 23.2.4;

(c) Aeronautical mobile service – Voice and Datalink described in Subparts 23.2.5 and 23.2.8;

(d) Aeronautical Radio Navigation Services as described in

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Subparts 23.1 and 23.2.6

(e) Installation, Operation and Maintenance of Communication, Navigation and Surveillance / Air Traffic Management (CNS/ATM) Systems; and

(f) Any other telecommunication service provided specifically to support Air Navigation Services.

23.6.3.3 The approval given by the Authority shall authorize the provision of:

(a) A single aeronautical telecommunication service by means of a single aeronautical telecommunication service units, systems or facilities: or

(b) A combination of aeronautical telecommunication services by means of a network of aeronautical telecommunication service providers.

23.6.4 DEMONSTRATION OF COMPLIANCE

23.6.4.1 The service provider shall:

(a) provide all the relevant evidence to demonstrate compliance with the applicable requirements of these Directives at the request of the Authority.

(b) notify the Authority of planned changes to its provision of aeronautical telecommunication services which may affect its compliance with the applicable requirements of these Directive.

23.6.4.2 Where the service provider does not comply with the applicable requirements any longer, the Authority shall take a decision within a time period not exceeding one month, requiring the service provider to take corrective action.

23.6.4.3 The decision made with respect to 23.6.4.2 shall immediately be notified to the relevant service provider.

23.6.4.4 The Authority shall check that the corrective action has been implemented before notifying its approval to the service provider. Where the Authority considers that corrective action has not been properly implemented within the agreed timetable, it shall take appropriate enforcement measures in accordance with the Ghana Civil Aviation Directives (GCADs) while taking into account the need to ensure the continuity of services.

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23.6.5 FACILITATION OF COMPLIANCE MONITORING (SAFETY INSPECTION AND AUDITS)

23.6.5.1 The service provider shall:

(a) facilitate inspections and surveys by the Authority or by authorized persons acting on the latter's behalf, including site visits and visits without prior notice.

(b) without charge, at the request of the Authority, allow and provide the equipment necessary to conduct any inspections, or conduct tests of aeronautical facilities, equipment or operating procedures at aerodromes or navigational sites where service is being provided to determine compliance with applicable parts of the Ghana Civil Aviation Directives (GCADs) for the purpose of ensuring the safety of Air Navigation.

23.6.5.2 The Authority shall perform the following:

(a) to examine the relevant records, data, procedures and any other material relevant to the provision of air navigation services;

(b) to take copies of or extracts from such records, data, procedures and other material;

(c) to ask for an oral explanation on site;

(d) to enter relevant premises, lands or means of transport.

23.6.5.3 The service provider shall allow the Authority to make special inspections to ensure aviation safety:

(a) as soon as practicable after any aircraft accident or incident.

(b) during the period of installation or repair of the aeronautical facilities or equipment that is critical to the safety aircraft operations; and

(c) under any other conditions that could affect aviation safety.

23.6.5.4 Subject to paragraph 23.6.5.1 above the Authority shall delegate credentialed Aviation Safety Inspectors to conduct safety inspections on its behalf.

23.6.5.5 The Authority shall:

(a) give reasonable notice of any tests to be conducted to the service provider; and

(b) carry out the tests at a reasonable time.

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23.6.5.6 Where unannounced inspections are to be conducted by the Authority, paragraph 23.6.5.5 does not apply.

23.6.6 FREQUENCY ASSIGNMENT, IDENTIFICATION CODES & CALL SIGNS

23.6.6.1 No person or organization may operate:

(a) a radio navigation aid, unless it has been assigned a frequency and/or allocated an identification code by the Authority; or

(b) a radio communication transmitter on an aeronautical radio frequency unless it has been allocated a call sign by the Authority under paragraph 23.6.6.3.

23.6.6.2 The service provider shall request for the frequency assignment, allocation of an identification code or a call sign under paragraph 23.6.6.1 in the form and manner prescribed by the Authority.

23.6.6.3 The Authority may allocate an identification code for a radio navigation aid or a call sign for a radio communication transmitter on an aeronautical radio frequency if the Authority is satisfied that the allocation of a code or call sign is not contrary to the interests of aviation safety.

23.6.7 PERSONNEL REQUIREMENTS

23.6.7.1 The service provider shall employ, contract, or otherwise engage—

(a) a senior person or persons responsible to the chief executive for ensuring that all activities undertaken by the service provider are in compliance with these requirements and that prescribed by the GCADs, and who shall in addition be vested with the following powers and duties in respect of the compliance with such requirements:

(1) unrestricted access to work performed or activities undertaken by all other persons as employees of, and other persons rendering services for and on behalf of the service provider;

(2) full rights of consultation with any such person(s) in respect of such compliance by him or her; and

(3) Powers to order cessation of any activity where such compliance is not effected; and

(4) Has a duty to establish liaison mechanisms with

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the Authority with a view to ascertain correct manners of compliance with the said requirements, and interpretations of such requirements by the Authority, and to facilitate liaison between the Authority and the unit concerned ; and

(5) Powers to report directly to the management of his or her organization, on his or her investigations and consultations generally, and in cases contemplated in 23.6.7.1 (a) (3), and with regard to the results of the liaison contemplated in 23.6.7.1 (a)(4).

(b) Sufficient personnel to inspect, supervise, and maintain the facilities listed in the Operations Manual.

23.6.7.2 The service provider shall ensure that its personnel are competent and are of sufficient numbers and have been provided with written evidence of the scope of their authorization to be able to discharge their allocated responsibilities. The job description ~~should~~shall depict the job purpose, key responsibilities, and outcome to be achieved of each staff.

23.6.7.3 The service provider shall establish procedures for personnel, who are authorized to place into operational service any of the facilities listed in their Operations Manual, to:

(a) assess the competence of those authorized personnel; and

(b) maintain the competence of those authorized personnel; and

(c) establish a means to provide those personnel with written evidence of the scope of their authorization.

23.6.8 TRAINING

23.6.8.1 The service provider shall:

(a) ensure that all its personnel possess the skills and competencies required in the provision of the aeronautical telecommunication services and licensed in accordance with the requirements ATSEP Licensing in Part 2 of Ghana Civil Aviation Directives.

(b) develop an overall training policy and programme for its personnel which include the details of the training courses that different levels of technical staff have to undergo to perform their duties. This ~~should~~shall include Basic, Advanced, Specialized, Recurrent training, On-job-training and Human factor initial and recurrent training.

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(c) ensure that, the training programme takes into consideration guidance provided in ICAO Doc 9868, PANS-Training – ATSEP Competency Framework, ICAO Doc 10057 ATSEP Competency-based Training and Assessment the service provider

(d) submit the training programme to the Authority for acceptance.

(e) maintain individual training records for each of its staff, which ~~should~~shall include a training plan detailing the courses completed by each staff as well as the time frame for attending future courses as required under this training plan.

23.6.9 AERONAUTICAL FACILITY REQUIREMENTS

23.6.9.1 The service provider shall establish a procedure in its Operations Manual to ensure that:

(a) each aeronautical facility:

(1) is designed, installed, and commissioned to meet the applicable operational specification for that facility

(2) conforms with the applicable system characteristics and specification standards prescribed in the Ghana Civil Aviation Directives and relevant ICAO Annexes and Documents; and

(3) has been assigned frequency Allocation, allocated an identification code or call sign, if a code or call sign is required.

(b) information on the operational status of each radio navigation aid, that is essential for the approach, landing, and take-off at an aerodrome, is provided to meet the operational needs of:

(1) the air traffic control unit providing an aerodrome control service for that aerodrome while that service is being provided;

(2) the air traffic control unit providing an approach control service for that aerodrome while that service is being provided;

(c) each aeronautical facility 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; and

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(d) each aeronautical facility is installed in accordance with the security programme required under paragraph 23.6.14 to minimize any risk of destruction, damage, or interference with the operation of the facility; and

(e) any critical site area of any aeronautical facility is:

(1) clearly identified on the site drawings for the aeronautical facility;

(2) physically protected by suitable signposts on the site; and

(3) 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.

23.6.9.2 A service provider who intends to operate a temporary aeronautical facility to carry out site tests shall establish a procedure in its Operations Manual, for conducting those tests such that:

(a) the operation of the temporary facility does not cause any interference with any other operating aeronautical facility; and

(b) appropriate information regarding the operation of the temporary facility is forwarded to the provider of the Aeronautical Information Services (AIS) for the issuing of a NOTAM, and if appropriate the publication of a Supplement to the Aeronautical Information Package (AIP); and

(c) An appropriate NOTAM has been published before the use of the temporary aeronautical facility.

23.6.10 DOCUMENTATION

23.6.10.1 The service provider shall hold copies of applicable Ghana Civil Aviation Directives (GCADs), Civil Aviation Advisory Publications and Information Circulars, relevant equipment manuals, ICAO Annexes, and any other documents necessary for the provision and maintenance of the facilities listed in its Operations Manual;

23.6.10.2 The service provider shall establish a procedure to control all the documentation required by paragraph 23.6.10.1. The procedure shall ensure that:

(a) all documentation is reviewed, and authorized as required, by an authorized person or Head of Organization before issue;

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(b) current issue of the relevant documentation is available to personnel at all locations where they need access to such documentation for the provision and operation of facilities;

(c) all obsolete documentation is promptly removed from all points of issue or use;

(d) any obsolete documents retained as archives are suitably identified as obsolete;

(e) changes to documentation are reviewed and approved by an authorized person or Head of Organization who shall have access to pertinent background information upon which to base their review and approval; and

(f) The current version of each item of documentation can be identified to preclude the use of out-of-date editions.

23.6.11 MANAGEMENT OF RECORDS

23.6.11.1 The service provider shall keep adequate and accurate records as they are necessary elements of a safety management system.

23.6.11.2 The service provider ~~should~~shall have a Record System to identify, collect, index, store, maintain and dispose of records in a manner to facilitate:

(a) Safe provision and operation of the facilities listed in their Operations Manual;

(b) Assistance with any accident or incident investigation; and

(c) The provision of a traceable history over the complete life cycle of services and facilities.

(d)

23.6.11.3 The records kept ~~should~~shall include the following:

(a) Records of installation, initial testing, commissioning and re-commissioning of aeronautical telecommunication facilities as prepared by the Installation team and handed over to the station during the handing over of the facility.

(b) Records of Flight Inspection Results in respect of commissioning and periodic checks of facilities.

(c) Records of test equipment required for the measurement of critical performance parameters. The record shall provide a traceable history of the location, maintenance,

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and the calibration checks (dates) for such test equipment;

(d) Records of hazard logs and risk assessments done;

(e) Records of investigation under the procedures required by paragraph 23.6.24 (Facility Check after Accident / Incident) and paragraph 23.6.25 (Facility Malfunction) that includes:

(1) details of the nature of the malfunction/incident;

(2) the findings of the investigation;

(3) the corrective actions taken; and

(4) if applicable, a copy of the report submitted to the Authority.

(f) Records of each internal quality assurance review of the service providers' organization carried out under the procedures required under paragraph 23.6.13.2 (f) (Quality Assurance and Safety Management System);

(g) Records for each person who is authorized by the service provider to place facilities into operational service. The record shall include details of their experience, qualifications, training, competence assessments and current authorizations;

23.6.11.4 The records may be either a paper or computer system or any combination of both and shall be stored in a safe way with regards to fire, flood and theft;

23.6.11.5 Paper system shall use robust material which can withstand normal handling and filing. The record shall be legible throughout the required retention period;

23.6.11.6 Computer systems used for maintenance records shall have at least one backup system which shall be updated regularly;

23.6.11.7 Each computer terminal is required to contain program safeguards against the ability of unauthorized personnel to alter the database;

23.6.11.8 The procedures required under paragraph 23.6.10 (Documentation) shall require:

(a) All written records to be legible and of a permanent nature; and

(b) All aeronautical facility records to be retained for a period of at least 3 years unless a longer period is required:

(1) by the Authority; or

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(2) to establish a performance history for the aeronautical facility.

23.6.12 FACILITY MAINTENANCE LOGBOOK

23.6.12.1 The service provider shall establish procedures in its Operations Manual to ensure that a logbook, with sequentially numbered pages, is kept at each facility and where a facility has physically separate operation areas, at each of such location within the facility;

23.6.12.2 The procedure shall ensure that:

(a) the logbook is maintained by the senior person, or the person on duty at a nominated operating position;

(b) the logbook is maintained throughout the operating hours of the facility;

(c) all entries include the date, time of entry and signature;

(d) Every page of the logbook ~~must~~shall be signed by the facility manager or a designated senior person;

(e) Logbook entries are:

(1) in chronological sequence and in ink;

(2) without erasure, defacement, or obliteration; and

(3) corrected by drawing a single line through the erroneous information and initialing the correction.

(f) Actual times of opening and closing facility are recorded in the logbook, together with the reason for every variation from published hours of service; and

(g) Logbooks are retained for a period of not less than two (2) years from the date of final entry.

23.6.12.3 The procedure shall ensure that the facility maintenance log:

(a) Contains sufficient information in the first pages of the logbook to identify:

(1) Facility information;

(2) Precautions of operation or its reference number that is included in the Operations Manual; and

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(3) The services being provided from the facility.

(b) Is retained for a period of two (2) years from the date of first filing.

23.6.13 QUALITY ASSURANCE & SAFETY MANAGEMENT SYSTEM

23.6.13.1 The service provider shall establish an internal Quality Assurance program and also implement a Safety Management System (SMS) acceptable to the Authority in accordance with Part 36 of Ghana Civil Aviation Directives which ensures compliance with the adequacy of the procedures required.

23.6.13.2 The Quality Assurance program and Safety Management System shall include:

(a) A safety policy, an important element of a Safety Management System (SMS) and procedures, including the procedure required under paragraph 23.6.25 for investigating facility malfunction incidents;

(b) 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 internal quality assurance system;

(c) A procedure for corrective action to ensure existing problems that have been identified within the internal quality assurance system are corrected; and

(d) A procedure for preventive action to ensure that potential causes of problems that have been identified within the internal quality assurance system are remedied; and

(e) An internal audit program to ensure conformity with the procedures in the Operations Manual and to achieve the goals set in the safety policy; and

(f) Management review procedures, that ~~should~~ includes ~~the~~ use of statistical analysis if appropriate, to ensure the continuing suitability and effectiveness of the internal quality assurance system in satisfying the requirements of under paragraph 23.6.13.

23.6.13.3 The procedure required under paragraph 23.6.13.2 (c) for corrective action shall specify how:

(a) to correct an existing quality problem; and

(b) to follow up a corrective action to ensure the action is effective; and

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(c) to amend any procedure required as a result of a corrective action; and

(d) Management will measure the effectiveness of any corrective action taken.

(e) The procedure required under paragraph 23.6.13.2(d) for preventive action shall specify how:

(1) to correct a potential problem;

(2) to follow up a preventive action to ensure the action is effective;

(3) to amend any procedure required under this Subpart as a result of a preventive action;

(f) management will measure the effectiveness of any preventive action taken.

23.6.13.4 The internal audit program required under paragraph 23.6.13.2(e) shall:

(a) specify the frequency and location of the audits taking into account the nature of the activity to be audited;

(b) measure the effectiveness of any preventive or corrective action taken by the personnel responsible for the activity being audited since the last audit; and

(c) require preventative or corrective action to be taken by the personnel responsible for the activity being audited if problems are found by the audit;

23.6.13.5 The procedure for management review required under paragraph 23.6.13.2(f) shall:

(a) specify the frequency of management reviews of the internal quality assurance system taking into account the need for the continuing effectiveness of the system; and

(b) identify the senior person responsible for the management reviews referred to in paragraph 23.6.13.6 (a) below;

23.6.13.6 The senior person responsible for the quality assurance and safety management system shall ensure that:

(a) the Safety Management Safety (SMS) safety policy and the safety procedures are understood, implemented, and maintained at all levels of the service provider's organization;

(b) the audits are performed by trained auditing personnel who are independent of those having direct responsibility

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for the activity being audited;

(c) the results of the audits are reported to the personnel responsible for the activity being audited;

(d) all corrective and preventative actions are followed up to review the effectiveness of those actions;

(e) the results of the management review are evaluated and recorded;

23.6.14 SECURITY PROGRAM

23.6.14.1 The service provider shall establish a security program for the facilities listed in its Operations Manual.

23.6.14.2 The security program shall specify the physical security requirements, practices, and procedures to be followed for the purposes of minimizing the risk of destruction or, damage to, or interference with the operation of any aeronautical facility operated if such destruction, damage, or interference could endanger the safety of aircraft.

23.6.14.3 The security program shall include such physical security requirements, practices, and procedures as may be necessary:

(a) to ensure that each aeronautical facility is subject to positive access control at all times to prevent unauthorized entry;

(b) for personnel to follow in the event of a bomb threat or other threat of damage to an aeronautical facility; and

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

23.6.14.4 The security program shall include procedures to notify, investigate, and report security incidents to the Authority as soon as practicable.

23.6.15 PREVENTION OF FATIGUE

23.6.15.1 The service provider shall establish procedures to ensure that all maintenance personnel are not subject to fatigue in that:

(a) a maintenance personnel does not serve for more than 8 consecutive hours or does not serve for more than 12 hours during a period of 24 consecutive hours, unless a rest period of at least 8 hours at or before the end of the 12 hours of duty have been attained;

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(b) at any time two (2) maintenance personnel shall be present in a shift;

(c) except in an emergency, maintenance personnel refrains from performing any duties for at least 24 consecutive hours at least once during each 7 consecutive days.

23.6.15.2 An Air Traffic Safety Electronic Personnel (ATSEP) shall not exercise the privileges of his license if he/she knows or suspects that he/she is suffering from or having regards to the circumstances of the period of duty to be undertaken, is likely to suffer from such fatigue as may endanger the safety of any aircraft to which an aeronautical telecommunication service is provided.

23.6.15.3 A service provider shall establish procedures to ensure that no person whose function is critical to the safety of aviation (safety sensitive personnel) shall undertake that function while under the influence of any psychoactive substance, by reason of which human performance is impaired and that they shall not engage in any problematic use of substances.

23.6.16 COORDINATION

23.6.16.1 The service provider shall establish systems and procedures in its Operations Manual to ensure, where applicable co-ordination with the following agencies:

(a) The Air Traffic Service provider in accordance with Part 24;

(b) National Security Agencies;

(c) Search And Rescue authorities;

(d) The Authority and National Communication Authority (NCA); relating to Frequencies for aeronautical telecommunication services; and

(e) Other telecommunication service providers operating in Ghana.

23.6.16.2 The service provider shall establish procedures covering each facility in its Operations Manual to ensure that Service Level Agreement (SLA) is in place between it (Service provider) and:

(a) entities providing services to the facility; and

(b) entities receiving services from the facility;

23.6.16.3 The entities in items 23.6.16.2(a) and (b) above may be internal within the service provider facilities or external to the service

providers such as the electric power company or the telecommunication service company.

23.6.17 SHIFT ADMINISTRATION

23.6.17.1 The service provider shall establish a procedure to ensure that:

(a) Adequate time is provided at the beginning and end of each shift, for the performance of those duties required:

(1) before start of the shift; and

(2) after the end of the shift.

(b) A minimum of 30 minutes is provided for each transfer of duties at an operational facility.

23.6.18 CONTINGENCY PLAN

23.6.18.1 The service provider shall establish a contingency plan acceptable by the Authority, providing for the safe and orderly continuation of service in the event of a disruption, interruption, or temporary malfunction of facility equipment or related supporting service.

23.6.18.2 The plan shall be made on the equipment level, system level and operational level.

23.6.19 PERIODIC INSPECTION AND TESTING

23.6.19.1 The service provider shall establish procedures for the periodic inspection and testing as required in Part 23.1 for the facilities listed in its Operations Manual to verify that they meet the applicable operational requirements and performance specifications.

23.6.19.2 These procedures shall:

(a) cover ground inspection, ground test and flights test where it is necessary in accordance with Standards stipulated in the GCADs, ICAO Annexes and the manufacturer technical manuals;

(b) include the criteria for establishing or changing the period between the periodic tests for a facility. The criteria shall have regard to:

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(1) any applicable information published by the Authority, International Civil Aviation Organization (ICAO) or the equipment manufacturer;

(2) any applicable reliability data for the facility; and

(3) the stability of the facility's operating environment;

(c) Ensure that the basis of establishing or changing the period between the periodic tests for a facility are documented and approved by the Authority.

23.6.19.3 In addition, the service provider shall establish:

(a) An approved program of periodic ground inspections for each facility;

(b) An approved program of periodic ground tests for each facility;

(c) An approved program of periodic flight tests for each radio navigation aid unless the service provider can establish from the criteria in paragraph 23.6.19.3 (b) (2) that periodic ground tests can replace the periodic flight tests for a facility without affecting the safety of air navigation taking into consideration the requirements of ICAO Doc 8071 for CNS facilities.

23.6.19.4 The programs required by paragraph 23.6.19.3(b) and (c) for the periodic ground and flight tests shall be based on the criteria in paragraph 23.6.19.2(b) (3) and shall specify the maximum period between the tests for each facility.

23.6.19.5 The program shall have procedure to check that all equipment in the facility are properly earthed to prevent electrical shocks and radio interference with the operational systems;

Note. – Additional guidance on earthing requirements for CNS facilities can be obtained from Manual on Testing of Radio Navigational Aids Volume 1 – 3 (ICAO Doc 8071).

23.6.19.6 The program shall have procedure to check that the data control cables are protected with lightening arrestors;

23.6.19.7 The program shall have procedure to check that the antennas and masts of the facilities shall be properly protected against corrosion, lightening and interference;

23.6.19.8 The service provider shall notify the Authority of any radio navigation aid that is not subjected to periodic flight tests.

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23.6.20 AERONAUTICAL FACILITY PERFORMANCE /OPERATION

23.6.20.1 The service provider shall establish a procedure to ensure that no aeronautical facility listed in their Operations Manual is placed into operational service unless—

(a) The person placing the aeronautical facility into operational service is assessed as competent and authorized according to the procedures required under 23.6.7;

(b) The appropriate checks detailed in the operating and maintenance instructions required under Paragraph 23.6.42 have been carried out to verify the performance of the aeronautical facility; and

(c) The aeronautical facility record has been completed according to the procedures required by paragraph 23.6.11.

23.6.21 MEASURING AND TEST EQUIPMENT

23.6.21.1 The service provider shall ensure that appropriate measuring and test equipment is available for their personnel to maintain the safe operation of each facility listed in their Operations Manual.

23.6.21.2 The service provider shall establish a procedure to inspect, control, calibrate and maintain all measuring and test equipment to ensure that each item of equipment has the precision and accuracy that is necessary for the measurements and tests to be performed.

23.6.21.3 The procedure shall ensure that each item of test equipment required for the measurement of critical performance parameters is:

(a) Calibrated before use or at prescribed intervals against certified equipment having a known valid relationship to national and international recognized standards. Where no such standards exist, the basis used for the calibration shall be documented. Records of such calibrations and the standards used shall be maintained in accordance with the procedures required by paragraph 23.6.11.3 (c);

(b) Identified with a suitable indicator to show its calibration status; and

(c) Controlled to:

(1) safeguard against adjustments that would invalidate the calibration setting; and

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(2) ensure that the handling, preservation and storage are such that the accuracy and fitness for use is maintained.

23.6.21.4 Where hardware and software systems are used as an alternative form of facility performance testing, the functions of the systems shall be checked before being released for use in order to establish that they are capable of verifying the performance of the facility. These functions shall be checked at prescribed intervals. Records of these checks shall be maintained as evidence and verification of adequate performance of the test system.

23.6.21.5 The procedure shall ensure that when the service provider intends to operate a temporary aeronautical facility to carry out on site tests shall establish a procedure for carrying out these tests as required by paragraph 23.6.47.

23.6.21.6 The procedure required under paragraph 23.6.19 above in addition to the procedures in paragraph 23.6.47, shall require that:

(a) The operation of the temporary facility does not cause any interference with any other operating aeronautical facility; and

(b) Appropriate information regarding the operation of the temporary facility is forwarded to the provider of the Aeronautical Information Service (AIS) for the issue of a NOTAM, and if appropriate, the publication of a Supplement to the AIP; and

(c) An appropriate NOTAM has been issued.

23.6.22 NOTIFICATION OF FACILITY INFORMATION

23.6.22.1 The service provider shall establish a procedure to notify the users of the facilities with the operational information for each facility.

23.6.22.2 The procedure shall ensure that:

(a) The operational information on any facility that supports an air traffic service is forwarded to an Aeronautical Information Service (AIS) provider for publication in the Aeronautical Information Publication (AIP);

(b) The users of a facility are notified without delay of any updates in the facility information that if updated, may affect the safety of air navigation. For those facilities published in the AIP the information concerning any

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change to their information shall be forwarded to the Aeronautical Information Service (AIS) provider for the issue of a NOTAM if so required.

23.6.23 NOTIFICATION OF FACILITY STATUS

23.6.23.1 The service provider shall establish procedures to notify users of its facilities, of any changes in the operational status of each facility or service.

23.6.23.2 The procedures shall ensure that:

(a) The change of status for each of the holder's units is forwarded to the Air Traffic Service provider and Aeronautical Information Service provider for AIP service; and

(b) The users of an aeronautical telecommunication facility/service are notified without delay of any change in operational status of the facility or service that may affect the safety of air navigation. Except where the change is temporary in nature, information concerning any change in operational status of the facility shall be forwarded to the Aeronautical Information Service provider for the NOTAM publication.

23.6.24 FACILITY CHECK AFTER ACCIDENT OR INCIDENT

23.6.24.1 The service provider shall establish a procedure to check and record the operating condition of any facility listed in their Operations Manual that may have been used by an aircraft or an air traffic service involved in an accident or incident.

23.6.24.2 The procedure shall ensure that:

(a) The checks are carried out as soon as practicable after notification to the service provider of such an accident or incident; and

(b) The record of the facility's operating condition as checked and the past recorded history are kept in a secure place for possible use by any subsequent investigation.

23.6.25 FACILITY MALFUNCTIONS

23.6.25.1 The service provider shall establish a procedure to record, investigate, and rectify any detected or reported malfunction of any facility providing aeronautical telecommunication service.

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23.6.25.2 The procedure shall ensure that a report is forwarded to the Authority whenever a facility malfunction investigation reveals that:

(a) The facility has been operating outside the allowable tolerances;

(b) The facility had the potential to operate outside the allowable tolerance;

(c) There appears to be a recurring cause for the facility malfunction reports.

23.6.25.3 The report required in paragraph 23.6.25.2 shall be forwarded within seven (7) days of malfunction being detected or reported and shall include full details of the malfunction, the findings of the investigation and/or the corrective action taken to prevent a recurrence.

23.6.26 INFORMATION FLOW REQUIREMENTS

23.6.26.1 The service provider shall establish procedures for the receipt of information on the following activities when the activity could affect air traffic services within the area of responsibility, a Technical / System Monitoring and Control (SMC) supervisor shall be available:

(a) to monitor the status of all en-route facilities or receive them either through the air traffic control supervisor or through the facility technical staff;

(b) to receive all status of all radio navigation aids facility and report the status to the AIS or to the ATC depending on the particular case; and

(c) to receive all status of aeronautical facilities reported at the aerodromes and take necessary actions including reporting the status to the appropriate authorities.

23.6.26.2 The service provider shall establish systems and procedures to ensure that for each facility, appropriate to the intended area of responsibility, the user (ATC) is kept informed of the operational status and the existence of temporary hazards of all:

(a) navigation aids in the system;

(b) surveillance radar in the system;

(c) air/ground and ground/ground communication facilities in the system;

(d) automation facilities in the system; and

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(e) environmental facilities in the system.

23.6.27 AERONAUTICAL TELECOMMUNICATION FACILITIES

23.6.27.1 The service provider shall establish procedures to ensure that:

(a) all radio communication services listed in the AIP are being served by physical facilities identified;

(b) ~~all radio~~ CNS equipment shall be installed and configured is fully redundant mode to ensure service reliability that is required by the system specifications;

(c) ~~all~~ remote radio sites are easily accessible to the maintenance personnel to allow on time arrival for them in case of emergencies;

(d) ~~all~~ voice switches and ATC position control panels are maintained to guarantee continuity of service according to the specifications;

(e) fully uninterrupted power supply units are available at each separate technical site;

(f) availability of a bypass to the equipment providing the service in case a full failure of voice switching system ~~should~~ occurs; and

(g) High Frequency (HF) communication facilities with Selective Calling (SELCAL) systems is maintained as an alternative means of communication to aircraft or as main means of communication to aircraft for areas that may not be covered by VHF communications if required.

(h) when two or more ATS frequencies are being used by an air traffic controller, consideration shall be given to provide facilities to allow ATS and aircraft transmissions on any of the frequencies to be simultaneously retransmitted on the other frequencies in use thus permitting aircraft stations within range to hear all transmissions to and from the air traffic controller.

(i) all aeronautical telecommunication stations, including end systems and intermediate systems of the Aeronautical Telecommunication Network (ATN), shall be protected from unauthorized direct or remote access.

(j) the use of circuit switching and signaling to provide speech circuits to interconnect ATS units not interconnected by dedicated circuits shall be by agreement between the Administrations concerned.

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(k) the application of aeronautical speech circuit switching and signaling shall be made on the basis of regional air navigation agreements.

23.6.28 AIR – GROUND COMMUNICATION FACILITIES

23.6.28.1 The service provider shall install systems and establish procedures to communicate between the en-route (area) control centres and remote air – ground communication stations or en-route radar stations or military control centres. The systems and the procedures shall be established and maintained to guarantee continuity of service according to the system specifications;

23.6.28.2 The service provider shall establish procedures to ensure that:

(a) All service interruptions to the air – ground communication services are promptly reported and acted upon according to the standard corrective maintenance procedures;

(b) The standard preventive and periodic maintenance procedures are applied to the air – ground communication facilities to minimize the probability of service interruption; and

(c) Alternative means to air – ground communications are identified in case of service interruption of the main means of air – ground communications. Alternative means of air – ground communications could include direct connections from the telephone company, satellite communications, microwave links and or other systems.

23.6.29 NAVIGATION AND SURVEILLANCE FACILITIES

23.6.29.1 The service provider shall establish systems and procedures to:

(a) ensure compliance with the provision of the Subparts 23.1, 23.2, 23.3, 23.4 and 23.5 of Part 23 of these Directives for the specified radio navigation and Surveillance facilities including frequency spectrum management related to these facilities to avoid interference thus ensure optimum operation.

(b) ensure that all systems are provided with remote monitoring and control facilities.

23.6.29.2 The service provider shall establish a procedure to ensure that:

(a) All service interruptions to these services are promptly

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reported and acted upon according to the standard corrective maintenance procedures;

(b) The standard preventive and periodic maintenance procedures are applied to these facilities to minimize the probability of service interruption;

(c) All services are provided in accordance with the Global Air Navigation Plan, Africa-Indian Ocean (AFI) Region air navigation agreement, AFI Planning and Implementation Group (APIRG) Decision and conclusions as well as such other meetings to ensure uniformity.

23.6.30 DATA AUTOMATION FACILITIES

23.6.30.1 The service provider shall establish procedures to ensure that:

(a) All automation systems that serve the en-route, the approach and the aerodrome facilities are properly maintained to ensure satisfactory operations;

(b) Terminals are manned continuously to monitor the automation systems functions efficiently.

23.6.31 CLOCKS AND TIME RECORDING DEVICES

23.6.31.1 The service provider shall establish procedures to ensure:

(a) Compliance with the Ghana Civil Aviation Directives (GCADs), regarding the clocks and time recording system of the ATC communications;

(b) Coordinated Universal Time devices that express time in hours and minutes of the 24- hour day beginning at 0000 UTC are available and properly maintained;

(c) Each facility is checked as necessary to ensure the correct time within 5 seconds of UTC as determined by reference to a standard time station or GPS time standard.

(d) Wherever data link communications are utilized, the service provider shall establish a procedure to ensure that all clocks and time-recording devices be checked as necessary to ensure correct time to within one (1) second of UTC.

23.6.31.2 The service provider shall establish a procedure to ensure that the correct time, to the nearest half minute, is provided:

(a) In respect of any aerodrome control service or aerodrome AIS, to IFR aircraft prior to taxiing for take-

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off; and

(b) To any aircraft on request.

23.6.32 RECORD OF DATA AND COMMUNICATION

23.6.32.1 The service provider shall establish a procedure to ensure compliance with the Part 23 Subpart 2 and Part 24 regarding the automatic recording system of the ATC communications and surveillance data.

23.6.32.2 The service provider shall establish a procedure to ensure that:

(a) the recording systems capacity and quality are adequate according to the international standards; and

(b) the recording system is maintenance properly and recording media used are securely handled to prevent unauthorized access and/or tempering with such recordings.

(c) recordings shall have time and date stampings.

(d) recordings of data and communications shall be retained for a period of at least thirty (30) days unless a longer period is required to assist in Accident and incident investigations.

23.6.33 AERONAUTICAL RADIO FREQUENCY SPECTRUM UTILIZATION

23.6.33.1 The Authority shall handle all matters relating to Aeronautical Radio Frequency Spectrum Utilization in accordance with these Directives and ICAO Annex 10 Volume V.

23.6.33.2 The service provider shall consult the Authority regarding all matters relating to frequency Spectrum Utilization in accordance with these Directives.

23.6.33.3 The service provider shall establish procedures to ensure compliance with Aeronautical Radio Frequency Spectrum utilization regarding frequency allocation to:

(a) Radio navigation aids;

(b) Air-Ground and Ground – Ground Radio communications using the HF, VHF, UHF etc. bands; and

(c) Aeronautical surveillance radar systems and other

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Surveillance systems employed for civil aviation use.

23.6.33.4 The service provider shall establish a procedure to ensure:

(a) Frequencies allocated for services outside those in items 23.6.33 (a) through (c) above are coordinated with the National Communication Authority (NCA) in consultation with the Authority, and

(b) Compliance with frequency allocation protection procedures regarding VHF frequencies.

23.6.34 ANCILLARY FACILITIES

23.6.34.1 The service provider shall ensure that, the operational aeronautical facility listed its Operation Manual are provided with means to ensure continuity of operation appropriate to the needs of the ATC unit or radio navigation service being provided. The following essential facilities shall be provided:

(a) **Power Supply system:** The safety of operations of aeronautical facilities depends on the quality of the supplied power. The total electrical power supply system may include connections to one or more external sources of electric supply, one or more local generating facilities and to a distribution network including transformers and switchgear. Many other aeronautical facilities supplied from the same system need to be taken into account while planning the electrical power system at aerodromes.

(b) ***Primary Power Supply***: Adequate primary power supply shall be available at aerodromes for the safe functioning of aeronautical facilities

(c) ***Secondary Power Supply*** shall be provided by either of the following:

(1) ***Independent Public Power: -*** Which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal (Primary) power supply route and such that the possibility of a simultaneous failure of the normal (primary) and independent public power supplies is extremely remote; or

(2) ***Standby Power Supplies*** which may be engine-generator sets, or turbine generators from which electrical power can be obtained and which can be automatically connected to the facilities requiring secondary power. The maximum load which can

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be connected ~~should~~shall be within the capacity of the stand-by units. Electric power supply connections to those aeronautical facilities for which secondary power is required ~~should~~shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

(3) ***Uninterruptable Power Supply (UPS)*** systems of required capacities shall be provided in all the essential units to ensure continuous operation of aeronautical facilities.

(d) **Transfer (switch-over) time requirements**

When the primary power supply to the more critical facilities, and radio navigation aids fails, the load ~~must~~shall be transferred to the secondary power source. The transfer, or switch-over, times permitted depend on the most critical instrument classification of the aerodromes operation. (See paragraph 23.6.34.3 for the list of the maximum permissible transfer times).

(e) **Air conditioning Facilities**

To reduce failures of equipment due to high temperature and humidity air conditioning shall be provided to all the Aeronautical Telecommunication facilities and equipment.

(f) **Battery Back-up / UPS**

For protection against power loss and voltage fluctuation, the provision of Uninterruptable Power Supply (UPS) and / or battery back-up system shall be made for all essential Aeronautical Telecommunication facilities according to the requirements of each aerodrome. The UPS / battery back-up system may be located centrally at a suitable location in the equipment room and extended to the required system / facility. Suitable UPS / battery back-up systems shall be provided for each navigational site. The system ~~should~~shall be arranged so the battery system will instantaneously come on line and maintain critical operations upon loss of power. The battery system ~~must~~shall have adequate capacity to maintain critical operations until the emergency generator can come up to speed and generate the required electrical demand.

23.6.34.2 Additionally the following ancillary facilities shall be provided:

(a) **Non exchange lines**

Multi-pair non- exchange lines shall be laid between different units for control, display of status, inter unit-communication, drop circuits, recording of voice and data monitoring of channels and dedicated speech

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circuits.

(b) **Private Automatic Branch EXchange (PABX)**
PABX Systems of required capacity shall be provided at all aerodromes between operational units and ATC operating Positions for providing intercommunication and co-ordination among different units. The telephone exchange, lines and connected telephones shall be maintained by ATSEPs.

(c) **Direct Speech Circuits (DSC) and Telephones**
The DSC and telephones may be provided by outside agencies and maintained by them on rental basis. The DSC lines shall be extended to concerned ATC operating Positions. Important inter-communication telephones and DSC shall be provided through Speech Switching System (SSS) for immediate Communications.

23.6.34.3 The power supply switchover time for Aeronautical facilities shall comply with the following table:

Type of runway	Aids requiring power	Maximum Switch – over times
Instrument approach	SRE	15
	VOR	15
	NDB	15
	D/F facility	15
	ILS Localizer	10
Precision approach, Category I	ILS Glide path	10
	ILS middle maker	10
	ILS outer maker	10
	PAR	10
	ILS localizer ILS	0
	Glide path ILS	0
Precision approach, Category II	Inner maker	1
	ILS middle maker	1
	ILS Outer maker	10
Precision approach, Category III	(same as Category II)	(same as Category) II)

23.6.34.4 The service provider shall establish a procedure to ensure that:

(a) All water supply is adequate to provide the water required for firefighting equipment and other purposes by ensuring proper operation of water pumps; and

(b) All ventilation systems in the Aeronautical facilities are maintained according to the accepted standards.

(c) The power supply voltage stability shall comply with

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the manufacturer of the specific equipment specifications;

(d) All Aeronautical facilities and equipment rooms environmental condition including room temperature and humidity are within the recommended values by the specific aeronautical telecommunication equipment manufacturer; and

(e) All Aeronautical facilities and equipment rooms are shielded and insulated against leakage of air and dust. All exit doors and windows shall be closed to ensure the environmental conditions meet the requirements of this directive;

23.6.34.5 The service provider shall establish procedures to ensure that:

(a) All services interruptions to the environmental facilities are promptly reported and acted upon according to the standard corrective maintenance procedures;

(b) The standard preventive and periodic maintenance procedure are applied to the environmental facilities to minimize the probability of service interruption;

(c) Alternative means to environmental facilities are identified in case of service interruption of the main means of environmental facilities.

23.6.34.6 The service provider shall establish systems and procedures to communicate between environmental facilities.

23.6.35 REPORTING SERVICE DISRUPTIONS

23.6.35.1 The service provider shall establish procedures to:

(a) Advise the ATS provider and the Authority of any planned disruption of equipment that will result in disruption of air traffic services that could have an impact on safety;

(b) Report to the Authority within 48 hours of the occurrence, the circumstances surrounding any unplanned disruption of equipment resulting disruption of air traffic services when the disruption affected, or could have affected, the safety of air traffic including development of a list of such disruptions of equipment that are reportable. All other disruptions that are not affecting the continuation of air traffic services are reportable internally only; and

(c) Investigate any unplanned disruption to the provision of air traffic services and send a report of the

investigation to the Authority.

23.6.35.2 Disruptions reportable under paragraph 23.6.35.1 (a) shall include, but are not limited to, any:

(a) Any interruption, of greater than 10 minutes, to the normal provision of an air traffic service;

(b) Any interference on the air-ground communications channel that may affect the service greater than 10 minutes;

(c) Failure of any radar coverage to areas that are declared as covered in the Accra FIR in the Ghana AIP for greater than 10 minutes;

(d) Failure of any radio navigation aids covered by Accra FIR and published in the Ghana AIP for more than 10 minutes;

(e) Routine maintenance of equipment that will have impact on the service when service brought off air;

(f) New installations or additions on established services that require the service to be off-air; and

(g) Any services that affect the air traffic services without having a contingency plan for operation.

23.6.36 REPORTING UNSAFE CONDITIONS

23.6.36.1 The service provider shall establish a policy encouraging the reporting of unsafe conditions or practices observed by facility personnel;

23.6.36.2 Shift personnel shall have a checklist to report at the beginning of each shift the conditions of equipment in the facility where unsafe condition exists. Unsafe conditions reportable under paragraph 23.6.36.1 may include, but are not limited to:

(a) Radar signal of fixed targets are not present on the screen;

(b) Unstable performance of navigation aid;

(c) Simultaneous failure of radar and voice signals;

(d) Failure of air conditioning of the facility to operate;

(e) Failure of the UPS to function when the main power supply is interrupted;

(f) Persistent power failures without adequate alarms or

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failure of UPS systems to function in case of power failure;

(g) Persistent failures of main or standby equipment in the facility;

(h) Problems with shift administration;

(i) Failure to comply with aeronautical telecommunication/radio navigation Facility instructions;

(j) Significant equipment reading deviations; and

(k) Procedural errors or inconsistencies that may affect the safety of air navigation services.

23.6.37 PROTECTION OF FACILITIES FROM RADIO FREQUENCY INTERFERENCE AND STRUCTURAL OBSTACLES

23.6.37.1 The service provider shall establish procedures to ensure that:

(a) All Aeronautical Telecommunication Systems ~~radio navigation aids are~~ protected in accoradance with the requirements of IS 23.6.37 ~~from radio frequency interference in accordance with these~~ of this Directives and ICAO Annexes;

(b) Additionally, a~~A~~ll aeronautical telecommunications facilities are protected from radio frequency interference in accordance to the following procedures:

(1) Where the protection heights determined are less than that operationally desirable, separation between facilities operating on the same frequency shall not be less than that necessary to ensure that an aircraft at the limit of the functional service range and the operationally desirable protection height of one facility does not come above the radio horizon with respect to adjacent facilities.

(2) The problem of inter-State interference on frequencies allotted worldwide or on a regional basis to national services, shall be resolved by consultation between the administrations concerned.

(3) For ground VHF facilities which provide service beyond the radio horizon, any spurious or harmonic radiation outside the band ±250 kHz from the assigned carrier frequency shall not exceed an effective radiated power of 1 mW in any azimuth.

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(4) No radio interfering devices shall be established in the proximity of the aeronautical telecommunication facilities utilizing radio reception without prior approval from the Authority.

(5) The service provider shall establish procedures to ensure that all Aeronautical Telecommunication systems that are using transmit or receive antennas shall not be obstructed by buildings towers structures that would impact their performance.

(6) The service provider shall report any harmful Radio Frequency Interference affecting the provision of air navigation services and air traffic to the Authority for prompt resolution.

23.6.38 APPROVAL OF AERONAUTICAL FACILITIES

23.6.38.1 The Authority shall approve all the technical facilities and navigational sites for Air Navigation Services, including Communications, Navigation, Surveillance facilities, systems and procedures before their deployment in the airspace and aerodromes within Ghana.

23.6.38.2 The CNS Section shall not introduce any new CNS/ATM system, including equipment, facilities, procedures and ATSEP rating courses, without the required regulatory approval prior to commencement of the new CNS/ATS system.

23.6.38.3 The concept of the change, including any design, specifications, purpose of introducing the change and initial safety assessment performed, shall be sent to the Regulator for assessment and approval before continuing with the process.

23.6.38.4 The CNS section shall include the Regulator (CNS Inspector(s)) in the training of its technical staff regarding any new equipment, procedures or other technical changes.

23.6.38.5 The ATS Section shall not conduct any Factory and Site Acceptance Tests (FAT and SAT) without the involvement of the Regulator (CNS Inspector(s). This is to enable the Regulator make appropriate evaluation prior to the acceptance of the equipment.

23.6.38.6 Installation and implementation processes of new CNS/ATM equipment shall be monitored and assessed by the Regulator (CNS Inspector(s)) to ensure proper procedures are being adhered to for safety assurance.

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23.6.38.7 The Regulator (CNS Inspector(s)) shall carry out post-implementation monitoring to ensure acceptable levels of safety are maintained.

23.6.39 COMMISSIONING PROCEDURES

23.6.39.1 The service provider shall establish procedures to ensure that each new facility:

(a) is commissioned to meet the specifications for that facility; and

(b) is in compliance with the provisions in Part 23 of Ghana Civil Aviation Directives and in ICAO Annex 10, where applicable.

(c) meets the certification procedures in paragraph 23.6.37.

23.6.39.2 The service provider shall ensure that the system performance of the new facility has been validated by the necessary tests, and that all parties involved with the operations and maintenance of the facility, including its maintenance contractors have accepted and are satisfied with the results of the tests.

23.6.39.3 The service provider shall ensure that the procedures required in 23.6.39.1 and 23.639.2 including documentation of tests conducted on the facility prior to the commissioning, the test on the facility to ensure compliance with the applicable Subparts of Part 23 of Ghana Civil Aviation Directives or Annex 10 SARPS and any flight check required in compliance with ICAO Doc 8071.

23.6.40 DEVIATIONS

23.6.40.1 Subject to compliance with paragraph 23.6.23, the service provider may deviate from any requirement of these Directives to meet an emergency situation if there is a need to take immediate action for the protection of life or property involving carriage by air.

23.6.40.2 The provider who deviates from a requirement of this Directive under paragraph 23.6.40.1 shall provide a written report to the Authority as soon as practicable, but in any event not later than 7 days after the emergency. The report shall cover the nature, the extent and the duration of the deviation.

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23.6.41 LIMITATIONS ON SERVICE

23.6.41.1 The service provider shall not operate a facility if there is any cause to suspect the integrity of the information being provided by the facility. A cause to suspect the integrity of the information being provided by a facility includes the infringement of any critical site area of the facility until performance checks on the facility verify that the infringement does not and will not affect the performance of the facility.

23.6.41.2 The service provider shall not operate a radio transmitting facility on an aeronautical radio frequency except pursuant to a written approval granted by the Authority, subject to the provisions of paragraph 23.6.3 in this Subpart.

23.6.41.3 Except where a deviation under 23.6.40 is required, the service provider shall not operate a facility unless:

(a) The facility is listed in their Operations Manual ;

(b) The performance of the facility meets the applicable facility published information;

(c) The performance of the facility meets the applicable facility requirements in paragraph 23.6.19;

(d) Any integrity monitoring system for the facility is fully functional;

(e) All the periodic tests for the facility are completed in accordance with the programs established under paragraph 23.6.19.3 (b) and (c);

(f) The facility is included in the service providers security program, if the destruction, damage, or interference of the facility is likely to endanger the safety of an aircraft in flight;

(g) The provisions of the service providers security program for the facility are being complied with.

23.6.42 OPERATING AND MAINTENANCE INSTRUCTIONS

23.6.42.1 The service provider shall:

(a) have operating and maintenance instructions that set out the requirements for operating and maintaining each aeronautical facility listed in its Operations Manual; and

(b) Provide the operating and maintenance instructions required for the use and guidance of its personnel.

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23.6.42.2 The operating and maintenance instructions required under paragraph 23.6.42.1 ~~must~~shall include:

(a) details of the critical performance parameters for each aeronautical facility; and

(b) the associated minimum performance levels for those critical performance parameters referred to in paragraph 23.6.42.2 (a); and

(c) details of the test equipment required for the measurement of those critical performance parameters referred to in paragraph 23.6.42.2 (a); and

(d) details of the mandatory inspections and test procedures for the operational service; and

(e) Details of the mandatory inspection and test procedures for the operation and maintenance of each aeronautical facility.

23.6.43 APPROVAL TO PLACE AERONAUTICAL FACILITY INTO OPERATIONAL SERVICE

23.6.43.1 The service provider shall ensure that no aeronautical facility listed in their Operations Manual is placed into operational service unless—

(a) The person placing the aeronautical facility into operational service is assessed as competent and authorized according to the requirement under paragraph 23.6.7.3;

(b) The appropriate checks detailed in the operating and maintenance instructions required under paragraphs 236.42 have been carried out to verify the performance of the aeronautical facility; and

(c) The aeronautical facility record has been completed according to the procedures required under paragraph 23.6.11.

23.6.44 APPROVAL TO RETURN EQUIPMENT/FACILITY TO SERVICE

23.6.44.1 The service provider shall ensure that the return to services of any aeronautical facility that has undergone maintenance, or alteration/ or upgrading shall not be approved unless:

(a) The appropriate entry has been made in the maintenance logbook;

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(b) The facility is tested, ground checked and flight checked if applicable.

23.6.44.2 The description in any required state in a maintenance logbook of an aeronautical facility as having been altered/upgraded shall not be used unless it has been disassembled, cleaned, inspected as permitted, repaired as necessary, reassembled, and tested to the same tolerances and limits as a new item, using either new parts or used parts that conform to new part tolerances and limits.

23.6.44.3 The service provider shall ensure that the return to service of equipment/facility after a major alteration or equipment part replacement shall not be approved unless the equipment is tested to determine satisfactory performance in accordance with the current manufacturer's recommendations.

23.6.44.4 The service provider shall establish procedures for the control, repair and return to service of equipment or modules. The procedures shall show which modules may be repaired on-site and ~~which should~~those to be returned to the manufacturer or recognized repair facility.

23.6.44.5 The service provider shall establish a procedure to ensure that equipment spares shall be—

(a) Maintained at a level appropriate to the level of service desired; and

(b) Be stored under suitable environmental conditions.

(c) Spares having a lifetime, or requiring regular Maintenance or Calibration shall be suitably identified to that effect.

23.6.45 AUTHORIZED PERSONNEL TO APPROVE RETURN TO SERVICE

No person, other than the person in Senior position described 23.6.7.1, shall approve the return to service of an aeronautical facility especially after a major component of the equipment/ facility has been replaced or undergone maintenance or alteration.

23.6.46 CONTINUED COMPLIANCE

23.6.46.1 The service provider shall:

(a) continue to meet the standards and comply with the requirements of this Directive and the applicable GCARs; and

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(b) comply with all procedures referred to in its Operations Manual ; and

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

(d) make each applicable part of its Operations Manual available to personnel who require those parts to carry out their duties; and

(e) Notify the Authority of any change of its operations occurs.

23.6.47 FACILITY FOR CONDUCTING TEMPORARY TEST

23.6.47.1 The service provider shall establish a procedure for the operation of the facility for conducting temporary test to:

(a) Advise the Authority of a plan to conduct the temporary test;

(b) Include the time frame for conducting the test;

23.6.47.2 The plan shall include the type and class of the facility that the test will be conducted;

23.6.47.3 The plan shall indicate the purpose of the test, and

23.6.47.4 The service provider shall not operate the facility for temporary tests unless the Authority's approval is obtained.

23.6.48 CHANGES TO SERVICE PROVIDERS' ORGANIZATION

23.6.48.1 The service provider shall:

(a) ensure that its Operations Manual is amended, as required, to remain a current description of the organization, the aeronautical facilities and services; and

(b) ensure that any amendments made to its Operations Manual meet the applicable requirements of the GCARs and this Directive; and

(c) comply with the amendment procedure contained in its Operations Manual ; and

(d) provide the Authority with a copy of each amendment to its Operations Manual , immediately after the amendment is incorporated into the Operations

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Manual; and

(e) Make such amendments to its Operations Manual as the Authority may consider necessary in the interests of aviation safety.

23.6.49 FIRE SAFETY MEASURES

23.6.49.1 The service provider shall ensure that precautions are taken to:

(a) prevent or reduce the likelihood of a fire that may result in death, injury, or property damage;

(b) alert those in a structure or building of the presence of an uncontrolled fire in the event one occurs; and

(c) enable those threatened by fire to survive in and evacuate from affected areas, or to reduce the damage caused by a fire.

23.6.49.2 Fire safety measures shall include those that are planned during the construction of a building, cabins housing equipment or implemented in structures that are already standing, and those that are taught to personnel and occupants of the building.

23.6.49.3 The service provider shall install fire detection and firefighting equipment with appropriate extinguishing agents and technologies in rooms housing the aeronautical facilities.

23.6.49.4 The service provider shall have a fire safety plan which shall be approved by the Authority and a copy of the approved fire safety plan ~~must~~shall be available for the responding fire department's use during a fire emergency. The fire safety plan shall include the following:

(a) Key contact information

(b) Utility services (Including shut-off valves for water, gas and electric)

(c) Access issues

(d) Dangerous stored materials

(e) Connections to sprinkler system if used

(f) Layout, drawing, and site plan of building

(g) Maintenance schedules for fire safety systems

(h) Personnel training and fire drill procedures

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23.6.50 RADIO FREQUENCY RADIATION HAZARDS

23.6.50.1 The service provider shall establish procedures to ensure that precautions are taken to prevent or reduce the likelihood of health hazard which may be caused by:

(a) Microwave energy (which are non-ionizing radiations) of sufficient intensity which can produce biological damage in humans; and

(b) other harmful radiation in the form of X-rays produced in High Power tubes such as Klystrons which uses high voltages to generate high Radio Frequency (RF) power.

23.6.50.2 The Service Provider shall ensure that the procedures required in 23.50.1:

(a) are in compliance with standards and safety guidelines for exposure of the public to RF Radiation from transmitting antennas developed by the Institute of Electrical and Electronic Engineers (IEEE), American National Standards Institute (ANSI), the International Commission of Non-Ionizing Radiation Protection (ICNIRP), the National Council on Radiation Protection and Measurements (NCRP) etc.

(b) Include safety precautions when operating high power radar and other communication systems such that:

(c) Areas of high power density shall be fenced off, locked or otherwise made inaccessible when transmitting;

(d) Personnel of any kind shall never look into an open waveguide or antenna feed horn connected to energized transmitters;

(e) Tubes and accompanying parts ~~must~~shall be properly shielded with lead; and

(f) The safety rules set are provided for workers and are posted at the site requiring employees and contractors to follow such stringent procedures.

23.6.50.3 The service providers personnel shall undergo regular medical checkup as a mitigatory measure as well as immediate treatment when working in environments likely to cause exposure or when exposure to such radiations has occurred.

23.6.51 FORMAT FOR DEVELOPMENT OF MANUALS

23.6.51.1 The manuals have been prepared in conventional manual format and provided in an electronic version or printed.

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(a) ***Introduction or Preface.*** The first page shall contain a brief description of the manual, its intent and intended users. This page shall contain a section for endorsement by the approving authority. The introduction or preface section shall contain a statement of signed by the Chief Executive on behalf of the service providers' organization confirming that:

(1) the manual defines the organisation and demonstrates its means and methods for ensuring ongoing compliance with the GCAR and this Directive; and

(2) the Operations Manual and all other technical manuals, operating and maintenance instructions, ~~must~~shall be complied with by the organization's personnel at all times. This section emphasizes that the procedures and policies in the manual are expected to be used by the organization personnel.

(b) ***Revision Control.***
The manual shall be bound in a manner easy to revise and shall contain a revision control page or section from which the user can readily determine whether the manual is current or not. This page or section ~~should~~shall follow the cover page. The control date of the most recent revision of each individual page ~~must~~shall appear on each page.

(c) ***A Bulletin system***
The manual may be established to bring temporary information or changes that ~~should~~shall not be delayed by a formal revision process, to the attention of the user. The bulletin system ~~should~~shall have a means of control that includes giving bulletins a limited life and systematically incorporating them into appropriate manuals in a timely manner. Users ~~should~~should be able to easily determine whether they possess all current bulletins.

(d) ***List of Effective pages (LEP)***.
The manual shall have a List of Effective Pages used to ensure that the manual contains current information. The LEP shows the revision status of each page.

(e) ***Table of Contents.***
The manual shall have a table of contents containing lists of major topics with their respective page numbers.

(f) ***References.***
The Manual may include references to other manuals when it is necessary to clarify the intent of the text or when it is useful to the user for looking up specific subject matter. References ~~should~~shall not be made to

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Advisory Circular (AC) as these sources are advisory. Service providers and Operators ~~should~~shall use caution when adapting the text of advisory documents into their manuals. AC text may not necessarily translate into a Regulation.

(g) ***Definitions.*** Significant terms used in manuals ~~should~~shall be defined. Any acronym or abbreviation not in common use ~~should~~shall also be defined.

(h) ***Elements of Style.*** The Manuals ~~should~~shall be composed in the style of general technical writing. This style ~~should~~shall be clear, concise, and easy to understand.

23.6.52 OPERATIONS MANUAL

23.6.52.1 The service provider shall provide to the Authority for approval, an Operations Manual in a format prescribed in paragraph 23.6.51 and subject to compliance with the requirements in these Directives.

23.6.52.2 Initial copies of the manuals shall be submitted to the Authority both in hard and soft copies for review. A comprehensive review shall be conducted by the Authority to verify that the manuals conform to the format and style as follows:

(a) The Operations Manual shall contain the following:

(1) the titles and names, duties and responsibilities of the senior person or person(s) in paragraph 23.6.7 including matters for which they have responsibility to deal directly with the Authority on behalf of the organization;

(2) an organization chart showing lines of responsibility of the senior persons in paragraph 23.6.52.2 (a) (1) and covering each location where the service provider performs operations;

(3) a summary of the organization's staffing structure at each location of operations;

(4) a summary of the scope of activities at each location where the organizations' personnel are based for the purpose of providing or maintaining the types of facilities listed under paragraph 23.6.52(5);

(5) a list of types of aeronautical facility and a summary of the operational details of each aeronautical facility associated with each location; and

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(6) the detailed procedures, or an outline of the procedures including information that identifies the documentation with respect to requirements under paragraphs:

(i) 23.6.7.1 (b) and 23.6.7.2 regarding the personnel requirements and competence;

(ii) 23.6.8 regarding the training requirements of personnel;

(iii) 23.6.9 regarding Aeronautical Facility requirements;

(iv) 23.6.10 regarding Documentation;

(v) 23.6.11 regarding Management of Records;

(vi) 23.6.12 regarding Facility Maintenance Logbook;

(vii) 23.6.13 regarding Quality Assurance and Safety Management System;

(viii) 23.6.14 regarding Security Program;

(ix) 23.6.15 regarding Prevention of Fatigue;

(x) 23.6.16 regarding Coordination;

(xi) 23.6.17 regarding Shift Administration;

(xii) 23.6.18 regarding Contingency Plan;

(xiii) 23.6.19 regarding Periodic Inspection and Testing;

(xiv) 23.6.20 regarding Aeronautical Facility Performance /Operation

(xv) 23.6.21 regarding Inspection of Measuring and Test equipment;

(xvi) 23.6.22 regarding Notification of Facility Information;

(xvii) 23.6.23 regarding Notification of Facility Status;

(xviii) 23.6.24 regarding Facility Check after Accident or Incident;

(xix) 23.6.25 regarding Facility Malfunction;

(xx) 23.6.26 regarding Information Flow

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requirement;

(xxi) 23.6.27 regarding Aeronautical Communication Facilities;

(xxii) 23.6.28 regarding Air-Ground Communication Facilities;

(xxiii) 23.6.29 regarding Navigation and Surveillance Facilities;

(xxiv) 23.6.30 regarding Data Automation Facilities;

(xxv) 23.6.31 regarding Clocks and Time Recording Devices;

(xxvi) 23.6.32 regarding Record of Data and Communications;

(xxvii) 23.6.33 regarding Aeronautical Radio Frequency Spectrum Utilization;

(xxviii) 23.6.34 regarding Environmental Facilities;

(xxix) 23.6.35 regarding Reporting Service Disruption;

(xxx) 23.6.36 regarding Reporting Unsafe Conditions;

(xxxi) 23.6.37 regarding Protection of Facilities from Radio Frequency Interference and Structural Obstacles;

(xxxii) 23.6.38 regarding Certification of Aeronautical facilities and procedures;

(xxxiii) 23.6.39 regarding Commissioning Procedures;

(xxxiv) 23.6.40 regarding Deviations;

(xxxv) 23..6.41 regarding Limitation of Services;

(xxxvi) 23.6.42 regarding Operating and Maintenance Instructions;

(xxxvii) 23.6.43 regarding Approval to Place;

(xxxviii) 23.6.44 regarding Approval to return Equipment / Facility into Service;

(xxxix) 23.6.45 regarding Authorized Personnel to Approve return into service;

(xl) 23.6.46 regarding Continued Compliance;

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(xli) 23.6.47 regarding Operation of facility for conducting temporary test;

(xlii) 23.6.48 regarding Changes to Service providers Organization;

(xliii) 23.6.49 regarding Fire Safety; and

(xliv) 23.6.50 regarding Radio Frequency Radiation hazards.

(b) The detailed procedures to control, amend, and distribute the Operations Manual.

(c) The Authority may not grant an approval to an ANSP for the provision of aeronautical telecommunication service unless the Authority is satisfied the ANSP's Operations Manual.

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GHANA CIVIL AVIATION (ANS) DIRECTIVES

PART 23.6 – IMPLEMENTING STANDARDS

For ease of reference, the number assigned to each implementing standard corresponds to its associated regulation. For example, IS: 23.6.2.1 would reflect a standard required in subsection 23.6.2.1

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IS 23.6.37 PROTECTION OF COMMUNICATION, NAVIGATION AND SURVEILLANCE SYSTEMS AND OTHER AIRPORT INFRASTRUCTURE

1. INTRODUCTION

Airways facilities at an airport permit the safe navigation of aircraft within the airspace of an airway, and include; navigation aids along the airway and for approach and landing at aerodromes, communication facilities, meteorological facilities and air traffic control (ATC) facilities.

The airways facilities for the safe, efficient operation of aircraft in the terminal area surrounding an airport and on the airport manoeuvring area need, in most instances, to be located on or at the perimeter of the aerodrome. Some of these facilities, in particular the precision approach facilities, ~~must~~shall be positioned in precise geometric relativity to runways or runway center line extensions. Most facilities have associated site clearance areas surrounding the site location to ensure proper operation of the facility.

Nothing ~~should~~ shall be permitted to derogate the signals generated by any existing or planned electronic navigational aids (NAVAID) or an existing ATC facility.

The siting criteria for these facilities define the minimum requirements for uncompromised performance of each facility. In situations where non-compliance or infringement does not result in the facility being unsafe or completely unserviceable, it functions may be degraded. Such degradation may, however, necessitate the facilities removal from service.

General requirements for airways facilities are a finite site for their physical installation, i.e. shelters, foundations, towers, antennae plus a reasonable service area around the physical features. In many instances, there is also a requirement for a clearance zone around this space, in some instances relatively extensive, for the purpose of ensuring transmission of electromagnetic waves without interference from extraneous sources, or for the purpose of unimpeded vision in the cases of ATC towers or rescue and firefighting service (RFFS) stations.

Airways facilities at an aerodrome may include any or all of the following:

(a) navigation aid facilities

- o ILS (instrument landing system)
- o DME (distance measuring equipment)
- o VOR (very high frequency omni-direction radio range)

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Implementing Standards Part 23 Subpar
– Aeronautical Telecommunication Service Provis

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o NDB (non-direction beacon)

(b) radar sensor sites

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(c) air/ground and point-to-point communications systems including radio bearer systems and satellite communications sites

*(d) air traffic services centres

*(e) fire stations (and satellite fire station); and

*(f) ATC towers.

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*Facilities that are not covered in the scope of this paper

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2. OBSTACLE LIMITATION SURFACES

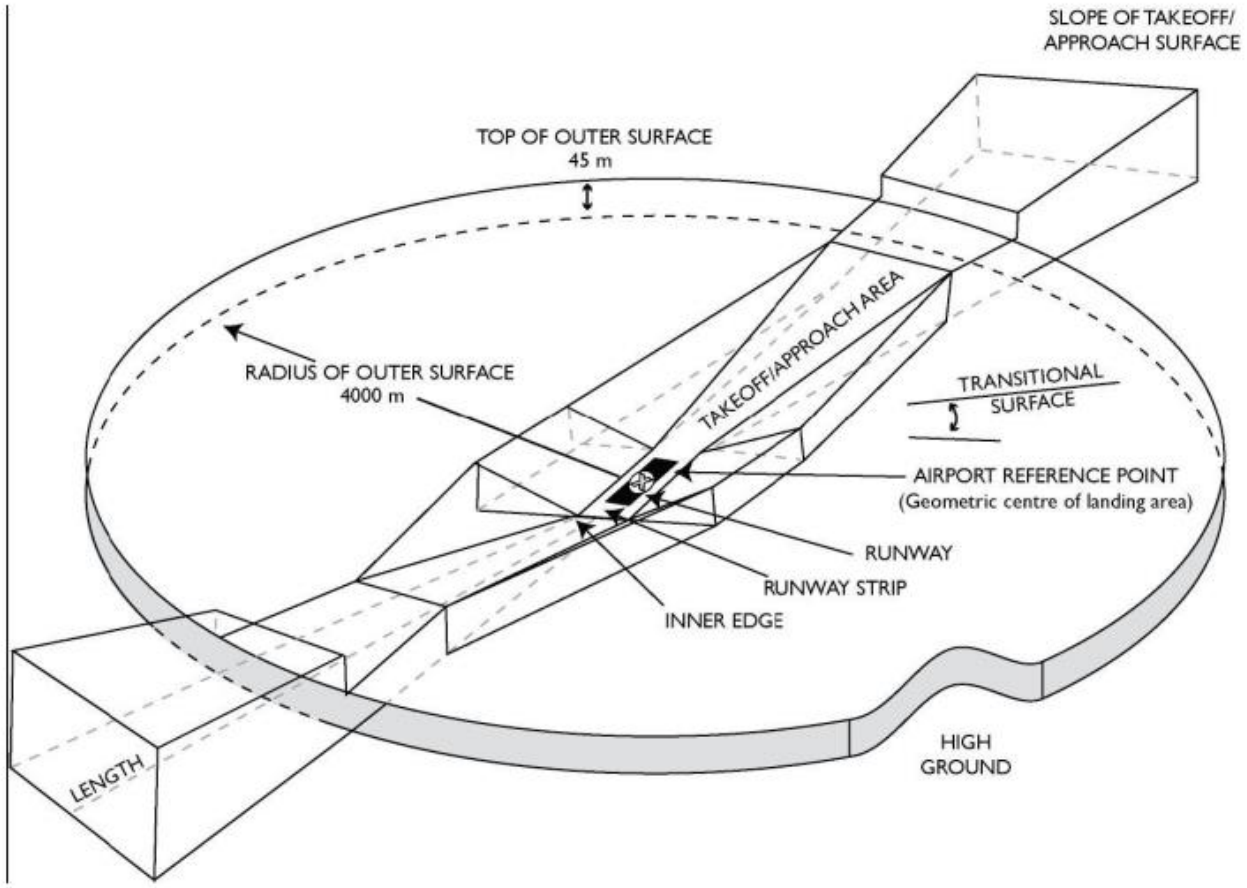

Figure 1: OBSTACLE LIMITATION SURFACES

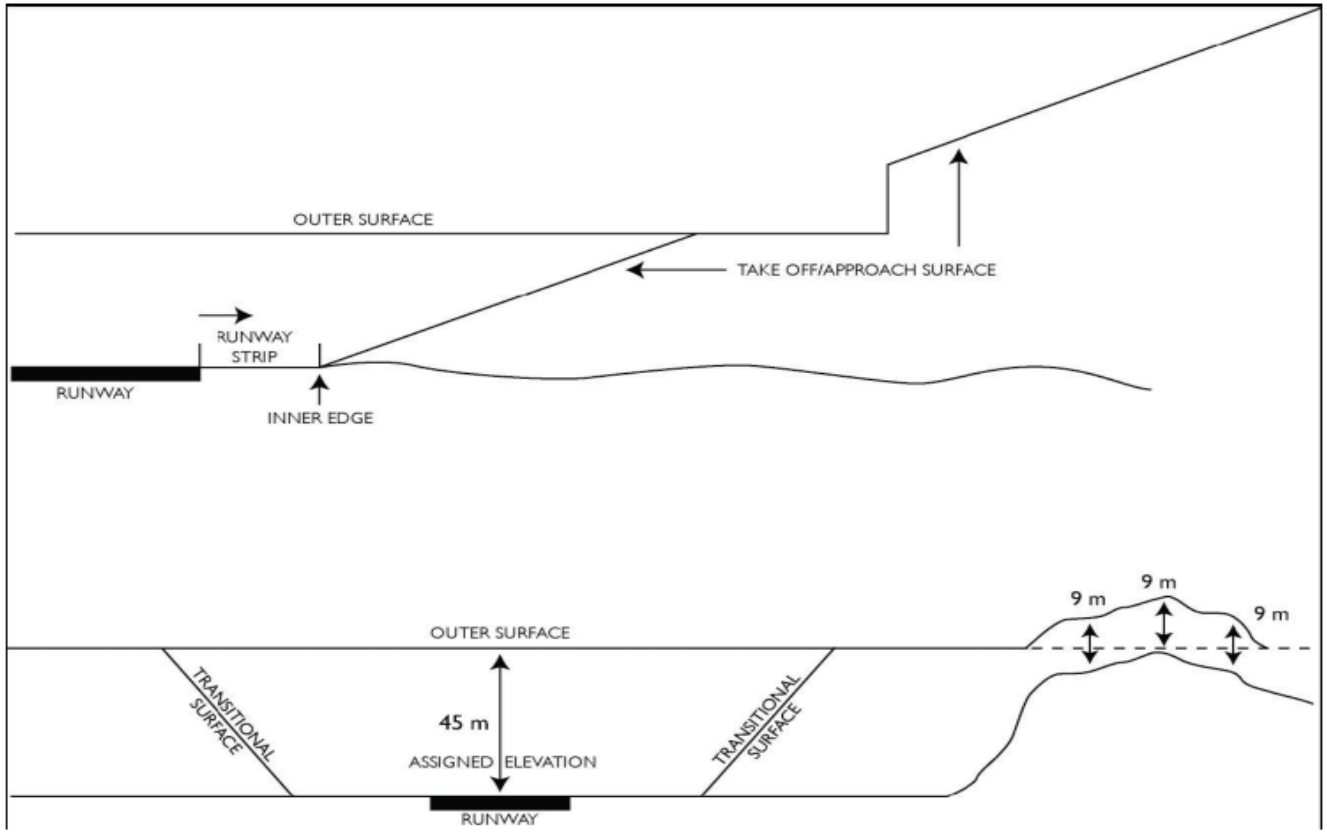

Figure 2: OBSTACLE LIMITATION SURFACES (SIDE VIEW)

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3. NAVIGATIONAL AIDS

The location of the radio navigation aids is largely determined by the air route or approach path on which they are to be used; they cannot normally be moved without some consequential change to or restriction placed on the approach path or air route.

There are sets of siting considerations that ~~must~~shall be addressed when siting a NAVAID on airport property.

These include consideration of runway-associated safety elements, system object clearance areas,

the footprint of the system, critical area impact on airport operations, interference to/from other systems, and installation considerations.

Except for NDBs, radio navigation aids are more complex in terms of the transmitting equipment, the antenna design and the electromagnetic fields, which are created about them. The accuracy of the paths defined by a particular navigation aid is determined not only by the transmitting facility but is largely dependent on the reflection of its signals from the objects about the facility; the terrain, vegetation, buildings, power lines, aircraft, other vehicles, fences, ditches, etc. In designing a facility, the position of these objects is taken into account. For example, sites are chosen so that these objects will provide least signal degradation; the vegetation is cleared, the ground levelled in key areas, and power lines may be moved or buried.

For the facility to remain a useful part of the airways system these environmental characteristics have to be maintained and any proposals for change need to be carefully examined.

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(A) VHF OMNI-DIRECTIONAL RADIO RANGE (VOR) FACILITIES

The ANSP or Service provider ~~CAA~~ shall ~~should~~ normally acquire (either through purchase, lease or other means) an area approximately 125 m square in which to locate this equipment and then seeks restrictive easements covering two areas adjacent to the site.

- Vehicle movements.

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 No aerodrome roadways, taxiways, public roads, tramways and railways, trees, fences, wire lines, structures, machinery or buildings shall be closer than a 300m radius centred on the geometric centre of the site, except with the prior written consent of the Director General, GCAA and only where calculations show that the proposed obstruction has no impact on the operation of the navigational aid.

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 Vehicles used by aerodrome maintenance staff shall ~~are~~ not ~~to~~ be parked within a 300m radius.

- Restricted area.

- No unauthorised personnel and vehicles shall be within a 300 m radius of the facility. Wooden signs or wooden fencing only may be used to clearly define the restricted area.
- Movement of vehicles between the VOR building and VOR antenna is prohibited.

- Site maintenance.

Grass and scrub within 150 m of the site shall ~~must~~ be mown or cut regularly. No grass cutting equipment shall~~to~~ be parked within a 300 m radius of the VOR building.

- Services.

All cables (e.g. power and telephone) shall ~~are to~~ be placed underground within 300 m radius of a VOR facility. Cables can be run above the ground from 300 m to 600 m radius from a VOR, if they are aligned radially to the VOR.

- Clearance zone.

- No structure, building, trees, fences, towers or large continuous metallic objects such as overhead power lines, masts, water towers or large metal-clad buildings is permitted within 600 m radius of the VOR if they will extend above which will penetrate beyond above the horizontal plane as measured from the array centre or which subtend an elevation angle of one degree as seen from the VOR site. Structures which subtend an angle of greater than 1° are to be analyzed for potential interference prior to being approved.

- The second zone is an area enclosed by a circle with a radius of 600 m centred on the geometric centre of the site but excluding the area within 300m. Within this area, the height, measured to the highest point of structures and buildings having large metal content, and wire lines and fences shall not subtend a vertical angle of more than 1.2° or extend more than above the horizontal plane as measured from the array centre. These limits may be increased by 50% for fences or lines which are essentially radial or which subtend an angle of not more than 10" measured in the horizontal plane. Wooden structures or buildings with negligible metallic content may subtend vertical angles up to 2.5°. No structures, buildings, wire lines or fences shall be permitted without written permission from the Director General, GCAA.

Note:

In the event that a Doppler type VOR is used, the designated areas can be reduced by at least one half as long as the optical line-of-sight requirement of the NAVAID is retained. Advice and prior approval ~~must~~shall be obtained from the Director General on this type of installation.

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(B) DME FACILITIES

- Vehicle movements.
  No restriction.

- Restricted area.
  No restricted areas

- Site maintenance.
  No requirement for grass or scrub clearing, within a radius of 300 m but grass ~~must~~shall not be allowed to grow above the height of the DME antenna mounting point on the DME mast.

- Services.

  - Overhead Low Vault power (LV) and control lines are allowable in the vicinity of the DME site provided that they do not project above the mounting point of the DME antenna to the DME mast.
  - Overhead 2 kV-22 kV High Vault (HV) lines ~~must~~shall be at least 400 m distant, while HV lines in excess of 22 kV ~~must~~shall be at least 1 km distant from the DME antenna system.

- Clearance zone.

  - Small structures, small buildings, overhead lines and fences are allowable adjacent to the DME antenna location within a 600 m radius, providing that they do not project above the mounting point of the DME antenna to the DME mast.
  - Larger obstructions such as multi-storey buildings, hangers, bridges, etc, may interfere with DME system performance and any proposal to erect large structures above a one degree elevation angle as seen from the DME antenna within a 5 km radius from the DME antenna location may affect the performance of the system.

(C) VHF DIRECTION FINDING SYSTEMS (VHF/DF)

Siting requirements for VHF/DF are of major importance. In particular, the equipment requires that:

- within 45 m of the site: Ground to be level ±1° and surface roughness ±30cm

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- within 90 m of the site: Ground to be clear of trees, masts, metal fences and vehicles.

- within 180 m of the site: Ground to be clear of buildings, car parks and small metal structures.

- within 365 m of the site: Ground to be clear of built-up areas, hangars, railways and other metallic structures.

In general, a clear line-of-sight through shall be maintained between the antenna system and local flying aircraft.

It is essential that the DF antennae be separated from any VHF air/ground communication (transmitting) antennae to the greatest extent practical, but by at least 2 km and be separated from any antennae transmitting a high power broadcast by at least 8 km.

(D) INSTRUMENT LANDING SYSTEM (ILS)

Instrument landing system (ILS) facilities are a highly accurate and dependable means of navigating to the runway in Instrument Flight Rules (IFR) conditions. When using the ILS, the pilot determines aircraft position primarily by reference to instruments. The ILS consists of:

a. the localizer transmitter;

b. the glide path transmitter;

c. the outer marker (can be replaced by an NDB or other fix);

d. the approach lighting system.

ILS is classified by category in accordance with the capabilities of the ground equipment. CategoryI ILS provides guidance information down to a decision height (DH) of not less than 200 ft. Improved equipment (airborne and ground) provide for Category II ILS approaches.

A DH of not less than 100 ft. on the radar altimeter is authorized for Category II ILS approaches.

The ILS provides the lateral and vertical guidance necessary to fly a precision approach, where glide slope information is provided. A precision approach is an approved descent procedure using a navigation facility aligned with a runway where glide slope information is given. When all components of the ILS system are available, including the approved approach procedure, the pilot may execute a precision approach.

In all cases, it is desirable that land planners consult engineers of the GCAA concerning details of Instrument Landing Systems (ILS) installed or planned at the airport in question. As an interim measure, ILS standards will be applied for all Microwave Landing System (MLS) installations.

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Generally, an ILS is made up of five major components:

- the localiser,
- glide path, and
- three markers (inner, middle and outer markers),
- remote monitor and
- locator beacons.

The component facilities perform specific functions and are separately located on the approach path to and alongside the runway they serve. Different siting requirements and restrictions toaccess and movement apply to each site.

The location for these components varies according to the terrain; however, typical locations are as follows;

(a)	Localizer	335 m outward from the stop-end of the runway on the extended centre line.
(b)	Glide Path	320 m (variable) in from the threshold for a 3.0° glide path. The antenna will typically be 122 m (Null Reference type) or 152 m (M-Array type) from the runway centre line, depending on the type of antenna, and may be located on either side of the runway (usually located on the opposite side of existing or planned taxiways).
(c)	Middle Marker	1050 m ±150m outward from the threshold of the runway in the approach direction and within 75 m of the extended runway centre line.
(d)	Outer Marker	7.2 km (nominal) outward from the threshold of the runway in the approach direction and within 75 m of the extended runway centre line. Limit: 6.5 km to 13 km.
(e)	Back Marker	7.2 km from the end of the runway in the departure direction and within 75 m of the extended runway centre line. Limits: 6.5 km to 13 km.

The **most significant sources of interference for ILS facilities are metallic objects** having appreciable horizontal dimensions such as structural steel towers, metal-clad buildings and power/telephone transmission lines. These objects reflect the ILS signals in unwanted directions,distorting the information provided to aircraft.

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High voltage power lines and substations radiate electromagnetic noise (EMN) due to corona, gap discharge, etc. This EMN may inhibit reliable reception of ILS signals. In addition, EMN radiated by industrial-scientific medical (ISM) apparatus such as dielectric heaters and plastic welders can also interfere with the reliable reception of ILS signals.

For planning purposes, all runways shall ~~should~~ be considered to be equipped with an ILS at each end. Therefore, the restrictions outlined below shall ~~hould~~ be applied to both ends of the runway. The requirements listed below may affect land use outside the airport property boundary.

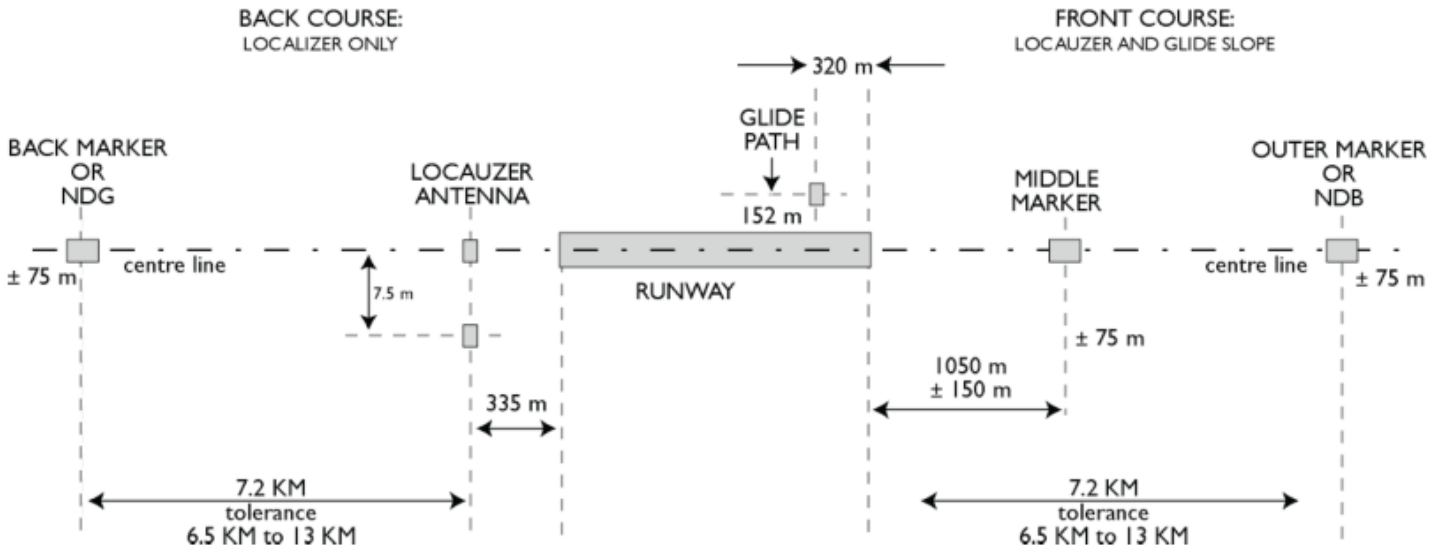

Figure 3: TYPICAL SITE CONFIGURATION

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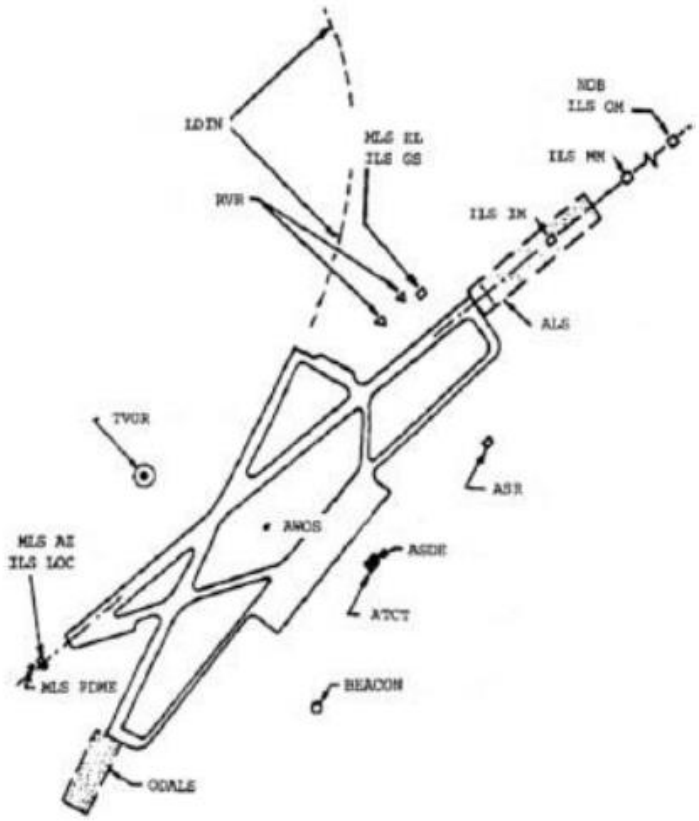

Figure 4: TYPICAL NAVAID PLACEMENT

- Services (electromagnetic compatibility).

It is important to ensure that EMN radiated by power lines, substations and ISM apparatus will not interfere with the proper reception of ILS guidance signals in the approach path. Within the site areas all power and control cables ~~must~~shall be laid underground.

- power lines with voltages greater than 100kV shall ~~hould~~ be no closer than 1.8 km from the runway centre line and no closer than 3.2 km from the ends of the runway;
- electrical substations for voltages greater than 100 kV shall ~~hould~~ be no closer than 3.2 km from the centreline of the runway and no closer than 16 km from the ends of the runway;
- power lines and substations shall ~~ould~~ be designed, constructed and maintained using state of the art techniques to minimize radiated EMN in the ILS frequency bands; and

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- ISM apparatus shall ~~should~~ be restricted from operating within the rectangular area extending 1.5 km on either side of the centre line of the runway to the outer markers.

Special sites or sites not conforming to the above criteria shall ~~hould~~ be discussed with the Director General of the GCAA on an individual basis.

- **Construction.**
  No construction or variation to access is permitted within the critical or sensitive areas without the prior approval of the GCAA.

- **Aircraft.**
  Aircraft shall not enter or remain within a critical area whilst the ILS is in use.

- **Vehicles and Plant.**
  Vehicles and plant shall not enter nor remain within a critical or sensitive area whilst the ILS is in use. Vehicles operating within the critical area may cause the equipment to automatically shut down.

- **Road Use.**
  Approval may be granted for the use of constructed roadways where the type and size of vehicle has been assessed and determined to be acceptable.

- **Access Control.**
  Access to the critical area shall be controlled by the responsible ATC officer.

- **Signs.**
  Signs shall be provided to delineate the boundaries of the critical area.

- **Critical/Sensitive Areas.**
  The occurrence of interference to ILS signals is dependant on the total environment around the ILS antennas, and antenna characteristics. The environment, for the purpose of developing protective zoning criteria, can be divided into two types of area, the critical areas and the sensitive areas.

  The **critical area** is an area of defined dimensions about the localiser and glide pathwhere vehicles, including aircraft, will cause unacceptable disturbances to the ILS performance.

  The **sensitive area** is an area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, may affect the ILS performance.

i. Localiser

- The primary component of the ILS is the localizer, which provides lateral guidance. The localizer is a VHF radio transmitter and antenna system using the same general range as VOR transmitters (between 108.10 MHz and 111.95 MHz). Localizer frequencies, however, are only on odd-tenths, with 50 kHz spacing between each frequency. The transmitter and antenna are

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on the centerline at the opposite end ofthe runway from the approach threshold.

The localizer *back course* is used on some, but not all ILS systems. Where the back course is approved for landing purposes, it is generally provided with a 75 MHz back marker facility or NDB located 3 to 5 NM from touchdown. The course is checked periodically to ensure that it is positioned within specified tolerances.

- The signal transmitted by the localizer consists of two vertical fan-shaped patterns that overlap, at the center (see ILS Localizer Signal Pattern figure, below). They are aligned with the extended centerline of the runway. The right side of this pattern, as seen by an approaching aircraft, is modulated at 150 Hz and is called the "blue" area. The left side of the pattern is modulated at 90 Hz and is called the "yellow" area. The overlap between the two areas provides the on-track signal.

The width of the navigational beam may be varied from approximately 3° to 6°, with 5° being normal. It is adjusted to provide a track signal approximately 700 ft wide at the runway threshold. The width of the beam increases so that at 10 NM from the transmitter, the beam is approximately one mile wide.

The *reception range* of the localizer is at least 18 NM within 10° degrees of the on-track signal. In the area from l0° to 35° of the on-track signal, the reception range is at least 10NM. This is because the primary strength of the signal is aligned with the runway centerline.

Site.

- The localiser antenna is located on the extended centreline of the runway typically 400 m from the stop-end.
- The localiser shelter is generally located 90 m to the side of the antenna system.

Critical area.

- The critical area for a localiser extends 90 m either side of the runway centerline commencing from 10 m behind the localiser antenna and extending forward to a point of 360 m in front of the antenna (see Figure 1).

Sensitive area.

The sensitive area commences at the localiser antenna origin and extends forward in a sector ±10 degrees of the runway centreline. Within this sector obstructions shall be less than 0.5 degrees elevation, when measured from ground level at the antenna base (see Figure1).

Site preparation.

The critical area shall be prepared to have a lateral gradient of not greater than ±1%, longitudinal gradient of not greater than ±1% and shall be graded smooth to within ±75 mm of design levels.

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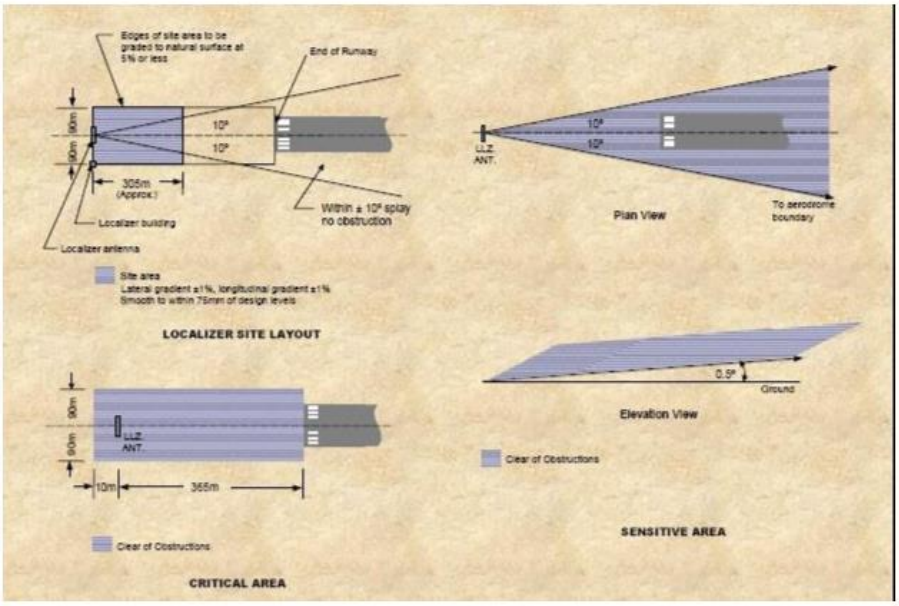

Figure 5 – LOCALISER SITE PREPARATIONS AND OBSTRUCTIONS

Figure 6 – ILS LOCALIZER SIGNAL PATTERN

Interference from Structures

Refer to Figure 4

Area A *:* Circle 75m radius centered on the localizer array. No objects higher than 1.2 m.

Area B *:* Rectangle 365m x 610 m centered on the localizer array. No metallic objects higher than
1.2 m, no non-metallic objects higher than 2.5 m.

Area C *:* The area originating at the centre of the localizer array covering an arc of 36° in the direction of the runway and terminating 6100 m from the localizer array; or to the distances specified for the takeoff approach surfaces, the transitional surfaces, and the horizontal surfaces; whichever is the lesser.

No metal-walled structure shall ~~ould~~ subtend a total vertical angle greater than 0.8°, no structural steel work shall~~ould~~ subtend a total vertical angle greater than 1.6° and no non-metallic object shall~~ould~~ subtend a total vertical angle greater than 2.4°. Trees are included in this latter category. Note that these are "bottom-to-top" subtended angles measured from the antenna elements, with no reference to the horizon or the horizontal plane being meant (See Figure 5 of Navaids siting). Within the remaining 324° these restrictions can be relaxed by a factor of approximately 2. Restrictive easements are normally obtained from the GCAA in coordination with the land development authorities when necessary.

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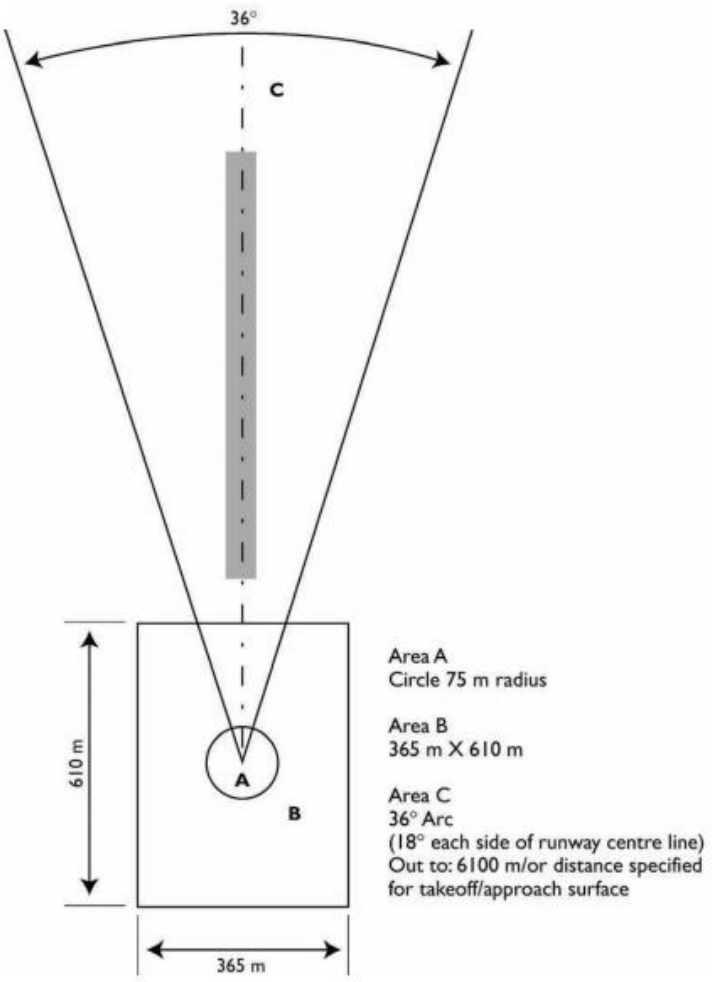

Figure 7: RESTRICTIONS FOR ILS LOCALIZER

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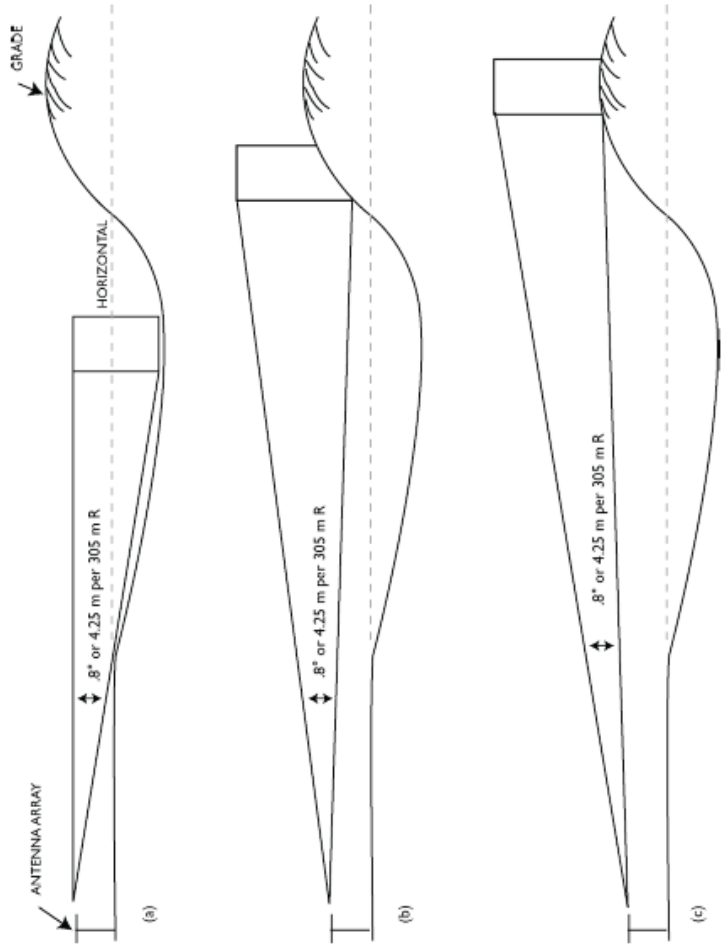

Figure 8: EXAMPLES SHOWING APPLICATION OF LOCALIZER RESTRICTIONS IN AREA C

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In the vicinity of the runway no large surfaces are to be constructed parallel to the runway centre line. Large surfaces will be considered only if they are:

(a) perpendicular to the runway centre line;

(b) at an angle to the runway such that reflections will occur away from the ILS course;

(c) radial to the localizer antenna; or

(d) in the electromagnetic shadow of other structures.

Airport service roads ~~must~~shall not intercept the front course or back course of the localizer within 180 m of the array.

If a service road ~~must~~shall cross the back course, it shall ~~ould~~ be at least 180 m from the array and the antenna counterpoise shall ~~ould~~ be a minimum of 2.5 m above the road elevation. "No Parking No Stopping" signs ~~should~~shall be erected at both ends of that portion of the road subtending an angle of ± 25° from the extended runway centre line, measured from the antenna array.

NOTES:
(1) Generally, the orientation of large surfaces shall ~~ould~~ be such as to cause minimum interference to any ILS on the airport. Surfaces radial to a transmitting antenna generally present minimum interference.

(2) In addition, all surfaces parallel to runway centre lines, or with an orientation, which may cause interference, shall ~~ould~~ contain as little metal as possible.

(3) Generally, the "mirror" concept may be used to determine where reflections will cause scalloping on the runway and/or extended centre line. Reflecting objects close to the runway centre line will cause scalloping of greater amplitude than objects farther from the centre line.

(4) Thin metallic and non-metallic vertical objects such as masts and poles (without guy wires) are excluded from the above restrictions.

(5) The effects of large parked aircraft ~~must~~shall be considered. The orientation of such aircraft shall ~~ould~~ be specified to ensure minimum interference to the ILS signals.

(6) If it is planned to utilize the localizer back course, it will be necessary to duplicate Area "C" in the back course approach direction.

(7) If any part of the restricted area depicted in Figure 4 is outside the airport boundary, restrictive easements shall ~~ould~~ be obtained to avoid future encroachment on restrictions.

(8) Identical restrictive areas exist at the other end of the runway.

(ii) Glide Path

- The glide slope provides vertical guidance to the pilot during the approach. The ILS glide slope is produced by a ground-based UHF radio transmitter and antenna system, operating at a range of 329.30 MHz to 335.00 MHz, with a 50 kHz spacing between each channel.The transmitter is located 750 to 1,250 feet (ft) down the runway from the threshold, offset 400 to 600 ft from the runway centerline. Monitored to a tolerance of ± 1/2 degree, the UHF glide path is "paired" with (and usually automatically tuned by selecting) a corresponding VHF localizer frequency.

  Like the localizer, the glide slope signal consists of two overlapping beams modulated at 90Hz and 150 Hz (see **Glide Slope Signal Pattern** figure, below). Unlike the localizer, however, these signals are aligned above each other and are radiated primarily along the approach track. The thickness of the overlap area is 1.4° or 0.7° above and 0.7° below the optimum glide slope.

  The glide slope signal is received by a UHF receiver in the aircraft. In modern avionics installations, the controls for this radio are integrated with the Localizer controls so that the proper glide slope frequency is tuned automatically when the localizer frequency is selected.

Site

- The glide path system is normally installed for a threshold crossing height of 15 m, with a path angle of 3 degrees. The glide path tower shall ~~ould~~ be situated on the non-taxiway side of the runway approximately 300 m back set from the threshold and between 150 m to 175 m from the runway centreline.

- The special earth mat laid between the glide path antenna and the monitor pick-ups ~~must~~shall be inspected at regular intervals. Growth of grass is to be prevented by applying weed killer as necessary.

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Critical area

The critical area for a glide path extends 700 m forward of the antenna and either side of a line, parallel to the runway centreline, which passes through the antenna tower (See Figure 2).

Sensitive area

The sensitive area includes the critical area plus an area bounded by lines at ±30 degrees to a ray commencing at the antenna and extending parallel to the runway centreline towards the threshold. An allowance of 0.5 degrees elevation is permitted for constructions outside the critical area

Remote monitors

Remote monitors are a non-executive monitor of the localizer located in the far field, typically in the area of the middle marker.

The sensitive area is detailed in Figure 10.

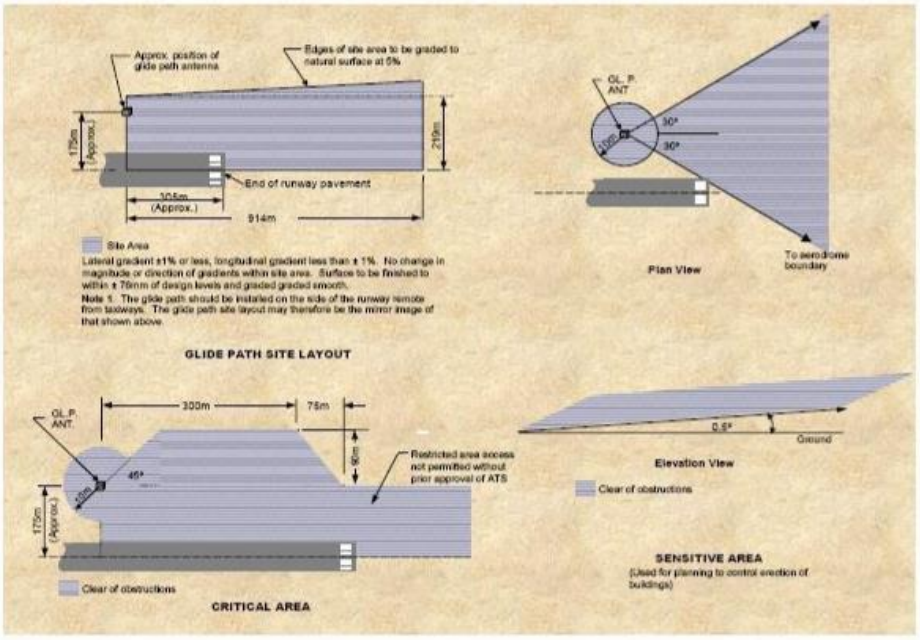

Figure 9 - ILS GLIDE PATH SITE PREPARATIONS & RESTRICTIONS

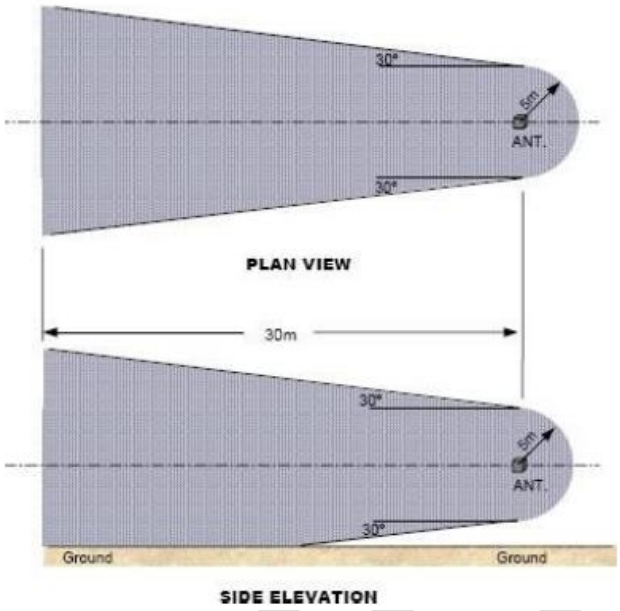

Figure 10 - ILS Remote monitor antenna sensitive area

(iii) Image Type Glide Path Restricted Areas

The restricted areas for image type glide paths are depicted in Figure 6. They are areas D, E and F.

Area D The area originating at the glide path antenna covering an arc of and extending 1500 m in the approach direction. No metallic fences, power lines, telephone lines, buildings, roads or railroads.

NOTE:
This is the "ideal" situation. In practice, compromise will be necessary at existing airports. Horizontal bars in approach lighting systems shall ~~ould~~ be avoided within 600 m of the glide path antenna. At CAT II sites in particular, every effort shall ~~ould~~ be made to ensure that existing encroachments on these restrictions are not aggravated. An obstruction-free area of 900 m minimum is highly desirable but this shall ~~ould~~ be extended to 1500 m if circumstances permit, particularly in the case of a categorized facility.

Area E
A triangle with a base 150 m wide extending from the glide path antenna in the direction away from the runway with the apex intersecting Area "D" at approximately 570 m in the approach direction.
Same restrictions as Area "D".

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Area F

Triangular area between Area"D" and the runway.
Same restrictions as Area "D".

NOTES:

(1) The glide path may be located on either side of the runway, depending on local site conditions, taxiways, runways, etc.

(2) Identical restrictive areas exist at the other end of the runway.

(3) If any part of the restricted area depicted in Figure 4 is outside the airport boundary, restrictive easements shall ~~ould~~ be obtained to avoid future encroachment on restrictions.

(iv) Marker Beacons

- Instrument landing system marker beacons provide information on distance from the runway by identifying predetermined points along the approach track. These beacons are low-power transmitters; that operate at a frequency of 75 MHz with 3 W or less rated power output. They radiate an elliptical beam upward from the ground. At an altitude of 1,000 ft, the beam dimensions are 2,400 ft long and 4,200 ft wide. At higher altitudes, the dimensions increase significantly.

Outer Marker (OM)

- The outer marker shall ~~ould~~ be located 3.9 nautical miles from the threshold of the runway. If this distance is unsuitable, it may be located between 3.5 and 6 nautical miles from the threshold within 250 ft of the extended runway centerline. It intersects the glide slope vertically at approximately 1,400 ft above runway elevation. It also marks the approximate point at which aircraft normally intercept the glide slope, and designates the beginning of the final approach segment. If the marker is situated off the extended runway centreline, it shall ~~ould~~ be not more than 75 m from it. The signal is modulated at 400 Hz, which is an audible low tone with continuous Morse code dashes at a rate of two dashes per second. The signal is received in the aircraft by a 75 MHz marker beacon receiver. The pilot bears atone over the speaker or headset and sees a blue light that flashes in synchronization with the aural tone (see the **Marker Beacon Lights** figure, above right**)**. Where geographic conditions prevent the positioning of an outer marker, a DME unit may be included as part of the ILS system to provide the pilot with the ability to make a positive position fix on the localizer. In most ILS installations, the OM is replaced by an NDB.

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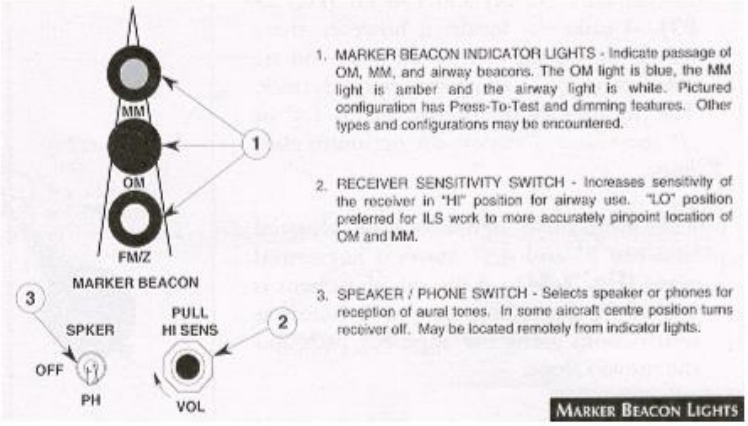

Figure 11: MARKER BEACON LIGHTS

- **Middle Marker (MM)**
  The middle marker is located approximately 0.5 to 0.8 NM from the threshold on the extended runway centerline. The middle marker crosses the glide slope at approximately 200 to 250 ft above the runway elevation and. is near the missed approach point for the ILS Category l approach.

  The middle marker shall ~~ould~~ be located 1050 ±150 m from the landing threshold at the approach end of the runway, and not more than 75 m from the extended centreline of the runway.

- **Inner Marker (IM)**
  The inner marker shall ~~ould~~ be located between 75 m and 450 m from the threshold and not more than 30 m from the extended centreline of the runway. Care ~~must~~shall be taken in siting the inner marker to avoid interference between it and the middle marker.

- **Obstructions.**
  Buildings, power or telephone lines, or clumps of trees shall ~~ould~~ not extend above an elevation angle of 30 degrees from a point 1.5 m above ground level at the location of the marker beacon antenna.

- **Vehicular movement.**
  No special requirements.

- **Services.**
  Within 15 m of the antenna, all power and telephone lines are to be laid underground. Beyond this distance any overhead construction shall ~~ould~~ meet the obstruction limits as above.

- **Electrical interference**
  No requirements.

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- **Restricted area**
  No special requirements

- **Maintenance of site**
  Grass, shrubs, etc., shall ~~ould~~ be kept cut to a reasonable level, e.g. less than 0.6 m. Trees on the site shall ~~ould~~ not be allowed to infringe the obstruction limits as above.

iv. Locator Beacons/Back Marker (BM)

- The back course marker (BM), if installed, is normally located on the localizer back course approximately four to six miles from the runway threshold. The BM low pitched tone (400Hz) is beard as a series of dots. It illuminates the aircraft's white marker beacon light. An NDB or DME fix can also be used and in most locations replace the BM.

- All requirements as for non-directional beacons (NDB) below.

vi Non-Directional Beacons (NDB)

Obstructions.

- Surrounding area within a radius of 150 m of the antenna shall ~~ould~~ be free of buildings exceeding 2.5 m in any dimension; vegetation ~~should~~shall be kept below a height of 0.6 m.

- Small buildings of substantially non-metallic construction extending less than 2.5 m in any dimension may be erected no closer than 60 m to the antenna.

- Overhead power and telephone lines serving the NDB ~~should~~shall Shall be kept at least 150 m clear of the antenna. Steel towers and masts ~~should~~shall Shall subtend elevation angles less than 3 degrees measured from ground level at the centre of the NDB antenna system.

Vehicular movements.
With the exception of authorized vehicles no vehicle shall approach the antenna within a distance closer than 60 m.

Services.
Power and telephone cables ~~should~~shall be underground to a depth of 0.45 m within 150 m of the antenna.

Restricted area.
No special requirements. Where necessary, fencing ~~should~~shall be provided to keep cattle and horses clear of the earthmat area.

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Site maintenance.

- No special requirement other than to keep undergrowth from exceeding a height of 0.6m and to maintain a neat appearance of the site. Ploughing is not permitted over any portion of the earth mat area.
- Grazing of sheep is permissible but cattle and horses ~~must~~shall be kept clear.

4. RADAR SENSOR SITES (Air Traffic Control Radars)

The size and construction material of buildings and other structures ~~must~~shall be controlled to ensure that the radar coverage volume is not reduced and that the number of false targets detected is not increased. The radar coverage volume for all types of radar systems can be reduced by a structure blocking the transmit or receive signal path. The severity of this blockage is proportional to the size of the structure and varies according to its location with respect to critical airspace.

False targets are usually a problem only with the Secondary Surveillance Air Traffic Control Radar System. They are created by transmitted or received signals being reflected from structures. The magnitude of the reflection is proportional to the size of the structure and the electrical behaviour of the material used. Non-metallic materials can reduce the magnitude of the reflection.

(A) PRIMARY SURVEILLANCE RADAR (PSR)

(i) within 300 m of the radar site, no building or other structure ~~should~~shall be allowed to exceed a height of 5 m below the geodetic height of the antenna platform. The preference is to have no structure at all or to have trees surrounding the site.

(ii) from 300 to 1 000 m from the radar site, the upper limit on the height of an allowable structure is increased at a rate of approximately 0.007 m per metre. Thus, at a distance of 1000 m from the site, the structure can be as high as the geodetic height of the antenna tower platform.

(iii) beyond 1000 m from the radar site, no site protection requirement is specified; however, it is preferable not to have any large structure exceeding 0.25° above the radar horizon. Large structures are defined as having an azimuth of more than 0.43°. No structure that blocks critical airspace ~~should~~shall be allowed.

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The consequences of building such a structure ~~should~~ shall be brought to the attention of those responsible for approving the proposal for construction.

(B) SECONDARY SURVEILLANCE RADAR (SSR)

The provisions given above for a Primary Radar System apply as well for a Secondary Surveillance Air Traffic Control Radar System. In addition, it is essential that all buildings or other structures within 1000 m of the radar be constructed with non-metallic materials having a low reflectivity at frequencies from 1.0 to 1.1 GHz.

(C) PRECISION APPROACH RADAR (PAR)

Within 900 m of the approach area to a runway served by a Precision Approach Radar System, no reflecting objects (trees, buildings or other structures) are allowable.

(D) AIRPORT SURFACE DETECTION EQUIPMENT RADAR (ASDE)

No structure ~~should~~shall be built on the airport that blocks the line-of-sight from the ASDE radar antenna to any runway, taxiway, intersection, etc., unless it is approved by the Director General, CAA, in co-ordination with the Director, Air Traffic Services. The blockage would have to be judged operationally insignificant.

(E) WEATHER RADAR

No structures exceeding the height of the radar antenna ~~should~~ shall be built within a radius of 300 m of weather radars. The Director, General will co-ordinate the necessary approvals with Environment Canada, which is responsible for siting weather radars.

Site requirements.

- The site requirement for existing types of radar sensors is a rectangular area about 50 m by 40 m, including sufficient space for a crane to maneuver and an antenna maintenance pad.
- For new sites, the above dimensions may be reduced, depending on whether or not standby power generation is co-located.

Clearance requirements.

Radar transmission clearance requirement are intended to prevent the following:

- Any construction, which geometrically intrudes above the existing skyline as seen by the radar, will have an effect. There will be holes in the coverage by new constructions blocking line of sight between radar and aircraft.
- Interference with near fields of the antenna, which may disturb the antenna pattern in the far field. This applies within 500 m of most radars.

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- Diffraction and bending of signals by edges and thin objects which can cause incorrect radar determined location, loss or confusion of radar tracks etc. Likely hazards in thisregard are poles such as lighting poles.

- Reflections of the radar signals from fixed or mobile surfaces. Reflections cause aircraft to appear on radar screens in more than one location.

- The following clearance requirements are to be maintained:

- No intrusion within 1 km of the radar into a height surface 5 m below the bottom of the antenna.
- No intrusion between the radar and the possible location of any desired targets, i.e. approx. above 0.5degrees elevation at any distance.
- No metallic or other electrical reflective surfaces anywhere which subtend an angle of more than 0.5 degrees when viewed from the radar, eg. fences, power lines, tanks as well as many buildings. All overhead power lines within 1 km ~~must~~shall be aligned radially from the radar or be located at least 10 degrees below horizontal from the antenna.
- No radio interference emitters within 2 km having any component of transmission in the radar bands, eg. welders and electrical transmission lines. No electrical transmission lines within following specified distances:

Line Capacity	Distance
2 kV – 22 kV	400 m
22 kV – 110 kV	1 km
above 110 kV	2 km

- Other electronic equipment which may be affected by the radar transmissions ~~should~~shall not be located where the radars may interfere with their performance.

(a) Terrain

Terrain within 1000 m of the antenna is of prime importance to the performance of the radar system. The terrain ~~should~~shall have either a rough surface (variations of 1 m or more) or be well covered with trees and shrubs, preferably of a coniferous variety. Terrain of this type will reduce the amount of ground reflection. Beyond 1000 m, rough or vegetated terrain, as described above, or low, small buildings
(e.g., residential housing) are preferred.

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(b) Coverage

The Primary and Secondary Surveillance Radar Systems ~~should~~shall be located more than 500m from the edges of areas where large, wide-bodied aircraft are known to remain for sustained periods of time. Structures or natural growth ~~should~~shall not block the line-of-sight from the radar to the airspace on approach to runways or to other critical airspace.

(c) Consultation

If large structures (e.g., warehouses, power lines, hangars, etc.) are to be constructed within 10 000 m of a radar, it is essential that the GCAA be consulted regarding the location, building material and orientation of the structures prior to authorization of the construction.

(d) Precautions against Exposure of Personnel to Radio Frequency Radiation from Radar Systems.

The primary surveillance radar transmitters on airports radiate high power beams of radio frequency energy. In close within the transmitted radar beam may be such that persons could be subjected to radiation exposure levels in excess of the safe limits. Airport staff is therefore to be cautioned against approaching any location within a 500 m radius of a primary radar antenna and which is between 5 m below and 50 m above the horizontal level of the bottom of the antenna.

5. COMMUNICATION FACILITIES

VHF/UHF transmitters and receivers ~~must~~shall be located in an environment as free as possible from sources of electrical noise. This noise can be caused by engine ignitions, electric motors, electrical switching gear, high tension line leakage, diathermic and industrial heating generators and many household appliances. Such electrical noise generators ~~should~~shall be kept at least 1.6 km from the radio antennae; in no circumstance ~~should~~shall they be closer than 500 m. Intermodulation problems, which can be caused by high powered, AM, FM and TV stations can be avoided by locating such equipment at least 8km from the transmitters and receivers. To prevent the screening of airspace, all structures shall not subtend a vertical angle of more than within 1.5 km of the radio antenna or extend more than 1.2° above the horizontal.

Metallic structures, which may cause reflection of communication signals, ~~should~~shall not be constructed within 300 m of a transmitter/receiver installation without prior consultation with the GCAA.

Site requirements.

The physical site requirements will vary significantly depending on the type of communications facility, and it is therefore not possible to specify a general requirement (other than for Satellite ground station sites).

Clearance requirements.

Reliable VHF/UHF communications require a clear line-of-sight path between the base station and aircraft and vehicles using the facilities. The construction of buildings, towers, etc. may prevent reliable communications.

Satellite Ground Stations.

The site requirement is a square area of dimension 25 m by 25 m. The clearances required around satellite ground stations are shown in Figure 4.

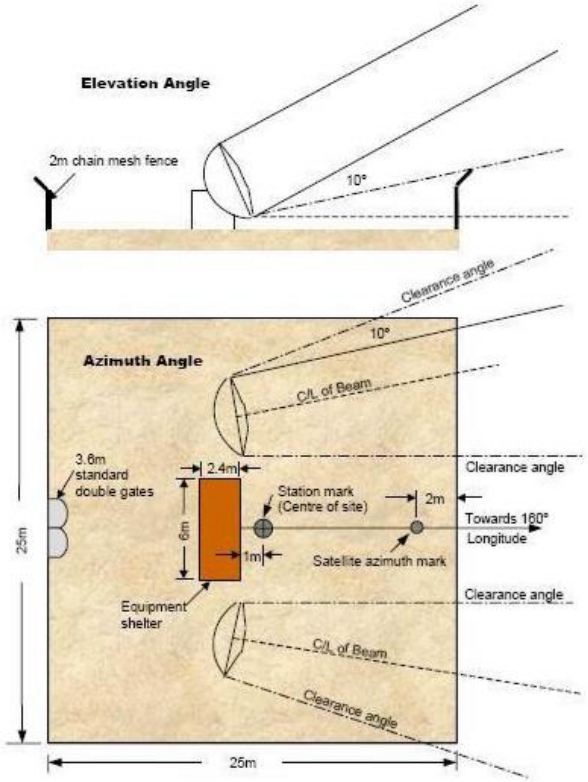

Figure 12: COMMUNICATIONS SATELLITE GROUND STATION MANNED CENTRE SITE

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APPENDICE

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APPENDIX 1

Proposed Navigational Aids Equipment and Structures			
Remote Transmitter/Receiver (RTR)	Provides communications between air traffic control specialists and pilots in the terminal airspace.	Typical 140 feet by 140 feet site includes four antenna towers and one equipment building, which may contain an engine generator.	Three siting criteria are surrounding terrain, ground conductivity, and ambient radio frequency noise.
Tactical Aircraft Control and Navigation (TACAN) at Very High Frequency Omnidirectional Range (VOR) TACAN only (TACR)	TACAN provides Omnidirectional azimuth information primarily for military users of the national air space and distance information to all national air space users.	TACR has footprint similar to that of VOR.	Same as for VOR.
Tower Building (TOWB)	Provides a support structure and/or accommodation for supplemental facilities for an ATCT	Same as for ATCT.	Same as for ATCT.
Visual Approach Slope Indicator (VASI)	Provides visual approach slope information.	Footprint depends on configuration. A VASI can be two-bar or three-bar VASI system. Two-bar system light units are arranged in bars called upwind (farthest from the threshold) and downwind (nearest to the threshold) bar. A VASI-2 is a two-bar system consisting of two light units, one unit in each bar. A VASI4 consists of four light units, two units in each bar. A VASI-12 consists of twelve light units, six light units in each bar. Three-bar system light units are arranged in bars called the upwind, middle, and downwind bar. There are two glide paths projected by the three-bar system that are seen by the pilot, the upwind zone for long-bodied aircraft and the downwind zone for other aircrafts. A VASI-6 consists of six light units, two light units in each bar. A VASI-16 consists of 16 light units, six light units in the downwind and middle bars, and four light units in the upwind	A two-light unit VASI can be accommodated in a footprint with overall dimensions, in the case of two-bar VASIs, of approximately four feet by 700 feet, plus 300 feet or minus 200 feet. Units with more box units would have the same length dimensions, with spacing between boxes within the upwind bar and downwind bar of sixteen feet, plus or minus six feet. Three-bar VASIs would encompass an additional length of 700 feet, plus 300 feet or minus 200 feet. All light units of the two-box, four-box, and six-box configurations are typically located on the left side of the runway (as viewed from the approach direction). Where terrain or cross runways, etc., make

Very High Frequency Omnidirectional Range (VOR)	Provides separate am and fm signals to the airborne avionics to determine the azimuth of the aircraft from the VOR site at a given time.	bar. A typical VOR site will require use of approximately 72 acres. • With few exceptions, all obstructions within a 1000 feet radius of the antenna must be removed. Normal grazing and crop raising may be permitted in this area, except at mountain top facilities where antennas are four feet high. • Single trees (up to 30 feet in height) may be tolerated beyond 500 feet. At mountain top sites, no trees within 1000 feet should be visible from the antenna array. • Ordinary farm-type wire fences about four feet high are not permitted within 200 feet of the antenna; chain type fences (six feet or more in height) are not permitted within 500 feet of the antenna. • Power and control line extensions should be installed underground for a minimum distance of 600 feet from the antenna. Overhead power and control lines may be installed beyond 600 feet but should be essentially radial to the antenna for a minimum distance of 1200 feet.	this impractical, they may be located on the right side of the runway. VASIs are located fifty feet, plus or minus ten feet, to the side of the runway. FAA Order 6850.2A figures show layouts of the different VASI configurations. If on airport, should be located in an area adjacent to the intersection of the principle runways in order to provide approach guidance to the ends of these runways. It should not be located closer than 500 feet to the centerline of any runway or 250 feet to the centerline of a taxiway. And, no part of the facility shall penetrate any surface defined in paragraphs 77.25, 77.28, or 77.29 of the Federal Aviation Directives. If off airport, consider selecting a site so that one or more of the course radials will provide an approach procedure to the primary bad weather runway in accordance with FAA Order 8260.3B. Other considerations include ground slope and ground smoothness, nearby structures and objects such as long wires, trees, cylinders, planes, and combinations of these

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Automatic Surface Observation System (ASOS)	ASOS provides weather observations that include: temperature, dew point, wind, altimeter setting, visibility, sky condition, and precipitation.	Specific footprint depends upon the type of sensor, whether the airport has precision instrument runways, and whether the sensors are on-airport or off-airport. Typically, sensors are on-airport and occupy an area of 50 feet by 50 feet.	ASOS sensor sighting must not violate runway or taxiway object free areas, runway or taxiway safety areas, obstacle free zones or instrument flight procedures surfaces. Notwithstanding these constraints, sensor exposure should minimize or eliminate effects of manmade or geographical obstructions. The tower used to mount the wind sensor is not considered an obstruction to the sensor collection system, but it will (with the exception of the temperature, dew point, and pressure sensors) be at least 3 meters away from other sensors. Sensors should be placed as far away as practicable from cultivated land to reduce contamination by dust and dirt. It may be necessary to increase the heights of some sensors based on the average maximum show depth for the location. Specific siting information is in FAA Order 6560.20B and in the U.S. Department of Commerce/National Oceanic and Atmospheric Administration Office of the Federal Coordinator for Meteorological Services and Supporting Research standard entitled "**Federal Standard for Siting Meteorological Sensors at Airports FCM-S4-1987**".

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Airport Traffic Control Tower (ATCT)	Provides an observation platform from which air traffic controllers direct air and ground traffic for the airport.	A typical ATCT site will range from 4 to 6 acres. Additional land may be needed for combined flight service stations/towers	• There must be maximum visibility of the airport's traffic patterns. • There must be a clear, unobstructed, and direct line of sight to the approaches, to all runways or landing areas, and to all runway and taxiway surfaces. • A tower penetrating an FAR Part 77 surface is an obstruction to air navigation. As such, it is presumed to be a hazard to air navigation until an FAA study determines otherwise. • The ATCT must not derogate the signal generated by any existing or planned electronic NAVAID or an ATC facility. • The proposed site must be large enough to accommodate current and future building needs, including employee parking spaces.
Glide Slope (GS)	Radiates an electronic signal from an antenna above a reflecting surface. The reflected signal travels to the receiving antenna of incoming aircraft. Pilot uses the reflected radiation signal to fly a prescribed angle of descent to the runway.	Includes an antenna tower, a 10ft x 12ft fiberglass equipment shelter, and a cleared and uniformly graded ground reflective plane for the broadcast signal. Tower height may be up to 65 feet, depending on terrain and specific type of glide slope system used. GS is connected to the adjacent taxiway by a paved road. The ground reflective plane measures approximately 300 feet x 1,200 feet.	Glide slope is located on a line parallel to the runway centerline. The glide slope may be located on either side of the runway. Most reliable operation occurs when it is on the side that provides the least interference from buildings, power lines, moving vehicles, and aircraft and which has the greatest extent of smooth terrain outbound from the antennas. Glide slopes should be a minimum of 400 feet from the runway centerline.

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Localizer (LOC)	Provides horizontal course guidance during an approach procedure. The horizontal guidance information indicates to the pilot of incoming aircraft whether the aircraft is right of, left of, or aligned with the runway centerline.	Antenna width may vary from 45.5 feet to 105 feet (perpendicular to the runway). A equipment shelter (typically 8' x 16') is required to support the LOC. Category II and III localizer systems include a far field monitor.	Localizer is normally near the end of the runway opposite the desired approach. Minimum distance from the stop end of the runway is the greater of 600 feet or the end of the runway safety area. When sufficient area is available, the localizer will be beyond 1000 feet from the stop end of the runway. Maximum standard distance from the stop end of the runway to the LOC is 2000 feet. The equipment shelter must not be within 250 feet of the extended runway centerline and should be within ±30 degrees of the antenna's longitudinal axis. FFM is sited at the opposite end of the runway from the localizer, often near the inner or middle marker.
Locator Outer Marker (LOM)	In precision approaches, there may be an NDB collated with the OM. If so, the marker is referred to as the locator outer marker (LOM). Indicates a position at which an aircraft at the appropriate altitude on the localizer course would intercept runway non-directional beacon (NDB) radiates a signal which provides directional guidance to and from the transmitting antenna	Same as for outer marker.	The LOM is located at the outer marker site.
Medium Intensity Approach Lighting System and Runway Alignment Indicator Lights (MALSR)	Provides visual information on runway alignment, height perception, roll guidance, and horizontal references as the FAA standard for category I precision landings.	2400 feet in length when the glide slope is 2.75 degrees or greater; 3000 feet when the glide slope is less than 2.75 degrees. The approach light plane is 400 feet wide centered on the extended runway centerline, runway alignment indicator lights (RAIL) excepted. The primary plane of the RAIL extends 200	The power and control station must be no closer than 400 feet to the MALSR centerline. Typically, this is located 1000 feet from the runway threshold.

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		feet beyond the last flashing light in the RAIL and has a total width in the RAIL portion of 100 feet.	
Outer Marker (OM)	Indicates a position at which an aircraft at the appropriate altitude on the localizer course would intercept runway glide slope.	Compact marker beacon system consists of a vertical stacked array antenna and a small solid state transmitter with a battery pack standby power source designed for mounting on a standard telephone pole. If siting problems (e.g., prevalent vandalism) dictate need for a marker plot, a 6 foot by 6 foot plot will be used. Most solid-state markers are housed in a transportable shelter. The shelter is approximately 6 by 6 or 8 by 8 feet. A fenced 16 by 18-foot plot is used for these shelters.	4 to 7 nautical miles from threshold (with tolerance of ±800 feet both longitudinal and lateral).
Remote Communications RCO	Provides communication between pilots and AFSS for weather and flight plans.	Typically collocated, frequently with VOR.	Three siting criteria are surrounding terrain, ground conductivity, and ambient radio frequency noise.
Runway End Identifier Lights (REIL)	Provides rapid and positive identification of the end of a runway.	Each REIL light unit is typically mounted on a pad with approximate dimensions of three feet by three feet.	Optimum location is 40 feet from each runway edge and in line with the existing runway threshold lights. Light units may be located laterally up to 75 feet from the runway edge and longitudinally up to 30 feet downwind and 100 feet upwind from the line of threshold lights.
Precision Approach Path Indicator (PAPI)	Furnishes the pilot with visual approach slope information to provide guidance for safe descent.	Basic configuration consists of four lamp housing assemblies (LHAs) arranged on a single bar on a line perpendicular to the runway centerline.	LHAs are located on the left side of the runway, as viewed from the approach direction. Where terrain, cross runways, or taxiways make this arrangement impractical, the

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			LHAs may be located on the right side of the runway. The PAPI must be sited and aimed so that it defines an approach path with adequate clearance over obstacles and a minimum threshold crossing height. The PAPI is typically located approximately 1000 feet past the runway threshold. The inboard LHAs shall be no closer than 50 feet from the runway edge or to other runways or taxiways. The PAPI LHAs must have a lateral separation of 30 feet, and the distance between LHAs shall not vary by more than one foot.

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