PRACTITIONER GUIDE

Management of Visual Aids at Military Aerodromes

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Who Should Read this: CEstOs, Top Level Budget Holders, Project Sponsors, MOD Project Managers and others within the IPT (for both Prime, PFI/PPP and traditionally procured contracts), Defence Estates Advisors and Property Managers/Site Estate Representatives with responsibility for MOD projects and Property Management Works Services (including the legacy work of EWCs/WSMs), Aerodrome Technicians.

When it takes effect: Immediately

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The aim of this Practitioner Guide is to ensure that all stakeholders are aware of extant DE requirements and technical recommendations for the design, installation, commissioning, maintenance and de-commissioning of Aerodrome Visual Aid Facilities.
Management of Visual Aids at Military Aerodromes

Foreword

This Practitioner Guide (PG) has been prepared for Defence Estates (DE) to provide guidance and to ensure that all stakeholders are aware of extant DE requirements and technical recommendations for the design, installation, commissioning, maintenance and de-commissioning of Aerodrome Visual Aid Facilities. The information provided in this is based on the Department’s experience, which includes a substantial programme of research and trial projects at various. All enquiries regarding this guide should be made to the PG Contact Point:
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1 Introduction

1.1 Purpose of Document

This PG provides recommended guidelines for the design, installation, commissioning, maintenance and de-commissioning of aerodrome visual aid facilities. It is not exhaustive and further information should be sought from manufacturers and suppliers where necessary. Since the function of such facilities is to assist in the safe and efficient movement of aircraft during landing, takeoff, and taxiing manoeuvres, it is essential that a high degree of operating reliability be maintained. To achieve this, it is necessary to establish and maintain an effective maintenance program. This PG provides suggestions on establishing such a program but, due to the varying complexities of airports and facilities provided, such a program must be tailored to suit each individual airport’s particular needs. Since corrective and preventive maintenance procedures for specific equipment are adequately covered in manuals supplied with the equipment, this PG addresses maintenance topics of a more general nature.

1.2 Status of Document

For Ministry of Defence (MOD) establishments occupied by United States Visiting Forces (USVF) the responsibilities of Facilities Manager, Property Manager, EWC and WSM are jointly held by the USVF and DE (USF). At base level this jointly managed organisation is to take appropriate action to implement the contents of this PG. Where this PG contains procedures which differ significantly from USVF practice, a DE (USF) Code of Practice section will be issued.

The contents of this PG are Advisory. No work, involving expenditure on any MOD account, is to be entered into without authority from the DE-Property Manager or the appropriate MOD Officer for that location or facility.

Where military standards are available and extant they are to take precedence over the civil standards unless advised otherwise. Where possible, specifications accord with national and the International Standards and Recommended Practices contained within International Civil Aviation Organisation (ICAO) Annex 14. All questions relating to the status of any of the References are to be addressed to the relevant DE Technical Authority through the DE PM.

2 Background

2.1 The Need for Visual Aids

Aeronautical Ground Lighting (AGL) and markings provide flightcrew with location, orientation and alignment information in adverse visibility conditions and at night. Joint Service Publication (JSP) 554 Table 205-4 outlines the minimum prescribed scales of AGL needed in order to satisfy the military requirement in respect of low visibility and night operations; it also highlights those elements of AGL equipment considered to be operationally desirable for a particular operation. The type of lighting is specified according to the runway approach category and takeoff (T/O) minima. Where the prescribed scale cannot be provided for an instrument runway there may be a consequential penalty on operational minima. The components, listed in Table 205-4, are described in the documents succeeding paragraphs in the order in which they will be seen by a pilot approaching an aerodrome. The characteristics of the lights and their overall height limits, are detailed in JSP 554 Annex 205B.
AGL for precision approach runways are to be high intensity (luminosity) so that it is usable by
day and night. Low intensity may be used for other runways, but high intensity lighting is
strongly recommended for non-precision approaches and should be provided where there are
transport passenger jet operations.

2.2 Examples of Air Incidents

Annex G details a selection of Air Incidents demonstrating the influence of probabilities and
affects of contributory factors.

2.3 Anecdotal Installation and Commissioning Problems (relates to Case Studies and
Lessons Learned)

An investigation into the cause of low IR readings at RAF Cottesmore, RAF Cranwell and RAF
Shawbury found a range of problems, which can be loosely grouped under three categories.

a. Accessory Design
b. Installation
c. Maintenance

Although the in-depth investigation concentrated on three Aerodromes, discussions with
manufacturers and suppliers as well as paper investigations showed the problems found were
not restricted to these three Aerodromes.

Annex H details a selection of problems encountered at a number of aerodromes with reference
to installation and commissioning works on AGL Series Circuits.

3. Standards

3.1 Military

3.1.1 Military and Civil Standards and their status

With the provision of “PG 01/2008 - Management of Visual Aids at Military Aerodromes”, the
status of each referenced document is shown in Annex A unless specific contract documents
state otherwise. Where possible specifications will accord with National and the International
Standards and Recommended Practices contained within ICAO Annex 14.

3.1.2 JSP554 Military Aviation Aerodrome Standards and Criteria

The authority to operate and regulate military aircraft is vested in the Secretary of State for
Defence. In practice, much responsibility is delegated to the Service Chiefs of Staff, the Chief of
Defence Procurement, Chief of Defence Logistics and the Chief Executives of Defence
Agencies for regulation of aircraft and air systems for which they are responsible. ACOS have
directed the establishment of a single military aviation regulatory structure with supporting
regulation for all 3 Services and the Defence Procurement Agency (DPA), hereinafter referred to
as the Regulations.
The development, construction and management of the Regulations are controlled by the Military Aviation Regulation Group (MARG) which represents all 3 Services and the DPA. The custodian of JSP 554 is HQ AIR COMMAND ATC.

The specifications and criteria within JSP 554 apply to the new construction, modification and the restoration of existing facilities. They are mandatory unless specific engineering or operational considerations dictate a variation, in which case sponsors are to seek formal dispensation from the appropriate military authority as specified in JSP 554. For the Temporary Aerodrome section (Part 400) the appropriate military authority is the Air Commander. The specifications do not, of themselves, establish an entitlement to construct new facilities or to modify or to restore existing facilities and changes to existing facilities will not be supported solely to meet the letter of the criteria.

JSP 554 is available to MoD Personnel through the DE / MoD website, [http://www.mards.dii.r.mil.uk/home.pdf](http://www.mards.dii.r.mil.uk/home.pdf)

If Civil contractors require a paper copy this is available from the Defence Storage and Distribution Centre (DSDC), Mwrwg Road, Llangennech, Llanelli, Dyfed SA14 8YP. Tel: 01554 822322 / 822422 / 822400, with authorisation from the Project Sponsor or Defence Estates Project Manager (DE-PM).


The purpose of this handbook is to provide instruction and guidance to the Line Manager on the policy, top-level organisation and arrangements by which the MOD ensures the maintenance of acceptable standards of health and safety throughout the organisation.

The Health and Safety Handbook is the first point of reference for all MOD staff to ensure activities are conducted in compliance with the law and international conventions and to provide a broad overview of MOD policy and programmes on health and safety issues.

3.1.4 JSP 454 - Procedures for Land Systems Equipment Safety Assurance

These procedures have been prepared for reference by all MOD staff and Commanders engaged in the acquisition, modification and operation of Land Systems equipment for UK Armed Forces. They provide the framework for ensuring equipment safety is properly addressed from the outset of a project, when the requirement is being defined, through service, to disposal.

The continuing achievement of high standards of safety in equipment and systems for which Land Systems equipment managers are responsible, are in their own interests as individuals as well as that of the MOD. Staff are to take all necessary steps to minimise risks to themselves and to those that use, or could be affected by, the equipment. They are to consult all relevant stakeholders via the Safety Panel and seek verification from suitable subject matter experts wherever appropriate.

The overriding principle on which Land Systems equipment safety is based is that of adequate and continuous assessment. The overall aim of these procedures is to facilitate the Safety Case approach, whilst recognising the differing requirements of the various items of equipment, their procurement and support strategies, and position in the acquisition cycle. This document also
defines the management organisation and the roles and responsibilities of the personnel involved, and provides guidance on compliance with legal requirements.

3.1.5 JSP 418 - Sustainable Development Environment Manual

This JSP applies to all military personnel and civilian staff and others employed by the Department either on a permanent or temporary basis, this includes contractors, private partners etc. The JSP applies to all TLBs, Trading Fund Agencies and Executive Agencies throughout the world.

The JSP applies to all activities carried out under the control of the Secretary of State for Defence. The Mandatory Requirements (Vol. One, Chapter 2) must be met by all MOD units, organisations and establishments, and contractors. Line management and contractors should therefore ensure that this manual is accessible to all personnel.

There are many different documents within the MOD that offer guidance on compliance with specific aspects of environmental policy and legislation. These JSPs include: JSP 362, the Defence Lands Handbook and JSP 317, the Joint Services Safety Regulations for the Storage and Handling of Fuels and Lubricants. Individual Services have also produced their own policy and guidance documents, such as the Navy Guide For Compliance for Commanding Officers and Heads of Establishment and The Army Standing Orders on topics such as Waste Management and Pollution Prevention. The revised JSP 418 will be sign-posted to and from these and to other relevant material.

3.1.6 JSP 434 - Defence Construction in the Built Environment

JSP 434 is intended to provide comprehensive ‘best practice’ guidance on all aspects of the delivery of Defence construction in the built environment. The objective is to improve effectiveness within the context of practicality, achievability and value for money on an ongoing basis. This is defined as the optimum combination of whole life cost and quality to meet user requirements effectively and efficiently. In the JSP, best practice is identified and derived from a combination of Ministerial commitments, mandated regulations and policies, industry best practices, research and applications to tools and improved performance, and business and commercial processes. In doing so it is acknowledged that construction is a significant, highly regulated, particularly diverse activity and, as such, will be subject to continual onward change.

It is expected that the stated best practice will be followed unless verified circumstances expressly warrant non-compliance.

Target audience

JSP 434 applies to:

1) All military personnel, civilian staff and others employed by the Department either on a permanent or temporary basis, including contractors, private partners et al who may be involved in the delivery of Defence construction in the built environment.
2) All TLBs, Trading Fund Agencies and Executive Agencies throughout the world.
3) All activities carried out under the control of the Secretary of State for Defence. In so doing the JSP acknowledges that Defence Estates (DE) acts in a key role as MoD’s intelligent client adviser and deliverer of projects, thus DE policies and business processes feature in JSP 434. However the JSP also summarises wider government policies for construction, and relates these to DE’s activities as a major construction client.
Format
The JSP is split into two parts

Part One: Governance and Best Practice
Comprising: Section One: Governance
Section Two: Standards & Best Practice

Part Two: Delivery and Performance
Comprising: Section One: Procurement and Delivery
Section Two: Performance Tools

The relationship of JSP 434 to other published MOD and DE policy guidance
JSP 434 aims to provide a one-stop facility for anyone involved in the delivery of Defence construction in the built environment. Therefore the relationship of this JSP to the DE Business Management System (BMS), and other relevant policy standards is explained, with onward links.

3.2 MOD
3.2.1 JSP 375, Volume 3 - Safety Rules & Procedures – Electricity
JSP 375, Volume 3, sets out the Electricity Safety Rules and Procedures that are to be adopted throughout the Defence Estate wherever the responsibility for Health and safety of personnel is assigned to the Commanding Officers, Chief Executives, Heads of Establishments or DE-PM's.

The Rules and Procedures relate to:

a) The Rules and Procedures have been drafted to secure compliance with United Kingdom statutory requirements and in particular MOD requirements to prevent danger arising from working on, near, testing or operating Electrical Equipment and systems.

b) the responsibilities for control of electrical danger;

c) the selection and appointment of competent persons to carry out the functions of Authorising Engineer, Authorised Person, Skilled Person, Person in Charge and Accompanying Safety Person;

d) the qualifications and training necessary for appointment of Authorising Engineers (AEs) and Authorised Persons (APs);

Compliance with the JSP 375, Volume 3 is mandatory on the Defence Estate for all persons working on, working near, testing or operating Electrical Equipment and systems for which the MOD has responsibility for the control of the electrical danger.

3.2.2 Defence Standard 00-55 Requirements for Safety Related Software in Defence Equipment (see also 3.3.4)

Part 1 Requirements
This Part of the Standard describes the requirements for procedures and technical practices for the development of Safety Related Software (SRS). These procedures and practices are applicable to all MOD Authorities involved in procurement through specification, design, development and certification phases of SRS generation, and maintenance and modification. This Standard has been produced for the MOD under the authority of the CIS Procurement Board.

Part 2 Guidance

This Part of the Standard contains guidance on the requirements contained in Part 1. This guidance serves two functions: it elaborates on the requirements in order to make conformance easier to achieve and assess; and it provides technical background.

3.2.3 Defence Standard 00-56 Safety Management Requirements for Defence Systems (see also 3.3.4)

Part 1 Requirements

This Part of the Defence Standard describes the requirements for safety management, including hazard analysis and safety assessment. It can be applied during the initiation, feasibility, project definition, full development and production phases of MOD projects embodying safety related components, and for in-service operation, maintenance and modification. This Standard is to be used by Defence Contractors as required by contract.

Part 2 Guidance

This Part of the Defence Standard provides information and guidance on the requirements for safety management, including hazard analysis and safety assessment, contained in Part 1. It may be applied during the initiation, feasibility, project definition, full development and production phases of MOD projects embodying safety related components, and for in-service operation, maintenance and modification.

These Standards are part of a family of standards dealing with safety that is being developed or adopted by the MOD, taking into account international standardisation activities and supporting research and development.

Each Standard has been agreed by the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc and whenever practicable by amendment to those already in existence. If any difficulty arises, which prevents application of this Defence Standard, the Directorate of Standardisation is to be informed so that a remedy may be sought.

The Standardization Policy Group in Abbey Wood is responsible for internal liaison with all MOD policy branches which have an impact on the content and processes associated with the application of procurement standards.

Externally, the Policy Group is responsible for national liaison with BSI, DTI, Industry and other government bodies and internationally with other military and civil Standardization Bodies.

The Helpdesk can be contacted at:
DStan Helpdesk
Any enquiries regarding the Standards in relation to an invitation to tender or a contract in which it is incorporated are to be addressed to the responsible technical or supervising authority named in the invitation to tender or contract.

These Standards have been devised for the use of the Crown and its contractors in the execution of contracts for the Crown. The Crown hereby excludes all liability (other than liability for death or personal injury) whatsoever and howsoever arising (including, but without limitation, negligence on the part of the Crown its servants or agents) for any loss or damage however caused where a Standard is used for any other purpose.

3.3 Civil

3.3.1 ICAO Annex 14, Volume I

Standards and Recommended Practices for Aerodromes were first adopted by the Council on 29th May 1951 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as Annex 14 to the Convention. The Standards and Recommended Practices were based on recommendations of the Aerodromes, Air Routes and Ground Aids Division at its third session in September 1947 and at its fourth session in November 1949.

Contracting States are required to notify the Organisation of any differences between their national regulations and practices and the International Standards. The United Kingdom is a full signatory to ICAO Annex 14, and publishes the adopted standards for civil/public aerodromes in CAA document CAP 168 Licensing of Aerodromes.

3.3.2 BS EN 61821: Electrical installations for lighting and beaconing of aerodromes: Maintenance of aeronautical ground lighting constant current series circuits

The BS EN 61821 applies to the maintenance of AGL constant current series circuits. The document contains the management, safety and procedural requirements specific to the maintenance of an Aeronautical Ground Lighting (AGL) constant current series circuit and has taken into consideration national standards, requirements and practices. The maintenance activities are required to ensure that the AGL constant current series circuit continues to meet the operational requirements and minimise the occurrence of operational failures.

3.3.3 BS EN 61823: Electrical installations for lighting and beaconing of aerodromes: Aeronautical ground lighting systems: AGL Series Transformers

The BS 61823 specifies the characteristics of aeronautical ground lighting series transformers (AGLST) used in aeronautical ground lighting for 6,6 A series circuits, at a service voltage of up to 5 kV, supplied by constant current regulators up to 30 kVA in rating. AGL series transformers provide power to airport lighting luminaires or other loads (resistive) from their secondary circuits. The AGL series transformers provide continuity of the series circuit in the event of a loss of the load on the transformer, and electrical isolation between the primary circuit supplied...
by a constant current regulator, and the secondary circuit connected to the load under conditions defined in the standard.

An AGL series transformer is to be able to withstand a permanent short circuit or open-circuit secondary series circuit\textsuperscript{10}.

Specifications for similar series transformers intended for any primary or secondary currents other than 6,6 A, or to supply alternative voltages, constant power, reactive loads, etc., are not detailed within BS 61823. However, the generic use of this standard may be applied to other service currents and voltages.

3.3.4 IEC 62143: Electrical installations for lighting and beaconing of aerodromes: Aeronautical ground lighting systems: Guidelines for the development of a safety lifecycle methodology AGL systems safety lifecycle

AGL at an aerodrome or heliport provides the pilots of aircraft on approach to or take off from an aerodrome, and pilots of aircraft or drivers of vehicles moving on the aerodrome surface, with location, orientation and alignment information. An AGL system therefore provides an essential safety-related service and functions. In order to assure that the safety of the service and functions provided by the AGL system is not compromised in any way; specific safety assessments, as detailed in Figure 1 of the document, should be performed at the agreed key stages during the design lifecycle of the system. IEC 62143 Technical Specification provides a methodology whereby this may be done\textsuperscript{11}.

4 Management of AGL systems

4.1 Introduction

Organisations involved in the management, design, installation, commissioning, maintenance and de-commissioning on the Defence Estate Aerodromes and AGL Systems need to manage the asset, efficiency, and occupational Health and Safety with a great degree of expertise and to rigorous standards. However, without adequate management systems, legal and moral obligations cannot be met, and operational losses may be incurred, including significant financial risk and losses.

Examples of such risks and losses include:

a) compromised aircraft safety and the potential for a catastrophic aircraft accident;
b) costs of replacing and compensating injured employees or others;
c) contractual penalties or loss of revenue if operations are delayed;
d) damaged assets (including aircraft and equipment);
e) asset degradation through mismanagement;
f) loss of reputation;
g) loss of existing and future contracts.

4.2 Organisation Roles and Responsibilities

The Management Maintenance Organisation (MMO) is responsible for the management and completion of maintenance activities on military aerodromes. The MMO is to appoint one or more named persons to manage, supervise and undertake specific maintenance tasks. These persons and their defined roles and responsibilities are to be recorded and retained by the MMO for record purposes. All persons involved in work on the AGL are to be aware of:
their role and responsibilities;
their duties and how to perform those duties;
the procedures to be followed;
contingency working arrangements;
Requirements for regular assessment and training (externally verified).

4.3 Competency

In accordance with the HSAW Act 1974 and MHSWA Regulations 1999, all persons involved in any activity, including management and maintenance activities, is to have the appropriate and verifiable training, technical knowledge, experience and qualifications relevant to the specific duties they have to perform.

The training, experience and qualifications of all persons involved in any activity is to be justified taking into account all the relevant competence factors. The justification is to be recorded in appropriate documentation (e.g. AGL Safety Plan).

The following competence factors should be addressed when assessing and justifying the competence of persons carrying out their duties:

- engineering (qualification / training / experience) appropriate to the application area;
- engineering (qualification / training / experience) appropriate to the technology (for example, mechanical, electrical / electronic / software engineering);
- safety engineering appropriate to the technology;
- knowledge of the legal and safety regulatory framework;
- knowledge of the operational aspects related to the AGL system at the aerodrome;
- the consequences in the event of a failure of a constant current series circuit;
- the consequences of failure to adhere to safety procedures when working on constant current series circuits;
- the innovation of the design, design procedures or application;
- previous experience relevant to the specific duties to be performed and the technology being employed;
- relevance of qualifications to the specific duties performed.

NOTE it is considered essential that the MoD and MMO encourage the development of a formal and structured competency training programme(s). The training programme(s) should consist of multiple tiers that enhance progressively a person’s skills and ensure a recognised level of competency for those persons who have satisfactorily completed the programme(s).

4.4 Use of Contractors

The DE-PM retains full accountability for all work undertaken on an AGL series circuit. This accountability is to include where the AGL series circuit, or part of it, is to be under the control of a contractor. The Prime Contractor is to ensure that all other organisations, including the users and operators of the AGL and other applicable aerodrome facilities are notified prior to the commencement of the work and the procedures used. Contractors and other non-aerodrome employees are to follow the Safety Rules and Procedures (SRPs) provided under JSP 375, Volume 3 (see Section SRP-01).
The DE-PM should ensure that evidence of competency in design and installation of AGL systems is provided by the Prime Contractor for each of their supply chain contractors. As a minimum the following information should be considered in any assessment before assurance can be demonstrated that the contractor can satisfy the CDM Regulations 2007, Section 4, and thus allow a project to proceed:

- Details of previous similar AGL projects at other airports including broad scope and equipment installed.
- References from previous projects.
- Project resource and how it is to be managed.
- List of personnel to be employed linked to their role and responsibility.
- CV's of each individual.
- Details of recognised AGL training courses attended by each individual.
- Identification of designated AGL jointers and confirmation that they have attended an AGL Jointers course.

DE-CST is available to assist in specialist areas and should be engaged at the earliest opportunity (see section 5.7 and Annex I).

4.5 Safety

It must be appreciated that unlike conventional electricity supplies in normal domestic and industrial facilities where protective measures are provided to ensure disconnection of a faulty circuit, AGL series circuits are designed to remain functional even with direct faults to earth. The maintenance of visual cues to pilots and the safeguarding of the lighting pattern are their primary function. The system will not differentiate between a faulty component or human contact.

It is therefore absolutely essential in term of personal safety that personnel performing work on aeronautical ground lighting are fully experienced in AGL techniques and if this is not the case then adequately supervised. Maintenance personnel should be deemed competent as defined in BS EN 61821 and be thoroughly trained in emergency procedures for treatment of electrical shock. Prior to any testing or works on Aerodrome equipment or systems, compliance with JSP 375, Volume 3 (see Section SRP-01) must be adhered to.

4.6 Foreign Object Damage (FOD)

It is the responsibility of all persons on military aerodromes and manoeuvring areas to report to ATC and/or remove where feasible any FOD.

For safety reasons the surfaces of runways, taxiways and aprons must be clean of sand, debris, stones or other loose objects. Reference is made to ICAO Annex 14, Volume I, Section 9.4 and JSP 554 501.105.

Aircraft engines can ingest loose material, and suffer severe compressor or propeller damage. There is also a significant risk that propeller or jet engine blast may cause loose objects to be projected against adjacent aircraft, vehicles, buildings or personnel.
All Contractors are required to carry out a thorough check of all work areas for FOD before vacating each work area.

The consequences of FOD range from the smallest debris being ingested into a jet engine which often can result in multi-million pound engine replacement costs, to near catastrophic incidents or catastrophic failure. (See typical result of FOD that caused a near incident at London Heathrow Airport in January 2001 http://www.aaib.dft.gov.uk/cms_resources/dft_avsafety_pdf_501279.pdf )

5 Operational Requirements and Design Concept

This brief describes an overview of the project or works process and the roles and responsibilities of key estate management personnel during the different project stages. It does not describe individual tasks in great detail; those are covered in operating procedures and supporting documents that form the total set of Projects documentation (See Estate Management Process, Reference DE BMS, Core Processes, 1.3 Projects).

5.1 Discussion with operators/sponsor defining scope of work

5.1.1 Introduction.

The client will detail any project works through a User Requirement Document (URD) (Royal Institute of British Architects (RIBA) Plan of Work process protocol Stage A). (See RIBA Plan of Work Stages 1999 http://www.ribafind.org/plan.asp)

5.1.2 Statement of Need (RIBA Stage A)

The Statement of Need will detail the following information based on the operational requirement.

- Background Information to the proposed project or works
- Project or works output in accordance with known operational requirements.
- Aerodrome constraint on the project or works
- Timing and Priority
- Justification
- Impact Statement - consequence if the project or works do not proceed.
- Interoperability – due cognisant of other projects, initiatives and plans that may affect the viability of possible solutions.

In order to avoid potential difficulties, it is recommended that the DE-PM obtain Defence Estates Construction Support Team (DE CST) advice and acceptance of the Operational Requirement, Design Concept and Strategic Brief before undertaking detailed design.

5.2 Operational Requirement / Strategic Brief (RIBA Stage B)

5.2.1 After an evaluation of the existing and proposed installation and operational procedures, the DE-PM will need to produce an Operational Requirement and Strategic Brief that identifies all the criteria to which the project will be designed. The Operational Requirement will be the main reference against which the project will be assessed.
5.2.2 The Operational Requirement should state inter alia:

(a) The objectives of the project.

(b) The intended Aerodrome operational capability (including the minimum Runway Visual Range (RVR) for take-off and landing and critical aircraft types).

(c) The desired maximum traffic flow rate where taxiway guidance systems are proposed.

5.3 Design Concept (RIBA Stage B-D)

5.3.1 From the details given in the Operational Requirement and Strategic Brief, the Regional Prime Contractor (RPC) will prepare a Design Concept (or Stage C Design) for the proposed installation. The Design Concept should describe and illustrate both the existing and the proposed layout of the AGL installation, such as the positioning of stop-bars, signage etc. and must clearly indicate the means by which the relevant requirements of JSP 554 are satisfied. The Design Concept must also clearly identify any potential hazards arising from the Operational Requirement and the methods proposed to counter such hazards. Any hazards that are not adequately covered by the requirements of JSP 554 must be identified, and addressed by the RPC.

5.3.2 Final detailed technical drawings and information on specific equipment will not be required at this stage. The Maximum Price Target Cost (MPTC) Technical Submission needs to address the advisory requirements and standards from extant reference documents so that a meaningful evaluation can be conducted and audited against at design, planning, installation, commissioning and handover stages.

The AGL is a primary output requirement, the installation success and integrity of which dictates future safe flight operations. Input from the RPC needs to be accurate, robust and provide confidence to the MoD and DE that all known reoccurring problems with installation, compliance, and competency are being proactively addressed.

Procedures and recommendations dealing with AGL circuit installation, commissioning, maintenance and fault finding is detailed in PI 29/2005 Installation, commissioning and maintenance of aeronautical ground lighting cable circuits. The Safety and Competency requirements in BS EN 61821, however, are the basis for all AGL works on aerodromes.

At this stage it is appropriate for the RPC to submit details of the proposed method by which the quality aspects of the project will be addressed. Further guidance on System Design is detailed in section 6. The following headings and issues must be addressed specifically for AGL works: Preliminaries, Scope of Work, Abbreviations and Definitions, General Conditions, AGL Safety Plan, Hazard Analysis, Design Standards, Design Drawings, Standard Drawings, Detailed Requirements, Existing Services, Manufacturers/Suppliers, Control System Interface & Modifications, MCS Safety Case, Training to Client.
5.4 Hazard Analysis (RIBA Stage B-D)

Hazard identification is to be initiated at the earliest possible stage in the project life cycle. Hazard identification is to be an evolutionary process starting with Preliminary Hazard Listing or Log, during the earliest project stages. This is to be followed by Preliminary Hazard Analysis and System Hazard Analysis which is to be conducted on an iterative basis as the programme proceeds, in order to refine and extend the identification and causes of hazards.

Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>harm</td>
<td>Physical injury and/or damage to the health of people or damage to property or the environment.</td>
</tr>
<tr>
<td>hazard</td>
<td>Potential source of HARM.</td>
</tr>
<tr>
<td>hazard analysis</td>
<td>The identification of hazards and their causes.</td>
</tr>
<tr>
<td>risk</td>
<td>Combination of the probability of occurrence of HARM and the SEVERITY of that HARM.</td>
</tr>
<tr>
<td>risk analysis</td>
<td>Use of available information to identify HAZARDS and to estimate the RISK.</td>
</tr>
<tr>
<td>risk evaluation</td>
<td>Judgement, on the basis of RISK ANALYSIS, of whether a RISK which is acceptable has been achieved in a given context based on the current values of society.</td>
</tr>
<tr>
<td>risk assessment</td>
<td>Overall process of RISK ANALYSIS and RISK EVALUATION.</td>
</tr>
<tr>
<td>safety</td>
<td>Freedom from unacceptable RISK of HARM.</td>
</tr>
<tr>
<td>severity</td>
<td>Measure of the possible consequences of a HAZARD.</td>
</tr>
</tbody>
</table>

5.5 Need for Safety Case (RIBA Stage D)

The Hazard Log is unlikely to be acceptable as a Safety Case (see section 11.4). A Safety Case is to be constructed using information from the Hazard Log. The Safety Case will provide a well-organised and reasoned justification clearly showing that the proposed system is acceptably safe. The Safety Case must describe the system and its boundaries fully. It must also identify the hazards and the risks and indicate the safeguards. A Safety Case is required for all systems that are:

(a) New

(b) Modifications of existing systems.

For example, to ensure the functional safety (the Safety Case) and standardisation of the Modular Control System (MCS), a formal approval process exists between the MOD and the
Support Contractor for all MCS changes/upgrades. This process is applied irrespective of whether the proposals are for standard or non-standard modifications. Standard and non-standard changes are defined in PI 19/2006 "Mandatory services available via a 'call off' contract to support the Modular Control System (MCS) installations on all MOD Aerodromes" Paragraph 6.

The Safety Case needs to provide traceable evidence to support the presented Safety Arguments in terms of existence/validation of Hazard Controls / Mitigations, in particular concerning procedures for the Installation, Commissioning and Transition activities between phases of works by the various contractors.

The Project Management need to progress and complete robust Method Statements and develop Safety Strategies for Installation/Commission/Transition (i.e. Fallback) and Dependencies. Method statements should name the responsible person or persons who will accept ownership for work elements and remedial actions during the installation works. In order for these to progress, parties need to liaise with SATCO /Station Authorised Person to mitigate engineering risks and operational disruption. In addition to details relating to the actual installation work being performed, the method statements should incorporate details of agreed (with SATCO) precautions/procedures to be observed by staff while working in proximity to operational areas.

On completion of the works, the Safety Case is to be "signed off", accepted and maintained by the establishment, represented by the Commanding Officer or his delegated representative.

5.6 Need for dispensations (RIBA Stage C-D)

The specifications and criteria within JSP 554 apply to the new construction, modification and restoration of existing facilities. They are mandatory unless specific engineering or operational considerations dictate a variation, in which case sponsors are to seek formal dispensation from the appropriate military authority (see JSP 554, Section 100).

Due to the design and installation processes followed (correctly at time of installation) in previous superseded Standards, systems may not comply with extant Standards. Dispensation should be sought for the non-compliance until the next major works are planned.

5.7 Regulatory guidance (RIBA Stage A-L)

Regulatory Guidance can be obtained from the DE CST on Electrical Systems as detailed in Annex I.

6.0 System Design (RIBA Stage D)

6.1 Design to JSP554 Military Aviation, Aerodrome Standards and Criteria

The MOD specifies the performance standards for AGL at all military aerodromes. The AGL functions will vary according to the role of the fitting but will be in accordance with JSP 554 or where not detailed, ICAO Annex 14, Volume I. Furthermore, in keeping with MOD policy, wherever a civil standard is available and suitable this will be applied. To support this further, the IEC Document 62143 Electrical installations for lighting and beaconing of aerodromes: AGL systems: Guidelines for the development of a safety lifecycle methodology provides details of the procedures necessary for meeting the Civil Statutory Requirements relating to AGL.

6.2 Technical Guidance documents
Users of this document should ensure that the current edition of the technical publications listed in Annex A are referenced. Latest editions can be sought from the DE Library. This list included in Annex A is not exhaustive.

6.3 Determination of installation /commissioning / O&M planning

The hazards involved in the installation, commissioning and operation of the AGL system are to be determined in accordance with IEC 62143.

6.4 Selection of equipment

The only AGL equipment that may be used is that which fully complies with JSP 554, ICAO Annex 14, and National and International Standards, where the bespoke system integration or homogeneous assembly design, including the use of installation materials, is underwritten by system designer, or if no system designer, the installer.

6.5 MOD Specifications

The required characteristics of the AGL fittings used for runway services is to be in accordance with JSP 554. The Figures given in Table 205B-1, Column 4 are to be read in conjunction with the relevant Collective Notes detailed in 205B.110 and 205B.115. Light fittings are to be installed so that the main beam is aligned within $\pm\frac{1}{2}^\circ$ of the specified requirement.

6.6 Whole Life Performance

The AGL and M&E services / plant design lifecycle of the selected equipment, components and continuing manufacturers support is to be have a capable installation life (i.e. be fit for purpose and is supported by the manufacturer) in excess of 15 years, before consideration may be given to major refurbishment.

The AGL series circuit cable, when installed correctly, should have a capable installation life in excess of 30 years, before consideration should be given to replacement.

The MMO is to ensure Whole Life Performance (WLP) is considered. The MOD recognises that the sustainable way forward on the procurement of services and works for the Estate is to look at WLP. A relatively small proportion of the Whole Life Cost of a facility is the capital expenditure. Cost is only one element of the performance. Other issues such as sustainability, environmental impact, respect for people/retention of servicemen, health and safety, employment legislation, access for the disabled etc all have to be considered in evaluating proposals as well as the changing needs of the Services.

7 Installation (RIBA Stage K)

7.1 Hazard Analysis

The MOD has, under the HSAW Act 1974, a general duty of care to the public and its employees. It is required to ensure that all hazards are controlled and reduced to a level that is “as low as is reasonably practicable” (ALARP). In addition, all recent safety legislation stipulates that ‘risk’ must be actively managed and this requires formal hazard analysis and risk assessment to achieve this objective.
7.2 System Installation

A full commissioning test plan based on the recommendations within PI 29/2005 Annex B (See Annex C AGL Commissioning Requirement \textsuperscript{14}) and schedule for the AGL installation must be submitted by the MMO to the DE-PM prior to any installation. On acceptance of the plan, the DE-PM will authorise the installation and, if appropriate, decommissioning of relevant AGL equipment. In addition, where the installation of AGL equipment necessitates disruption to the normal operations or services at an aerodrome, the following details must be submitted to the DE-PM at a date previously agreed with the DE-PM, before the intended date of disruption.

(a) Details of the impact on normal operations.

(b) Temporary Operating Instructions (Aerodrome and ATC).

7.3 Pavement Issues/co-ordination (RIBA Stage K)

The following typical issues are to be addressed in the Hazard Analysis and Risk Assessments:

- Selection of inset luminaire seating furniture.
- Type, quality and dimensions of luminaire fixings.
- Installation method for seating furniture.
- Installation and specifications of cable slots
- Installation materials and their compatibility with equipment, type of pavement, safeguarding and maintenance of the pavement structure.

8 Commissioning (RIBA Stage K)

8.1 Commissioning Plan

The DE-PM will carry out an inspection of the completed installation and may require access to the results of any on-site commissioning trials prior to operational use. Where necessary, an inspection programme will be agreed in order to allow for a phased introduction of the final installation. The inspection will include the following items:

(a) System Operation Functionality Check

This check covers the following items where appropriate:

(i) The submission of a satisfactorily completed commissioning test schedule (Annex C refers) and a full demonstration of the system operational functionality.

(ii) A flight check (for changes to the infield and approach lighting systems). Where the installation includes the addition of, or a change to, the control and monitoring elements of the AGL system, the following aspects will also be included:

(b) Staff Training
Evidence of the completion of training for relevant staff should be presented to DE-PM. Procedures must be in place for the training of new staff and for refresher training.

(c) **Operational Procedures**

The following items must be accepted by the Client prior to full system operational use:

(i) The Local instructions to ATC staff produced by the Provider of ATS and approved by the DE-PM for the new or revised system.

(ii) Amendments to the AGL Safety Plan (see section 11.1).

(d) **System Environmental Aspects**

The DE-PM will require evidence that the Contractor has addressed those requirements that are applicable to environmental aspects. This is to cover the following items:

(i) A demonstration by the Contractor that adequate protection from hazards exist in the ATC and engineering working environment (i.e. compliance with appropriate aspects of the Health and Safety at Work Act 1974 and Regulations made under that Act, such as the Electricity at Work Regulations 1989).

(ii) Evidence that the equipment installation is complete, adequate and functional.

(ii) Evidence of compliance, where applicable, with the EMC Regulations 1992. The EMC Directive, 89/336/EEC, came into force in 1992 and has been mandatory for CE marking of electronic/electrical products since January 1, 1996.

(e) **Quality**

This covers a demonstration of the System Life-Cycle Quality Plan designed to support the AGL service (see Section 8.2.4).

8.2 Verification of installation to required standard including selection of equipment

8.2.1 Quality

The purpose of Quality Management (QM) in accordance with ISO 9001 (or equivalent) is to ensure that adequately defined areas of responsibility and procedures exist and that all of the requirements internal and external to the organisation are complied with. The Contractor must submit to the DE-PM details of the methods employed by the aerodrome and major equipment suppliers, relevant to the project, intended to ensure that requirements are complied with. As a minimum this would normally include the organisational exposition, procedure manuals and specific quality plans. This is an important indication of the likely quality of the project and a measure of the probability that the AGL system will provide satisfactory operation throughout its life-cycle.

8.2.2 Project Plan
The production of a Project Plan will indicate to the DE-PM that a structured approach to the project has been determined at the outset. Identified tasks, the nomination of responsible post holders and forward planning are essential items that are of benefit to any project. Dependent upon the scale and scope of the project, the Project Plan may include the following items:

(a) **An Organisation Exposition** - This will identify key personnel and outline their responsibilities, including such posts as:

   (i) Accountable Manager.

   (ii) Safety Manager

   (iii) Provider of ATS

(b) The names of those persons with responsibility for the completion of identified tasks for the project. These persons may have the following job titles:

   (i) Approval Manager.

   (ii) Design Authority.

   (iii) Quality Manager.

   (iv) Project Manager and Sub-Managers.

The posts of Safety Manager and Quality Manager should not be the same person, however, it is acceptable that more than one of the other posts may be held by a single person.

(c) Project documentation control, including the provision of site records.

(d) Proposed maintenance plans, including spares and test equipment holdings.

(e) Proposed contractual arrangements.

(f) Staff training requirements (operational, engineering and maintenance).

(g) Project time scales.

The Contractor should notify the DE-PM in writing of personnel changes in the key areas of responsibility for the AGL system as identified in the Project Plan.

In the case of an AGL development that is carried out in-house by the aerodrome, the Project Plan should provide details of the procedures that will be used throughout the System Design to enable appropriate maintenance of the installed system.

Where a tender is issued for the design or supply of any major part of the AGL system the tender documentation should state that prospective Suppliers should provide a Quality Plan for the DE-PM System Design assessment.

8.2.3 Supplier’s Quality Plan
In order to maintain quality throughout the project, each major supplier, within the Prime Contractor Supply Chain, must have an appropriate Quality Plan that demonstrates a structured and controlled approach to their contribution to the overall design of the AGL system. The Supplier’s Quality Plan should detail the arrangements that are in place to cover the following items:

(a) The names of those persons holding responsible posts for the project. These posts will include where appropriate:

(i) Quality Manager.
(ii) Project Manager.
(iii) Hardware Project Manager.
(iv) Software Project Manager.
(v) Installation and Commissioning Manager.

(b) Design and testing procedures.

(c) Documentation control.

(d) Change Control procedures, including the control of issue states of hardware and software modules.

(e) A register of design, manufacturing, calibration and testing tools.

Suppliers must provide details of how their quality management procedures support the aviation safety aspects of the system supplied and must address the use of subcontractors.

8.2.4 System Life-Cycle Quality Plan

The implementation of an appropriate System Life-Cycle Quality Plan will provide an assurance that the AGL system will be maintained in the certified state throughout its life-cycle. The Plan must be in place prior to the commissioning of the AGL system and any subsequent changes must be notified in writing to the DE-PM.

The System Life-Cycle Quality Plan should include the following items:

(a) Safety Management

(i) Records showing the performance history of the equipment, equipment stability, reliability and availability.

(ii) Procedures for the operation of the equipment in normal and reduced capability mode.

(iii) Maintenance requirements and procedures.

(iv) Fault reporting procedures.

(v) Spares and test equipment control procedures.
(vi) Technical safeguarding arrangements.

(vii) Procedures for modification programmes.

(viii) Staff training plans and procedures.

(ix) System/product life-cycle support plans.

(b) Configuration Management

(i) Technical manuals and drawings, including details of equipment configurations, serial numbers, modification states, etc.

(ii) The recording of site acceptance tests, including the required system parameters and performance figures.

(iii) Action to be taken when upgrading or down-grading the service and when returning it to operational use.

(iv) Maintenance records – date of maintenance, actions taken and results obtained (this relates to both routine maintenance and fault repair).

(v) Change Control – the updating of records and procedures.

8.3 Photometric measurement to ensure compliance

I. New, refurbished or modified installations where more than 25% of the system has been changed is to be subject to a photometric compliance test at commissioning stage. The Defence Estates site test specification of requirements for photometric testing at commissioning and maintenance of aeronautical ground lighting systems is detailed in Annex C.

8.4 Acceptance criteria for photometric tests.

The Photometric Performance of each AGL system is to be measured by an APPROVED Mobile Photometric Testing Device (See Annex F) to demonstrate that the installed luminaire performance is operating at 100%, or above, of the requirements for the specific system defined in the Isocandela Figures referenced in JSP 554. Approval of a Mobile Photometric Testing Device is authorised by DE-CST after an assessment of the system compliance with specification criteria detailed in Annex F.

8.5 Commissioning approval and acceptance of works.

DE CST guidance and support is available to the client at all stages of commissioning to ensure that the estate needs are represented and assured (see Annex I). DE CST may when requested act as the Clients Agent to accept works on his behalf.

8.6 PAPI Flight Commissioning Checks and Acceptance

Flight Test Form W2375 is now superseded by the PAPI Acceptance Form, reference JSP 554; the format and purpose remains the same. The document is intended to provide evidence that
the PAPI system, after installation or major adjustment, is installed correctly and has been formally accepted by the Senior Air Traffic Controller (SATCO) as fit for purpose.

A flight inspection of a new installation or modified system should be undertaken by a competent authority to confirm the correct operation of the system. The inspection should include checks of range, setting angles, brilliancy control and compatibility with the PAR, ILS glide path or MLS minimum glide path (if provided).

9 Operations and Maintenance (O&M) (including minor modifications)

9.1 O&M records

a) Maintenance Plan (See Section 11.8)

A maintenance plan is to be produced, approved by the DE-PM and implemented in compliance with this PG and BS EN 61821. The following maintenance documentation and records are to be maintained within the maintenance plan and are to be presented with a “Master Index” at each scheduled AGL Inspection.

b) Aerodrome Lighting Schedule

The AGL Schedule is the main summary document of the AGL system and is to accurately record the AGL system installed at each aerodrome.

c) As Installed Drawings

The MMO is to ensure that copies of all extant and relevant AGL as-installed drawings are kept in the Central Record Location in the Station Records Office. Information is to be held in paper format and supported electronically. Hard copies are to be available to the AGL technicians for day to day reference. All superseded drawings should be marked to indicate their status, recorded and archived.

d) Approved Approach Drawings

Approved High Intensity Approach (HIA) layout drawings are to be retained in the Station Records Office.

e) MCS Site Specific and Standard Drawings

Extant standard and site specific MCS drawings are to be available in each A Centre, B Centre’s and in the Station Record’s Office (see PI 19/2006 Annex A for details on the comprehensive list of CU (M&E) standard drawings to be retained).

f) Manufacturers’ Operation and Maintenance Manuals

O & M Manuals for the AGL equipment and for other Aerodrome M&E equipment is to be maintained by the Facilities Manager Records Office and are to be made accessible for day to day reference.

g) Identification of Luminaire Positions

Identification of Luminaire positions is to be maintained in accordance with JSP 554. An AGL layout drawing showing luminaire identification numbers is to be maintained and kept
with the as-installed drawings. The numbering of each position is to be permanent, reusable and may be repositioned when required without the necessity for refurbishment. Identification of fittings, particularly inset type, should be considered as part of an overall maintenance strategy and potential asset audit system. The use of electronic tagging is to be viewed as an innovative solution.

h) Failure Records

Records are to be maintained to enable analysis of full details of system operation and records of performance and failure trends. Changes in the condition of the system will assist in forecasting potential failures and planned remedial action.

i) Maintenance Records

Maintenance records are to be generated to record all maintenance activities for each Aerodrome system and are to conform to the approved maintenance plan.

All activities and work carried out on the AGL constant current series circuit is to be recorded in a suitable log or other form of documentation generated from a computer based maintenance system. Each entry is to be identified by a reference that allows traceability of all coherent activities that have taken place. All relevant records and documentation is to be made available at places of work.

The documentation is to record, *inter alia*, the following:

i. the activity that has taken place;

ii. the results of any measurements or tests that have been performed;

iii. details of any repair or corrective action;

iv. details of any work that has been carried over to another task;

v. the date and time of the activity;

vi. the name of the persons who carried out the activity.

NOTE IEC 62143 contains details of the type of documentation appropriate for the maintenance of AGL.

j) PAPI Flight Commissioning Check and Acceptance Form

The purpose of PAPI Flight Commissioning Check and Acceptance Form is to provide evidence that the PAPI system, after installation or major adjustment, is installed correctly and has been formally accepted by the SATCO as fit for purpose.

k) Photometric Measurements

Photometric Measurements showing compliance with JSP 554 Maintenance Objectives and serviceability levels.

Photometric measurements are to be generated and presented in tabular and bar chart formats as illustrated in Section 9.6 of this document.
I) Insulation Resistance

Insulation Resistance records showing compliance with PI 29/2005 Installation, commissioning and maintenance of aeronautical ground lighting cable circuits.

Insulation Resistance records are to be generated and presented in tabular and line graph formats as illustrated in PI 29/2005 Installation, commissioning and maintenance of aeronautical ground lighting cable circuits.

9.2 Maintenance strategy

9.2.1 General.

a. The Electricity at Work Regulations 1989 (Statutory), JSP 375 (Mandatory) and BS EN 61821 (Advisory) encompass all work carried out on AGL and other electrical installations in and around aerodromes. The equipment and system is to be shown to be electrically safe by means of demonstrated compliance with recognised standards and Approvals and is to comply with all Health and Safety and personal safety requirements in this respect. This includes the compliance with the Low Voltage Directive 72/23/EEC where applicable.

b. The maintenance of AGL equipment is to consider the objectives of aerodrome operations and address the impact on such operations whilst maintenance activities are being performed. In addition, during periods of maintenance, or equipment failure, it may be necessary to operate AGL circuits on local control at the 'A' and/or 'B' Centres, thus removing control from ATC whilst the work is being performed. A procedure for local operation is to be agreed with ATC before local switching of AGL circuits commences. A record of all maintenance operations is to be kept including periods when local operation of a circuit or 'A' and 'B' Centre is under the control of maintenance staff.

c. By assessing the performance of each light on a regular basis and targeting maintenance on the under-performing light, the overall performance of the installation can be considerably improved. Targeting work on those fittings that are under-performing ensures that maximum benefit can be obtained from maintenance activity thereby minimising wastage and enabling maintenance expenditure to be optimised.

d. The conventional AGL maintenance strategies of block change or change on failure, have been shown to be inadequate with many of the lamps failing to meet the required standard either immediately or shortly after the maintenance activity (see section 9.5). Lamps and associated equipment do not age at a uniform rate and consequently only limited benefit is achieved from a routine block change. On the other hand, if the performance of individual lights is allowed to decay until lamp failure occurs, then each light will be operating below the required standard for a substantial percentage of its life. Both strategies result in the possibility of entering Low Visibility Procedures (LVP's) with the installation operating below the required serviceability levels. Routine and regular targeted maintenance procedures are essential if this scenario is to be avoided.

e. The performance of lights can change rapidly, especially at large aerodromes with high movement rates. Therefore, it is important to assess performance accurately.
on a regular basis and act upon the information collected. The frequency with which such assessments are to be undertaken is dependant upon the type and age of the installation, maintenance policy adopted, movement rates and prevailing weather conditions. Typically, a weekly survey, with associated maintenance, has been found to be adequate for a major aerodrome.

f. Changing the light fitting will not always ensure the required performance is achieved since the luminous intensity of the beam is dependent on the total electrical and optical system. The importance of maintaining the primary series circuit current is only a single factor in the system and additional work may be required at specific locations, for instance a faulty transformer or a slightly dirty lens can reduce output by up to 50%. A single application of de-icing fluid to a runway can reduce the light output of centreline lights by up to 70%.

9.3 Maintenance Objectives.

a. The objectives contained in Table 1 specifically target precision approach runways and operations in low visibility. For precision approach runways the aerodrome authority is expected to provide evidence that the performance of the associated AGL meets the requirements for all weather operations, which include Table 1. One method of providing such evidence is to carry out regular measurements of the photometric performance (i.e. the luminous intensity, beam coverage and alignment) of the AGL when in service (Source – JSP 554, Section 225).

b. A light is to be deemed to be unserviceable when the main beam average intensity is less than 50% of the value specified in the appropriate figure detailed in JSP 554 Table 205B-1 Annex B. For light fittings where the designed main beam average intensity is above the value shown in JSP 554, the 50% value is to be related to the design value. In order to verify serviceability levels are being maintained a formal procedure for the photometric measurement and recording of serviceability is to be implemented. This may take the form of an approved rapid speed photometric measurement equipment in compliance with the extant specification detailed in Annex F of this Practitioner Guide or measurements taken by a hand held Luxmeter with the average candela commuted from three readings as described in this document (see section 9.6.2).

c. In order to provide continuity of guidance an unserviceable light is not to be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

d. The objectives contained in Table 1 specifically target precision approach runways and operations in low visibility. For precision approach runways the HQ AIR COMMAND ATC expects the aerodrome authority to provide evidence that the performance of the associated AGL meets the requirements for all weather operations, which include Table 1. One method of providing such evidence is to carry out regular measurements of the photometric performance (i.e. the luminous intensity, beam coverage and alignment) of the AGL when in service.
<table>
<thead>
<tr>
<th>AGL Service</th>
<th>CAT I</th>
<th>CAT II/III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach beyond 450m</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Approach inner 450m</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Runway threshold</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Runway end</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Runway edge</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Runway centre line (where fitted)</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>TDZ (where fitted)</td>
<td>85%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Table 1 AGL Serviceability Levels

9.4 Maintenance practices and associated tools

a. Persons are to be protected against dangers that may arise from contact with live parts of the installation. Only limited protection against overcurrent (may result from overload, short circuit, or ground fault if CCR regulation becomes unstable) and open circuit, can be provided therefore no work is to be undertaken on live AGL series circuits installations.

b. The overall performance of AGL can be dramatically improved and maintained with the introduction of an adequate cleaning regime. The nature of their general location makes inset fittings particularly susceptible to the presence of dirt, dust, moisture and the effects of heavy loads. Staining of the glassware and rubber deposits can considerably reduce the light output of these lights and reductions of the order of 50% are not uncommon. The periodicity of AGL cleaning will depend upon environmental and operating conditions but typically AGL on runways that are subjected to a heavy traffic density should be cleaned at least once per week, other AGL should be cleaned at least once every two weeks.

c. A routine ground inspection of all AGL systems where practicable is to be made daily or before use as appropriate and any defects remedied as soon as practicable. All deficiencies and associated remedial action is to be logged and the system should again inspected before use after remedial action.

d. A logbook is to be provided at each 'A' and 'B' Centre for this purpose. As an aid to maintenance each AGL location is to be marked with an identification number legible, where practicable, from a passing vehicle (e.g. 27/A/14 refers to light position No 14 of circuit A on runway 27) as follows:

   Short term measures for no more than 12 months may utilise:
   
   i. Lights in paved areas – Numbers painted with white road paint adjacent to the light fitting.
   
   ii. Lights in grassed areas – Numbers painted on a suitable tag, plate or existing plinth.
   
   iii. Pole or mast mounted lights – Numbers painted on plates attached to the poles or masts.
The numbering of each position is to be permanent, reusable and may be repositioned when required without the necessity for refurbishment. Identification of fittings, particularly inset type, should be considered as part of an overall maintenance strategy and potential asset audit system. The use of electronic tagging is to be viewed as an innovative solution.

e. An up-to-date set of drawings showing the AGL layout, light fitting location numbers and cable routing, along with operating and maintenance manuals containing adequate information for the safe operation and maintenance of the AGL system is to be provided at all appropriate sites.

f. Where AGL and equipment is installed on private land, rights of access are to be maintained in order that regular maintenance may be carried out.

g. If the process detailed in section 9.5.3 is carried out on a regular and adequate basis, individual lamp conformance can be assessed and therefore a lamp could be changed or cleaned on an individual basis and only when necessary. Any observed deterioration of an AGL pattern is to be promptly corrected.

h. The insulation value of a primary series circuit may decrease by a very significant amount before any operational effect on the AGL is noticed; however in this case there would be a much greater risk of harm to maintenance or installation persons. Procedures and recommendations dealing with AGL circuit installation, commissioning, maintenance and fault finding is detailed in PI 29/2005 Installation, commissioning and maintenance of aeronautical ground lighting cable circuits,

Annex A - Works for the Correction and Prevention of Low Insulation Resistance on AGL primary cable circuits,

Annex B – Commissioning requirements for the installation of new and refurbished works on AGL primary cable circuits

Annex C - Fault Finding Methods and Procedures on Aeronautical Ground Lighting Cable Circuits.

i. Adequate spares are to be held on site and need to be readily available to the Airfield Technician in order to support the complete AGL system maintenance procedures. An appropriate parts control system is to be instigated in order to ensure that the correct parts are available and used when replacements are carried out. Components such as lenses may appear to be identical but may have substantially different photometric performance.

j. The maintenance procedures detailed below are to be adopted as a minimum requirement. Additional maintenance may be needed following extreme weather conditions, where high incidence of vandalism occurs or following agricultural work within the area bounded by the approach system. A competent engineer is to assess the AGL maintenance requirements and augment the requirements in scope and frequency to maintain systems in accordance with the recommendations in this PG, in JSP 554, specifically with respect to photometric compliance and equipment manufacturer’s maintenance recommendations and procedures.
k. Guidance on maintenance procedures, to be incorporated in any maintenance programme and associated schedules to be submitted for approval, are published in Annex E of this document.

l. PAPI Systems:- PAPI serviceability gives rise to additional considerations as moisture and/or dirt on the lenses will diffuse the beam and can result in a white signal being emitted at all angles of elevation. To prevent this potentially hazardous situation from occurring additional measures are to be adopted as follows:

1. Daily inspection to ensure:
   (i) All lamps are serviceable and evenly illuminated.
   (ii) There is no damage to units.
   (iii) All lenses are clean.
   (iv) The change from red to white is coincident for all elements of a unit.
   (v) The heating facilities are functioning correctly.

2. Bi-monthly (additionally after bad weather or disturbance through local works) inspection to ensure:
   (i) Vertical alignment of each PAPI unit to a tolerance of ± 1 minute of arc.
   (ii) Azimuth alignment of each PAPI to a tolerance of ± 1 minute of arc.

3. Yearly inspection.
   (i) Internally inspection of unit.
   (ii) Correct setting of black heat current. (Approx. 1.5A RMS)

9.5 Planned Maintenance

Schedules of routine maintenance of the individual elements of the airport electrical system should be based on manufacturers’ recommendations adjusted to individual Aerodrome operational and environmental demands and the frequency of malfunctions generated from the Failure and Maintenance Records.

As the frequency of servicing depends on the type of equipment, it is not possible to set up generally applicable maintenance programmes. Guidance on maintenance procedures, to be incorporated in any maintenance programme and associated schedules to be submitted for approval, are published in Annex E of this document.

9.5.1 Block Change

Block Change maintenance - whereby all lights are simply re-lamped or refurbished after a set period - is based on the assumption that all light fittings age uniformly with time. It has established that the rate
of individual light fitting performance deterioration varies significantly under service conditions. A number of factors have been found to have a dramatic effect on average beam intensity, beam spread and orientation, the most significant being:

- **Current**: Small variations in circuit current, or the series circuit transformer, have a large impact on light intensity.
- **Contamination**: The build-up of rubber and dirt on the optical surface varies significantly between light fittings and normally the rate of this build up increases as fittings age.
- **Lamp Ageing**: A tungsten halogen light source deteriorates significantly as lamp burn hour’s increase, but again this rate of deterioration is very variable.
- **Installation and pavement quality within the vicinity of the light fitting.**

Therefore, in practice, a Block Change strategy will mean:

- Either an AGL service is refurbished too early, when only a few lamps are below standard. This is a costly waste of time and effort.
- Or, more likely, it will be delayed too long, so that at times the system is operating well below serviceability level set by JSP 554.

### 9.5.2 Change on Failure

Similarly, with the “Change on Failure” replacement technique - where light fittings are only replaced when observed to have failed completely - the assumption is that serviceability is maintained until the moment of complete failure. It has been established that lamps often run with very low output for a considerable time before complete failure occurs. Under these conditions, AGL performance can be below the required serviceability level for a considerable period of time.

### 9.5.3 Condition Based Maintenance

Condition Based Maintenance targets work by using in-field measurements to identify when, where and what corrective action if any is required. Serviceability levels are maintained in an effective and efficient manner by:

1. **Measurement**: The routine collection of accurate, reliable and timely performance data, using a mobile measurement system.
2. **Targeted Maintenance**: Work is scheduled on the basis of the recorded measurements and targeted on those specific light fittings that are below or fast approaching the pre-defined serviceability level, and basing the work required on the specific needs of that location.
3. **Monitoring**: Assessment of the effectiveness of the maintenance work based on additional photometric measurements. Additional work to be undertaken if performance remains low.
4. **Management**: The maintenance loop is closed by control procedures and actions.

This approach takes into account all the variable factors that are found to contribute to light fitting performance deterioration, and effectively identifies maintenance priorities. It is also aimed at obtaining the maximum benefit from any maintenance activity, thereby utilising resources in an efficient and effective manner. The measurement and rectification frequency required to maintain the JSP 554 serviceability standards will vary according to:

a) **Movement rates**
b) Mix of aircraft types  
c) Runway Category  
d) Environmental conditions  
e) Age and condition of equipment  
f) Specification of equipment

9.6 Photometric Testing

Regular photometric measurements are the only practical way of determining if the light fittings are meeting the specified regulated requirements and for determining misalignment errors. By the use of regular photometric measurements, maintenance of light fittings may be targeted only where needed thereby saving resources and time while allowing the aerodrome to be assured of meeting light output specifications, especially in low-visibility conditions. The required frequency of photometric measurements will vary from aerodrome to aerodrome and from runway to runway depending on amount of traffic, environment and age of fixtures, etc. After experience has been gained with the measurement equipment and the determination of light output, inspection schedules may be evaluated. Due to the susceptibility of runway centreline and TDZ lights to accumulate rubber deposits on the lens, weekly checks may be necessary. This is especially true for CAT II runways where low visibility operations are conducted. As a minimum photometric testing should be performed:

(1) Before cleaning, to establish whether cleaning is necessary, and

(2) After cleaning, to check the effectiveness of the cleaning and determine the degradation of the internal optical assembly. Lights that are below minimum levels are to be scheduled for removal and servicing.

Consider Table 1 and the AGL serviceability requirements in CAT I: Where a given systems serviceability is below 85%, that is where 15% of unserviceable fittings are below 50% of the initial light design output requirement, when new; the Facilities Manager should instigate a programme of increased “Targeted Maintenance” until the system serviceability is again re-established. Monitoring and assessment of the effectiveness of the maintenance work based on additional photometric measurements is a key element to determine where additional work is to be undertaken if performance remains low.

Any light fitting with measured output of less than 70% of the initial design output required when new is ineffective for high background, low visibility conditions.

Photometric Testing equipment is now available to allow for rapid and accurate testing of the output of both in-pavement and elevated runway lighting fixtures (See 9.6.1 and Annex F Specification Requirements for Mobile Photometric Measurement Tool).

Equipment is also now available to perform photometric testing in the maintenance workshop to verify that a refurbished light fitting is meeting the required specification prior to being reinstalled in the runway or taxiway (See Annex F Specification Requirements for Mobile Photometric Measurement Tool).

9.6.1 Mobile Photometric Measurement
In looking for new AGL performance monitoring and maintenance methods, which would help aerodromes ensure their compliance with the ICAO standard, a major research programme was undertaken in the UK during the 1990s to study the performance of certain AGL systems on operational runways. This was sponsored by the UK Civil Aviation Authority (CAA) with the support of the DE (UK MOD), Defence Evaluation Research Agency (DERA) (since privatised QinetiQ) and UK aerodromes.

A critical component of this research was the development, by TMS, of a mobile photometric measurement system. The resulting Mobile Airfield Light Monitoring System (MALMS) was specifically developed to accurately, reliably and rapidly measure the photometric performance of AGL systems against the criteria for beam intensity and orientation defined in ICAO Annex 14, using the test methodology that Annex 14 also specifies.

This mobile measurement device was subsequently used, as part of the research programme, in a detailed study of AGL performance at UK aerodromes. Initially, all operational Cat II and Cat III runways in the UK were surveyed, and the system proved the importance of photometric measurement. The survey results showed that even though all airports had maintenance programmes in place, many were finding it difficult to consistently maintain their AGL systems within the defined serviceability levels, with significant variations between aerodromes as Figure 1 shows. A particular problem encountered was that too many light fittings performed below the minimum average beam intensity as specified in ICAO Annex 14.

These findings prompted further investigations, and a more detailed assessment of the maintenance strategies, working with a number of aerodromes, was undertaken. This work determined that the primary cause of these performance variations was directly related to the inadequacy of the monitoring and maintenance practices being applied by many aerodromes. These practices included the visual observation of lamp failures, measurement of the primary series circuit current, and the application of ‘Block Change’ and ‘Change on Failure’ replacement maintenance strategies. The assessments also revealed that the ability of an AGL system to meet the minimum standards could be severely limited by the individual components of that system. For instance, individual light fittings are typically designed and manufactured to
meet the standard defined in ICAO, Annex 14. However, little account, if any, is taken of the reduction in its performance during its lifecycle due to ageing. Furthermore, the impact on the light fitting’s performance of the individual elements in the system, such as the series circuit transformer, constant current regulator and the lamp, do not appear to be taken into account.

9.6.2 Lux Meter (In-field) Photometric Measurement

Light output reference measurements can also be performed with a hand held Lux Meter. Measurements for comparison with an as “new fitting” and the MMO’s in situ routine photometric measurements (reference JSP 554 225.100.2) should be made where a mobile system may not be available.

For accurate measurements, the distance between the luminaire and the device used for photometric measurements should be sufficient so that the inverse square law applies.

For each luminaire, the maximum Lux reading is found within the beam area. These readings are taken at varying distances (4m, 6m, and 8m are thought to be the optimum distances that should be adopted) and the Candela is calculated by multiplying the square of the distance (D) by the Lux reading (L). The Peak Candela is the average over the number of readings (n). The Average Candela over the beam area is calculated at approximately 0.66 of the Peak.

Photometric measurements are to be generated and presented in tabular and bar chart formats as illustrated below:

<table>
<thead>
<tr>
<th>Runway</th>
<th>Luminaire Type</th>
<th>Peak reading obtained (Lux)</th>
<th>Average Candela</th>
<th>Datum Value (Minimum Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>ZA 415/1</td>
<td>1745 703 384</td>
<td>17117</td>
<td>10000 Candela</td>
</tr>
</tbody>
</table>

Figure 2. Example Photometric graph generated from Average results
The datum value quoted is the Minimum Average as specified in JSP554 Section 205 Annex B and the station should aim to maintain these levels.

Peak Candela = \[\frac{\sum_n (L_n \times D_n^2)}{n}\]

Average Candela is calculated as 0.66 Peak Candela

Where – \( L \) = Peak reading in lux  \( D \) = Distance in metres  \( n \) = Number of readings taken.

**Figure 3. Example readings for a ZA 415/1 & ZA 173/18**

The measured results are dependent on the accuracy of the measuring techniques when using hand-held equipment under site conditions to measure the light output from fittings but regular use of the measuring equipment by maintenance staff should lead to consistent results.

It should be appreciated that this method of photometric measurement is a relative guide to the condition of light output and does not provide for measurement or confirmation of the correct horizontal alignment and azimuth.

Routine elevation and alignment checks to verify compliance with JSP 554 Annex B, are to be made using a calibrated alignment tool. Inset seating ring level and alignment should be correct at time of installation. These checks do not establish misalignments due to failure in the light fittings internal components or lamps. Misalignments within a fitting can only be determined by the use of a Mobile Photometric Measurement device such as “MALMS” (see 9.6.1)

### 9.7 CCR and TMSE Testing

All necessary maintenance is to be performed in accordance with the manufacturer’s recommendations and instructions contained within their relevant “Operation and Maintenance Manual”. All work is to be performed in compliance with JSP 375, Volume 3.

Routine maintenance must include checks to verify the functionality of all installed equipment facilities such as:

a. Brilliance Settings (Refer to JSP 554, Table 220-2)

b. Overcurrent Trip (refer to manufacturers manual)

c. Undercurrent Relay Operation (refer to manufacturers manual)

d. Open Circuit Trip (refer to manufacturers manual)

e. Earth Leakage Indication and Alarm circuits (refer to manufacturers manual)

f. Lamps Out Detection and Alarm Circuits (refer to manufacturers manual)
9.8 Fault identification and rectification

PI 29/2005 provides installation, commissioning and maintenance guidance for new and existing AGL cable circuits. It is not exhaustive and further information should be sought from manufacturers and suppliers where necessary.

Annex A contains recommended procedures to be followed for works for the correction and prevention of low insulation resistance on AGL primary cable circuits.

Annex B contains commissioning requirements for installation of new and refurbished works on AGL primary cable circuits.

Annex C contains fault-finding methods and procedures for all types of aerodrome series lighting circuits. The fault-finding procedures provide detailed step-by-step procedures for locating one or more faults.

9.9 Biennial AGL Inspection Reports

9.9.1 Frequency and Purpose of Inspection

Each Aerodrome is inspected on behalf of DE-CST, by their appointed Specialist Term Contractor, at approximately 24 month intervals with respect to both pavement and when installed, AGL. However, the inspection frequency for any Aerodrome will vary according to such factors as previously reported conditions and the implementation of works projects. The inspection will inform the Forward Maintenance Register, Maintenance Plans, Long Term Costing and Option Studies for Aerodrome works. Where relevant the inspection method may vary or be supported by an Asset Management System.

9.9.2 Data

Prior to an inspection, the previous inspection report will be made available to the Inspecting Engineers. The report contains information as described in “Format of Aerodrome Inspection Report". In addition, at the Inspector’s request, updating information will be provided by the Facilities Manager of the inspected Aerodrome.

9.9.3 Brief

The Inspecting Engineer will be briefed by DE-CST for each inspection. Briefs will include the dates when the inspection is to be made, the scope of the inspection including whether pavement and AGL, contact name, address and telephone number for the Aerodrome and a requirement for briefings with Aerodrome staff at the start and finish of inspections.

9.9.4 Health and Safety

Aerodromes will remain operational during inspections. Movement of the inspecting staff, around the Aerodrome pavements, will be controlled by air traffic control officers. Escort and/or radio communication will usually be provided by the Aerodrome maintenance staff or ATC.

9.9.5 Access to Areas Requiring Inspection

Immediate and continuous access to all areas cannot be guaranteed. Aircraft operations have priority. In particular, inspection of runways and their associated AGL may well be disrupted or may have to be carried out early morning or late evening. Up to 24 hours notice will be provided
for access to hangars and aircraft shelters. Support by Aerodrome staff for access to A & B centres and switching of services will be provided, the exact details are to be arranged in advance. Switching and service disconnection for tests may be affected by operations and will be under the control of the appropriate Authorised Person from the site staff. Clearance should be sought from the site Facilities Manager before taking photographs.

10 Decommissioning

10.1 Hazard Analysis

A hazard analysis is to be carried out on the impact of the decommissioning and the results are to be documented in the AGL Safety Case.

Prior to decommissioning taking place an AGL Decommissioning Plan is to be prepared. The AGL Decommissioning Plan must include safety procedures for:

a. the removing from operational service of the AGL system or component thereof;

b. safeguarding the operational environment;

c. dismantling and disposal of the decommissioned system.

d. wider environmental and sustainability considerations.

10.2 Removal and disposal of redundant equipment.

Unless advised otherwise, all redundant equipment and materials, including cables, are to remain the property of the Station and are to be removed from the relevant work area by the contractor and returned to the appropriate aerodrome store as directed by the DE-PM.

Some runway and taxiway fittings supplied by GEC / Cegelec and Luminaire Spares, and which may remain installed, were originally supplied with asbestos impregnated gaskets. The RPC Facilities Manager should ensure that as maintenance is performed on these luminaires that personnel are made aware of the risk and that they follow instructions as detailed in DE Safety Notice 03/02 - AGL Asbestos in seating (or base) gaskets and DMG 16 The Management of Asbestos Containing materials on the Defence Estate – 2nd Edition.

11 Documentation

11.1 AGL Safety Plan

An AGL Safety Plan is to be prepared by the MMO and implemented following the guidelines in this Practitioner Guide and IEC 62143 The AGL Safety Plan is to include the following aspects:

The AGL Safety Plan is to outline the responsibilities and procedures to be undertaken by management and staff engaged in the design, installation or maintenance an AGL system or its components.

NOTE – The AGL Safety Plan focuses on safety. It may be included in:

- a section in the Quality Plan entitled “AGL Safety Plan”, or
- a separate document entitled “AGL Safety Plan”, or
• several documents which are referenced in either of the above (e.g. one document could be for the Overall AGL System or one document for each component (e.g. CCR)), or
• an overall aerodrome safety management system.

11.2 AGL Safety Assessment Plan

11.2.1 An AGL Safety Assessment Plan in accordance with IEC 62143 is to be developed as a means of co-ordinating, conducting, and determining the objectives of the assessments of the safety of the AGL system or one of its components.

11.3 AGL Verification Plan

11.3.1 A Verification Plan is to be established, concurrently with the development, for each phase of the AGL System Safety Lifecycle and detailed in the appropriate and relevant documentation. The Verification Plan is to provide and document or refer to the criteria, techniques and tools to be used in the verification process.

11.3.2 Completion of a verification process is essential if a project is to achieve a successful handover. Handover documentation is to include Verification Assurance Certification as detailed in JSP 554 Table 105-2.

11.4 AGL Safety Case

A Safety Case to a minimum standard is required for all systems that are:

   a) New
   b) Modifications of existing systems.

This is set using the Defence Standards 00-55/00-56. However, in line with MOD policy wherever there are civil standards of equal or higher standard then they are to be used. Therefore, for AGL Systems the IEC Document 62143 Electrical installations for lighting and beaconing of aerodromes: AGL systems: Guidelines for the development of a safety lifecycle methodology are to be applied. The recognised mechanism for providing assurance that Safety Requirements have been met is through a Safety Case. This provides a “reasoned, auditable argument that the system is, and will remain, tolerably safe for operation”. A safety case is sometimes presented in four parts that cover the following four aspects of the lifecycle: operational requirements, system design and manufacture, installation and commissioning, and operations. It uses the principle that the “system” consists of people, procedures and the equipment.

Further advice on Safety Case Management can be obtained from:

DE-CST
AIR COMMAND ATC – Aerodrome Infrastructure & Safeguarding
AIR COMMAND ATC – Military ATC Policy
AIR COMMAND ACC – Safety Management Cell
Example Structure

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Records the functions and functionality to be performed by, and the Safety Requirements of the AGL system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 2</td>
<td>Records the evidence, arguments and assumptions used to verify that the design of the AGL system will meet its Safety Requirements.</td>
</tr>
<tr>
<td>Part 3</td>
<td>Records the evidence, arguments and assumptions used to verify and validate that the AGL system can be introduced into service in a safe manner. It describes specific operating and maintenance procedures necessary to assure safety and provides arguments to support the claim that the system will not affect the safety of ATS during operational use.</td>
</tr>
<tr>
<td>Part 4</td>
<td>Is required as an operational acceptance that the AGL is fit for safe operational use throughout its lifecycle.</td>
</tr>
</tbody>
</table>

Table 2. Typical Structure of the Four-Part Safety Case

11.5 AGL Maintenance Policy

11.5.1 Maintenance Plan

A maintenance plan is to be produced, approved by the DE-PM and implemented following the guidelines in this Practitioner Guide and BS EN 61821. The maintenance plan is to include the following aspects:

- the maintenance philosophy, that includes and takes account of
  - the maintenance objectives;
  - the operational requirements;
  - the maintenance resources;
- a maintenance schedule and procedures, which includes
  - planned, controlled, conditional and corrective maintenance programmes;
  - post-maintenance activities;
  - the modification or upgrading of equipment;
- reference to the maintenance procedures;
- reference to specific safety procedures;
- the management of records and documentation;
- the provision of spares, tools, test and safety equipment;
- inspections;
- provision for the review and amendment of the maintenance plan.

**NOTE 1** Maintenance activities can be described as:

- planned, where prescribed tasks are carried out on a routine basis;
- controlled, where an analysis of the equipment is carried out in order to minimise the amount of planned maintenance required;
- conditional, where the maintenance requirements have changed during the life of the equipment;
- corrective, in order to restore equipment to the required operational state.
12 Bibliography

1. JSP 554 Military Aviation Aerodrome Standards and Criteria
2. JSP 375 MOD Health and Safety Handbook
3. JSP 454 Procedures for Land Systems Equipment Safety Assurance
4. JSP 418 Sustainable Development Environment Manual
5. JSP 434 Defence Construction in the Built Environment
6. Defence Standard 00-55 Requirements For Safety Related Software In Defence Equipment
7. Defence Standard 00-56 Safety Management Requirements For Defence Systems
9. BS EN 61821: Electrical installations for lighting and beaconing of aerodromes : Maintenance of aeronautical ground lighting constant current series circuits
10. BS EN 61823: Electrical installations for lighting and beaconing of aerodromes: Aeronautical ground lighting systems: AGL Series Transformers.
11. IEC 62143 : Electrical installations for lighting and beaconing of aerodromes : Aeronautical ground lighting systems : Guidelines for the development of a safety lifecycle methodology AGL systems safety lifecycle
13. Prime Contracting on the MOD Estate
14. PI 29/2005 Installation, commissioning and maintenance of aeronautical ground lighting cable circuits
15. PI 19/2006 Mandatory services available via a ‘call off’ contract to support Modular Control System (MCS) installations on all MOD Aerodromes
16. Format of Aerodrome Inspection Report
17. DE Safety Notice 03/02 - Aeronautical Ground Lighting (AGL) Asbestos in seating (or base) gaskets

13 Hierarchy of Standards Affecting MOD

With the exception of overarching strategic standards such as the OGC Common Minimum Standards, MOD standards and JSP Scales represent the standards the Authority is accustomed to. Proposals that deviate from these requirements must be clearly identified and supported by valid justifications and demonstrable benefits due to the deviations.

Hierarchy of Technical Standards. It is MOD policy that the following hierarchy (in priority order) is applied to technical standards:

1. Regional – British Standard implementing European standards
2. International - British Standard implementing international standards
3. National – Other British Standards
4. NATO (North Atlantic Treaty Organisation) Allied Agreement publications STANAGS (Standardisation Agreement) and QSTAGs (Quadripartite Standardisation Agreements)
5. UK MOD Defence Standards (Def Stans)
6. UK MOD Departmental Standards and Specifications - such as Defence Estate standards and specifications
7. Other nation’s military standards - e.g. from USA, MoD Mil Specs and Standards
8. Recognised Industry/Partnership/Consortium Standards - e.g. trade association standards
MOD Internal Stakeholders:

TLBs/Agencies - Operations & Front Line:

- Chief of Joint Ops
- Commander in Chief (CinC) Fleet
- CinC Strike
- CinC Land
- GOC NI

Personnel:

- Chief of Naval Personnel
- Personnel & Training Command
- Adjutant General

Acquisition & Support:

- DPA Defence Procurement Agency
- DLO Defence Logistics Organisation
- DE Defence Estates
- Science Innovation & Technology

Central

CEstOs:

- RNEO Royal Navy Estate Organisation
- AIO Army Infrastructure Organisation
- RAFIB RAF Infrastructure Branch
- CENTRE Centre/DPA
- DLISS Defence Logistics Infrastructure & Security Services
- PJHQ the Permanent Joint Headquarters
- 2PUS as owner of Main Building - and as the Procurement Process Owner (PPO) responsible for acquisition

MoD Centre

- CBSSBC Central Budget Safety & Security Business Continuity
- CESO MoD Chief Environmental Safety Officer – Director of DS&C
- D S&C Directorate of Safety and Claims

Other Formations:

- ATRA Army Training and Recruiting Agency AG
- ASU Accommodation Services Unit
- AWE Atomic Weapons Establishment
- CRE (A) Commander Royal Engineers (Airfields) AIR Command
- CRF Commander Regional Forces LAND
- DSF Director Special Forces CENTRE
- HQ 2 Div 2nd Division Headquarters LAND
- HQ 5 Div 5th Division Headquarters LAND
- HQ Londist Land
- UK(SC) Germany
- JHC Joint Helicopter Command LAND
- RFCA Reserve Forces & Cadets Association LAND
- USVF (United States Visiting Forces)

On-vote Agencies:

- ATRA Army Training and Recruiting Agency AG
- DBA Defence Bills Agency Centre
- DCSA Defence Communications Services Agency
- DDA Defence Dental Agency Centre
- DE Defence Estates
- DGIIA Defence Geographic and Imagery Intelligence Agency Centre
- DMETA Defence Medical Education & Training Agency Centre
- DPA Defence Procurement Agency DPA
- DSA Disposal Services Agency Centre
- DSDA Defence Storage and Distribution Agency DLO
- DTMA Defence Transport and Movements Agency DLO
- DVA Defence Vetting Agency Centre
- MDP Ministry of Defence Police Centre
- MSA Medical Supplies Agency DLO
- PPA Pay & Personnel Agency Centre
- TGDA RAF Training Group Defence Agency RAF PTC

Trading Fund Agencies:

- ABRO Army Base Repair Organisation
- DSTL Defence Science & Technology Laboratory
- DARA Defence Aviation Repair Agency
- MET O Meteorological Office

Other Associations:

- AUMB Army Utilities Management Board
- AWE Atomic Weapons Establishment
- CVWW Council for Volunteer Welfare Workers
- DDefSy - Directorate of Defence Security
- DFG Defence Fuels Group
- DFRS Defence Fire and Rescue Service
- DESO Defence Export Services Organisation Centre
- DFSTS Defence Fixed Telecommunications Service
- DOSG Defence Ordnance Safety Group
- DRE Defence Rail Executive; Railway Operations involving property, working restrictions; safety; capital works
- DSTL Defence Science Technology Laboratories
- DS&C Directorate of Safety & Claims
- NAAFI Navy, Army, Airforce Institutes (inc. Junior Ranks Clubs) - Catering, Retail shops, etc
- QINETIQ (formerly DERA – now Privatised)
- RFCA - Reserve Forces and Cadet Associations
- SSVC Services Sound & Vision Corporation
- SSAFA Soldiers, Sailors & Air Force Association
- SSG Security Services Group (part of Defence Estates)
- WRVS Women's Royal Voluntary Service