Directorate of Airspace Policy

Civil Aviation Authority

CAP 736

Guide for the Operation of Lasers, Searchlights and Fireworks in United Kingdom Airspace

(Including Helium-Filled Toy Balloon Display Guidelines)

www.caa.co.uk

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Chapter 1 Introduction

1 Aim

Individuals or organisations wishing to direct light sources, pyrotechnics or fireworks into the air are obliged to do so in a safe and sensible manner, as mandated by legislation contained within the United Kingdom Air Navigation Order 2005, so that their activities may safely co-exist with aircraft operations. The CAA is responsible for policy regarding light displays, permanent laser sites, other light source installations, fireworks, helium-filled toy balloon releases and their effects on aviation. Consequently, the aim of this CAP is to state existing policy and to provide individuals or organisations wishing to conduct directed light, firework, or helium-filled toy balloon operations in the United Kingdom, with a means of notifying their activities to the CAA. This will enable the aviation community to properly assess the impact of any such proposed activity and take appropriate measures to mitigate any dangers to flight safety.

2 Structure

This document should be read in its entirety in order to appreciate the relevance of the issue to aviation. Following the introduction, **Chapter 2** gives a general overview of the issues surrounding the impact of light and fireworks displays and balloon releases on the safety of flight operations and gives the legislative background to the subject. **Chapter 3** describes the light display guidelines and indicates areas within which the UK considers it especially necessary to protect flight operations from the dangers presented by temporary light displays. This chapter also refers to firework displays and helium-filled toy balloon releases. **Chapter 4** describes the issues surrounding the establishment of permanent laser or searchlight sites. The **Annexes** provide a notification proforma to be used by organisers to notify the CAA of their activities, together with graphical illustrations of the safety zones considered necessary to exist in the vicinity of aerodromes. Finally a list of reference documents is attached.

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Chapter 2 General

1 The Threat to Aircraft Safety

The use of lasers, searchlights, fireworks and helium-filled toy balloons is now widespread throughout the UK. Many of these activities make use of a generated light source to produce intense and directional beams of light and create special lighting effects. Whilst the production of many light sources is important for the purposes of the research and entertainment industries, this can create a potential risk to aircraft operations. The risk to aviation is increased when such activities take place in the vicinity of aerodromes - particularly during such critical phases of flight as approach and landing - and when pilots are wearing night vision goggles and similar devices which amplify the available light. The risk is more likely to be from the unexpected dazzle rather than actual ocular or physical damage, although the risk of actual injury should not be discounted.

2 Light Displays and Legislation

2.1 Adequate lighting is necessary for all visual tasks. An excess of light, however, can detrimentally affect vision to the extent of rendering it ineffective. In aviation, a pilot may experience high levels of lighting when flying into the sun or looking at very bright artificial light sources such as searchlights. Sudden and intense bursts of lights can also cause distraction and confusion, especially if the occurrences are unexpected. Instances such as light displays, lasers or firework shows can be the cause of such events.

2.2 Ideally, pre-event analysis and discussion with aviation authorities should safely de-conflict flying and light display activities. Failure to take suitable or adequate measures to prevent a risk to aircraft may result in prosecution under the Air Navigation Order (ANO) 2005 that refers to endangering the safety of an aircraft, or under Article 135 of the same Order that refers to dangerous lights.

3 Lasers

3.1 Lasers used in the vicinity of aerodromes add to the known aviation-related problems associated with high intensity lights. The technology can produce a beam of light of such intensity that permanent damage to human tissue, in particular the retina of the eye, can be caused instantaneously, even at distances over 10 km. At lower intensities, laser beams can seriously affect visual performance without causing physical damage to the eyes.

3.2 Protection of the pilot against deliberate or accidental laser beam strikes has been of interest to military aviation medicine specialists for many years. However, it was with the advent of the laser light display for entertainment or commercial purposes, and subsequent accidental illumination of civil aircraft from such displays, that civil aviation authorities have become increasingly concerned with the issue of projection of laser light into the air.

3.3 An event recorded in 1995 related the experience of a pilot on a commercial flight in the USA. Shortly after take-off the pilot was hit in the eye by a laser beam. He was completely flash-blinded in his right eye and suffered impaired vision in his left eye. He was unable to see for 30 seconds and for another two minutes was unable to

interpret any of his flight instruments. Such an event has obvious safety implications in imperilling the lives of aircrew, passengers and those living in the vicinity of aerodromes.

3.4 Lasers used in outdoor Light Displays produce an intense, coherent, directional beam of light with wavelengths covering the visible spectrum of 400-700 nanometres. Such concentrated energy creates not only the potential for permanent eye injury to pilots, crew and passengers, but also loss of night vision. When such Light Displays are projected or reflected into airspace and intercept aircraft, unplanned exposure (incidents of illumination, startle and glare) may cause pilot distractions or create temporary vision impairments (flash blindness, afterimage). These effects may pose significant flight safety risks during critical phases of flight, in particular during approach and landing operations.

3.5 In view of the increasing risk to flight safety posed by the more widespread use of laser emitters around airports, the International Civil Aviation Organisation (ICAO) formed a study group in 1999 to evaluate the laser risk. During 1999 and 2000, the Aviation Medicine Section of the ICAO Secretariat developed the laser-related Standards or Recommended Practices (SARPs) which are now included in Annexes 11 and 14 to the Convention on International Civil Aviation. These standards, to which the UK subscribes, require states to take adequate steps to prevent laser beams from adversely affecting flight operations and recommends establishing zones around aerodromes within which the use of lasers should be restricted.

3.6 Safety regulations for laser displays are already taken into consideration by Local Government Authorities when carrying out risk assessments for associated planning applications or entertainment licences. Aviation risk assessments are carried out along similar lines to establish Hazard Zones. ICAO Recommended Practices suggest the establishment of Laser Beam Free Flight Zones, Laser Beam Critical Flight Zones and Laser Beam Sensitive Flight Zones. The UK approach, which has been established for several years, does not prescribe precise dimensions for such zones around each UK airport, but considers that a Notification Zone exists around every UK aerodrome within which laser emissions must be controlled.

3.7 A Nominal Ocular Hazard Zone is considered to exist around any laser within which visible and invisible laser beams can pose a potential threat to safety by exceeding the Maximum Permissible Exposure. Assessment of lasers producing visible beams will also take into account the additional risks from dazzle and distraction in order to calculate a Sensitive Level and Visual Interference Level that determine whether the installation can safely co-exist with aircraft operations and, if appropriate, what restrictions or limitations should be applied. This assessment will depend on the range and bearing of the installation from any nearby aerodrome. If the proposed display or installation is particularly complex or contentious, a Local Laser Working Group may be convened to assess the implications of the proposal and produce a final assessment.

4 Searchlights

Searchlights are frequently used to provide spectacular backdrops to individual events. They are also used to provide lighting displays for structures or special events over periods of weeks or even months. Apart from the potential to distract aircrew, they may also appear similar in appearance and position to airfield lighting, hence their position and operation must be considered with care.

5 Fireworks

Firework displays[1] can vary from the small-scale garden event to a major commercial or ceremonial occasion. As with laser or searchlight displays, fireworks have the potential to distract and confuse aircrews or damage aircraft during flight operations. A unique feature of fireworks displays is that solid objects are physically launched into the air to create the full visual effect. Many fireworks associated with large-scale events can dispense canisters several hundred feet into the air. Whilst the risk of collision with aircraft is small, the existence of such projectiles needs to be borne in mind when carrying out an assessment for firework displays in the vicinity of aerodromes.

6 Helium-Filled Toy Balloons

The release of helium-filled toy balloons is viewed as a valuable source of publicity and/or fundraising at many events. However, the conduct of such activities in the vicinity of aerodromes could present a risk to aviation. Discussions between Rolls Royce Engineering and the CAA Safety Regulation Group's Propulsion Department have determined that the ingestion of balloons would not have a detrimental effect on a gas turbine engine's performance, regardless of its passage through the engine. However, regardless of any assurances apropos the nil effect of ingestion, pilots will tend to manoeuvre to avoid large concentrations of balloons. Therefore, to increase awareness and to minimise the potential risk, CAA guidelines are laid down for the benefit of balloon operators, Air Traffic Control and aerodrome managers.

1. For the purposes of this CAP, 'Fireworks' and 'Firework Displays' includes 'Sky Lanterns' and 'Sky Lantern Displays'; both involve the launching of one, or more solid combustible object into the air with the risk of either impacting against an aircraft, or causing a distraction to aircrew.

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Chapter 3 Light, Firework and Helium-Filled Toy Balloon Display Guidelines (Temporary Displays)

1 Action By Light and Firework Display Organisers

1.1 This chapter refers to procedures concerned with temporary light, firework and helium-filled toy balloon displays. Refer to Chapter 4 if the light display is designed as a permanent (longer than one month) installation.

1.2 For light and firework displays, or helium-filled toy balloon releases, Organisers should notify the CAA of their proposed activity by completing the notification proforma at Annex A. To allow time to deconflict or co-ordinate the activity, as well as promulgate warnings to the aviation community and establish any control measures considered necessary, **notification needs to be given at least 28 days in advance**.

1.3 The CAA will examine the proposal based on the following guidelines. If no further information is required then appropriate warning action will be carried out. While the Display Organiser will not routinely receive written confirmation of this, if further information or action is required from the Display Organiser, the CAA may contact the originator of the proposal to discuss suitable future courses of action.

2 Guidelines for Light and Firework Displays

2.1 It is of prime importance that light displays and fireworks are never directed at or towards aircraft or aerodromes. The Light Display organiser should also nominate a single point of contact, known as a Light Display Operator (LDO), who will be directly responsible for the conduct of the actual event. Display organisers should be aware of the following geographical zones, also illustrated at Annex B, within which the CAA considers it necessary to impose restrictions in order to protect flight operations:

2.1.1 Within 3 miles of an aerodrome's notified Aerodrome Reference Point (ARP) or similar, or within 10 miles of the notified ARP along the track of the extended runway centreline and 0.5 miles either side of said centreline.

2.1.2 For Light Displays within 3 miles of an aerodrome's ARP, but not on the extended runway centreline, or within 10 miles of an aerodrome but only if within 500 metres either side of the extended runway centreline, the following procedures should be adhered to:

a) Ideally, measures should be in place to prevent light escaping towards the aerodrome or along the extended runway centreline.

b) If this proves impractical, other precautions are to be taken to ensure that light displays do not impinge on safe flight operations, such as arranging for a direct telephone or radio communications link between the LDO and relevant aerodrome, through which the Light Display can be terminated immediately on request from either an aircraft or the affected aerodrome.

NOTE: If this is not possible, then the light display may represent a threat to flight safety and should not proceed.

2.1.3 Elsewhere**,** although the light display is unlikely to affect aerodrome flight operations, the Light Display organiser should notify the CAA to ascertain if there are any other aviation activities that may be affected by the display.

3 Additional Guidelines for Firework Displays

3.1 Aerial fireworks displays should be limited to a height of 1500 ft above ground level. Any firework conforming to BS7114/BS EN 14035-36 will not exceed this height.

3.2 Displays within 10 miles radius of an active aerodrome or within an Aerodrome Traffic Zone (ATZ)[1] may require notification and coordination action and must be notified by the event supervisor to the CAA for consideration.

3.3 If the fireworks display is planned to take place near the coast, the organisers should pass all the relevant details to HM Coastguard.

4 Additional Guidelines for Helium-Filled Toy Balloon Releases

4.1 While the geographical zones described in para 2.1.1 do not apply for helium-filled toy balloon releases, the CAA will usually consider placing restrictions upon any request for such balloon releases within 5 miles of an aerodrome ARP; however, all applications are considered on their individual merit.

4.2 Balloons should be made of latex, not metallic foil, nor have a metallic finish. It is strongly recommended that plastic inserts are not used to close the balloons, nor lengths of string, streamers or ribbons; the balloons are not to be tied together. Where the balloons are restrained prior to release, the restraining medium must be attached to the ground or a fixed structure to prevent any inadvertent release of the restraining medium with the balloons.

4.3 The application procedure for helium-filled toy balloon mass releases[2] varies as the number of balloons to be released changes. Details are as follows:

Table 1

Number of Balloons	Procedure
Between 1,000 and 5,000	The organiser should contact AUS (contact details at Annex A) to ascertain which ATC Units may be affected by the release. AUS will instruct the organiser to contact the appropriate ATC Units **before the date of release and again on the day of the release**. The organiser should also inform the local Police of the release.

1. An ATZ is airspace established in the vicinity of an aerodrome with the purpose of providing protection to aircraft landing, taking off and flying in the visual circuit. An ATZ extends to a height of 2000ft above the aerodrome within a circle centred on the notified mid-point of the longest runway and a radius of two miles if the longest runway is notified as 1850 metres or less, or a radius of two and a half miles if the length of the longest runway is notified as greater than 1850 metres.
2. Balloon releases that do not meet the definition of mass release are less likely to cause a hazard to aircraft. However, organisers are encouraged to seek advice from the Airspace Utilisation Section (AUS) (contact details at Annex A) on the safe conduct of such releases.

Table 1 (Continued)

Number of Balloons	Procedure
5,001 to 20,000	The organiser must apply *in writing* to AUS, giving at least 28 days notice. Co-ordination will be affected by AUS with any ATC Units affected by the release. Deconfliction process will be taken by AUS from other notified unusual aerial activities. For sites *outside* controlled or notified airspace, AUS will issue an *approval letter* to the organiser and copy this to the affected ATC Units, aerodromes, Police Air Support and Air Ambulance Units. For sites *within* controlled or notified airspace, AUS will issue a *Permission* to the organiser and copy this to the affected ATC Units, aerodromes, Police Air Support and Air Ambulance Units. AUS will promulgate the release by NOTAM[1].
20,001 or more	The organiser must apply *in writing* to AUS, giving at least 28 days notice. Co-ordination will be affected by AUS with any ATC Units affected by the release. Deconfliction process will be taken by AUS from other notified unusual aerial activities. AUS will issue a *Permission* to the organiser and copy this to the affected ATC Units, aerodromes, Police Air Support and Air Ambulance Units. AUS will promulgate the release by NOTAM.

1. A NOTAM, or Notice To Airmen, is created and transmitted by government agencies to alert aircraft pilots of any hazards en route or at a specific location.

It is acknowledged that the above procedures differ from those detailed in the ANO 2005 (Section 1, para 97); however, the CAA is currently seeking to have the ANO amended to reflect what it believes to be best practice.

5 Further Advice

5.1 Further advice on the use of lasers and fireworks for display purposes can be obtained from the following Health and Safety Executive publications:

HS(G)95 - 'The Radiation Safety of Lasers Used for Display Purposes'

ISBN 0-7176-0691-0.

HS(G)123 - 'Working Together on Firework Displays: Guide to Safety for Firework Display Organisers and Operators'.

ISBN 071-7608352.

5.2 Laser safety guidance can be obtained from the Health Protection Agency, at the following telephone number: 01235 831600, fax 01235 833891, or email laser@hpa.org.uk

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Chapter 4 Permanently Sited Lasers and Searchlights

1 Permanent Laser and Searchlight Sites

1.1 Any laser or searchlight site that is likely to remain in position for more than a month is considered a permanent site. Not every site will be significant to aviation, but the CAA should be consulted during the initial planning process for any such installation.

1.2 An initial approach should be made to the Off-Route Airspace Section in the Directorate of Airspace Policy at the CAA. The Section will examine the proposal and advise the originator of whether it is likely to affect aircraft operations and, if so, what measures to take to mitigate its effect. The guidelines given in Chapter 3 and Annex B will be utilised to make an initial assessment of the likely risk to aircraft operations. Further advice may be sought from the Health Protection Agency and the Air Traffic Standards Division of the Safety Regulation Group of the CAA.

2 Lasers, Searchlights and Other Lights Used for Air Traffic Control Purposes

Several types of laser, searchlights and other lights are used on or near airfields for Air Traffic Control (ATC) meteorological purposes or as a bird hazard control. These include cloud and visibility measurement, communications, and navigation aid calibration tasks. It is the responsibility of individual aerodrome licensees to ensure that equipment used for such purposes is operated in accordance with the manufacturer's instructions, international, national and local ATC procedures, and in a manner that will neither endanger any aircraft nor prejudice flight safety.

3 Use of Lasers by Military Units

The use of lasers by military units is widespread across all three Services. Lasers are commonly used for range finding, target designation and weapon guidance. This document does not cover the use of lasers, searchlights or other light sources by the military as MOD, and their subordinate organisations, produce separate regulations concerning the safe use of lasers by the military. However, such regulations do not absolve any person from using best judgement to ensure the safety of aircraft and aircrew while operating equipment employing lasers, searchlights or other light sources.

4 Further Contacts and Advice

4.1 Initial guidance and advice on the impact of light sources on aviation can be obtained from:

Off-Route Airspace Section
Directorate of Airspace Policy
CAA House
45-59 Kingsway
London WC2B 6TE

Tel: 020 7453 6541
Fax: 020 7453 6565

4.2 Any questions concerning the military use of lasers, searchlights or other light sources should be addressed to

Secretary, Military Laser Safety Committee

TES DOSG
MOD DPA
Abbey Wood
Birch 3a #3323
BRISTOL
BS34 8JH

Tel: 0117 91 35344/35515

5 Laser Safety Guidance

Laser safety guidance can be obtained from the Health Protection Agency, at the following telephone number: 01235 831600, fax 01235 833891, or email laser@hpa.org.uk.

Annex A Notification of Outdoor Laser, Searchlight, Firework or Helium-Filled Toy Balloon Operations

To: Airspace Utilisation Section Directorate of Airspace Policy 702 CAA House 45-59 Kingsway London WC2B 6TE Tel: 0207 453 6599 Fax: 0207 453 6593 Email: ausops@caa.co.uk	From: (Applicant)	Date: (this form requires submission **at least 28 days** in advance of the date of the event given in para 1)

1 GENERAL INFORMATION

Event or facility		
Customer	Site address (must include postcode)	
GEOGRAPHIC LOCATION		
Latitude ___ *deg (°)* ___ *min (')* ___ *sec (")*	Longitude ___ *deg (°)* ___ *min (')* ___ *sec (")*	
OS Grid Ref :	Post Code (if available) :	
Ground elevation at site *(Above Mean Sea Level)*	Elevation above ground (if on buildings, etc.)	For Firework Displays – maximum height of display (Above Ground Level)
DATE(S), TIME(S) AND DURATION OF EVENT		
Testing and/or alignment	Operation	

2 BRIEF DESCRIPTION OF OPERATION

3 TOY BALLOON RELEASE INFORMATION

Number of balloons
Method of Release: Mass/Batches/Individual* If batches, state size and number of batches
Total time taken to release the balloons (in minutes)
BALLOONS MUST BE MADE OF LATEX/RUBBER, NOT METALLIC NOR HAVE A METALLIC FINISH

4 ON-SITE OPERATION INFORMATION

Operator(s)	
On-site phone 1 (Emergency Contact)	On-site phone 2
BRIEF DESCRIPTION OF CONTROL MEASURES	

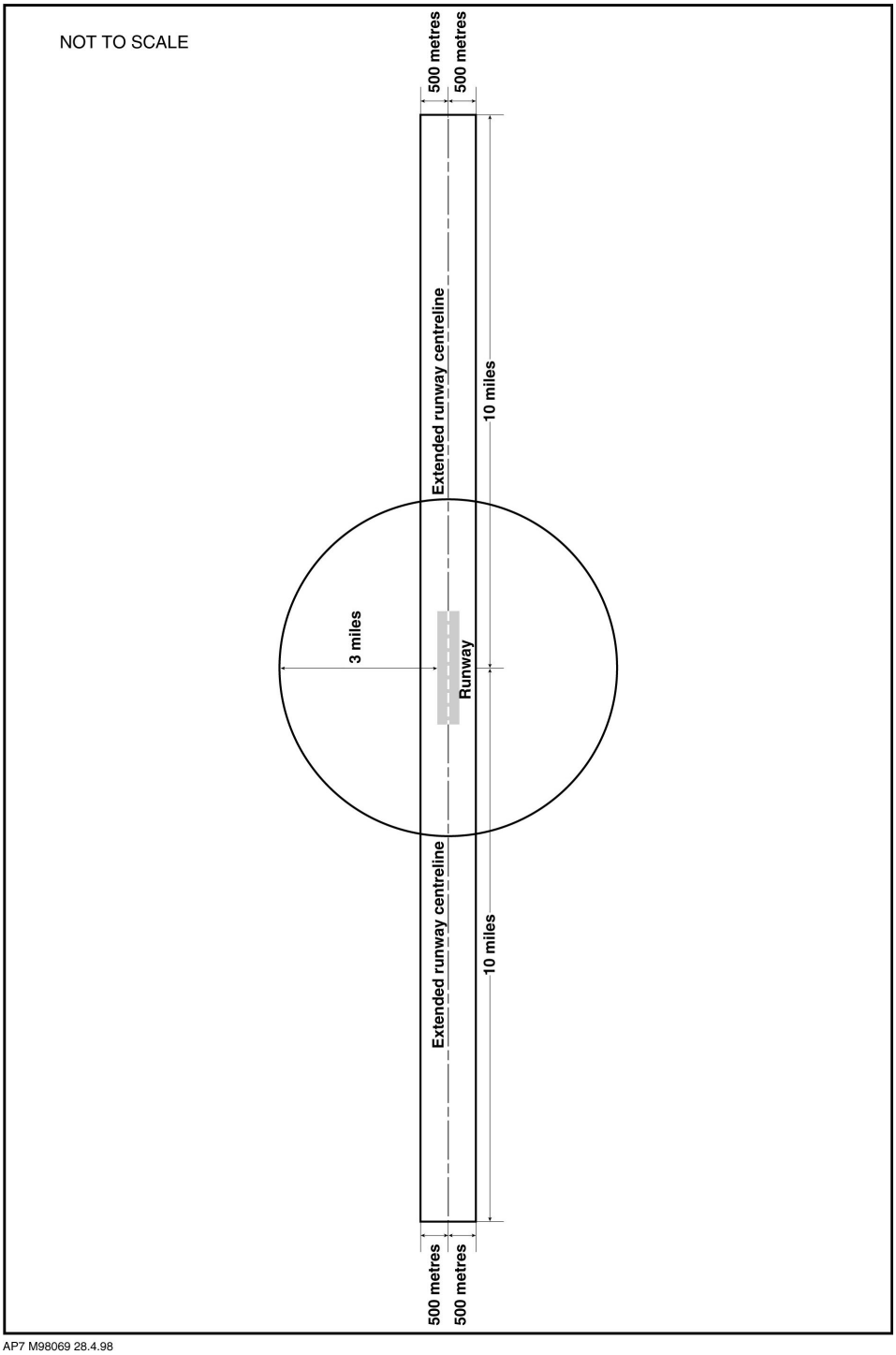
5 ATTACHMENTS

List any additional attachments needed to evaluate this operation *(could include maps, diagrams, and details of control measures)*

6 DESIGNATED CONTACT PERSON *(if further information is needed)*

Name	Position	
Phone	Fax	E-mail
STATEMENT OF ACCURACY To the best of my knowledge, the information provided in this Notice of Proposal is accurate and correct.		
Name *(if different from contact person)*	Position	
Signature	Date	

Annex B Notification Zones for Light and Firework Displays (Diagram)



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(Note: miles = nautical miles)

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Annex C Reference Documents

The following documents contain further specific guidance on the risks, notification and conduct of Light Displays:

CAP 168 Appendix 6E to Chapter 6.

AIP ENR 5 - 3 – 2 Permanently Sited Lasers (available from www.ais.org.uk).

Eurocontrol Safety Regulation Commission Document – SRCDOC 7 (Outdoor Lasers in the Navigable Airspace) 2001 (available from www.eurocontrol.int).

ICAO Annex 11 Chapter 2 and Annex 14 Chapter 5.

ICAO document 'Laser Protection at Aerodromes' (AN5/19.3-01/56).

ICAO document 'Manual on Laser Emitters and Flight Safety' (Doc 9815).

UK HSE - HS (G) 95 - 'The Radiation Safety of Lasers Used for Display Purposes'. (ISBN 0-7176-0691-0).

UK HSE - HS (G) 123 - 'Working Together on Firework Displays: Guide to Safety for Firework Display Organisers and Operators'. (ISBN 071-7608352).

DIRECTIVE 2006/25/EC on the minimum health a safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation).

PD IEC/TR 60825-3: 2008 'Safety of laser products – Part 3: Guidance for laser displays and shows' (available from BSI).

The following documents contain further specific guidance on the risks, notification and conduct of Light Displays:

DAP/AUS/45/Air – 'Safeguarding Co-Ordination – Guidelines for Toy Balloon Releases in UK Airspace'

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