Australian Government
Civil Aviation Safety Authority

CIVIL AVIATION ADVISORY PUBLICATION CAAP 174-01 v2.1

Night vision imaging - helicopters

Date	October 2017
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This Civil Aviation Advisory Publication (CAAP) provides guidance, interpretation and explanation on complying with the Civil Aviation Regulations 1988 (CAR) or a Civil Aviation Order (CAO).

This CAAP provides advisory information to the aviation industry in support of a particular CAR or CAO. Ordinarily, the CAAP will provide additional 'how to' information not found in the source CAR, or elsewhere.

Civil Aviation Advisory Publications should always be read in conjunction with the relevant regulations/orders.

Audience

This Civil Aviation Advisory Publication (CAAP) applies to:

- Operators of helicopters using Night Vision Imaging Systems (NVIS)
- Crew members such as flight crew members (pilots) and aircrew members using NVIS in approved operations.
- Individuals and organisations carrying out modifications and other engineering work on helicopters which are to be used for NVIS operations.
- Organisations considering carrying out operations using NVIS in helicopters.
- CASA personnel involved in the assessment process of any industry organisation wishing to become involved with NVIS operations in any way.

Purpose

The purpose of this publication is to provide guidance on the conduct of helicopter operations using NVIS.

This publication supports and expands upon the content of Civil Aviation Order (CAO) 82.6 under which approval must be obtained to use NVIS.

For further information

For further information on this CAAP, contact CASA's Flight Standards Branch (telephone 131 757).

Status

This version of the CAAP is approved by the Manager, Flight Operations Branch.

Note: Changes made in the current version are not annotated. The document should be read in full.

Version	Date	Details
v2.1	October 2017	CAAP 174-1 was originally issued in 2007 to support and expand upon the content of CAO 82.6. During the period 2007 to 2016, CAO 82.6 underwent a number of amendments. CAAP 174-1 was not amended during this period and subsequently was out of date with the content not aligning to the current version of the CAO or other legislative requirements. The purpose of this amendment is to align CAAP 174-1 to the current legislative framework, with no substantive policy changes.
(1)	October 2007	This is the first CAAP to be written on this subject.

Contents

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this CAAP are listed in the table below.

Acronym	Description
ADF	Australian Defence Force
AGL	Above Ground Level
AIP	Aeronautical Information Publication
ALARP	As Low as Reasonably Practical
ANVIS	Aviator Night Vision Imaging System
AOC	Air Operator's Certificate
AS	Australian Standard
ATS	Air Traffic Services
AWB	Airworthiness Bulletin
CAA	Civil Aviation Authority (of the UK)
CAAP	Civil Aviation Advisory Publication
CAP	Civil Aviation Advisory Publication (UK)
CAR	*Civil Aviation Regulations 1988*
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CAO	Civil Aviation Order
CG	Centre of Gravity
CP	Chief Pilot
CRM	Crew Resource Management
EMS	Emergency Medical Services
FAA	Federal Aviation Administration (of the USA)
FLIR	Forward Looking Infra Red
FOI	Flying Operations Inspector
FOR	Field of Regard
FOV	Field of View
FRMS	Fatigue Risk Management Systems
ft	foot/feet
G	Gravity
HLS	Helicopter Landing Site

Acronym	Description
HUD	Heads Up Display
ICAO	International Civil Aviation Organization
PICUS	Pilot In Command Under Supervision
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IR	Ice on Runway
LSALT	Lowest Safe Altitude
MOPS	Minimum Operational Performance Standard
nm	Nautical Miles
NOTAM	Notice to Airmen
NVD	Night Vision Device
NVIS CCF	NVIS Capability Check Flight
NVFR	Night Visual Flight Rules
NVG	Night Vision Goggles
NVIS	Night Vision Imaging System (s)
OEM	Original Equipment Manufacturer
PIC	Pilot-in-command
RIFTO	Restricted Instrument Flight Take-off
RTB	Return to Base
SAR	Search and Rescue
TAF	Aerodrome Forecast
TCO	Training and Checking Organisation
TEM	Threat and Error Management
TSO	Technical Standard Order
UK	United Kingdom
USA	United States of America
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

1.2 Definitions

Terms that have specific meaning within this CAAP are defined in the table below.

Term	Definition
adverse event	means any event or incident in which life, health or property is: 1. lost or damaged in, on, or by a helicopter in which NVIS are used; or 2. at significant risk of loss or damage in, on or by a helicopter. **Note:** The following are some examples of significant risks: a near miss; NVIS equipment failure, malfunction or abnormal operation; the failure, malfunction or abnormal operation of NVIS-related or affected equipment; unintentional IMC penetration; inadvertent loss of visibility; abnormal degree or accelerated onset of fatigue.
aerial fire fighting	means an operation, in an operational area for a fire, to fight the fire from the air using: 1. a flight crew of at least 1 pilot and 1 aircrew member; and 2. either: a. incendiaries for controlled burning dropped from the helicopter by means of a device operated by a person specifically carried for that purpose (incendiary dropping) provided that the operation is supported by an operational safety case approved in writing by CASA; or **Note:** If acceptable to CASA, an operational safety case may be in the form of, or include, relevant additions or supplements to the operator's operations manual for the aerial fire fighting. b. a helicopter equipped with a belly tank that is filled and refilled with water, fire retardant or similar substance taken from: i if the helicopter is on the ground — a source on the ground at a conforming HLS; or ii if the helicopter is in the hover and using the helicopter's on-board pump — a portable tank at a conforming HLS.
aerial fire fighting support	means an operation for: 1. the tactical insertion or extraction of fire fighting crews in an operational area for a fire; or 2. the carriage of persons to map, locate or observe fires, or to control or direct fire fighting operations. **Note:** In CAO 82.6 aerial fire fighting support does not include aerial fire fighting in the form of, for example, water bombing.
aided flight	means a flight in which NVIS are used in an operational position by trained personnel to enhance night vision. **Note:** Aided flight is associated with the procedure of goggle-up where the crew member places NVIS in the operational position.
aircrew member	means a crew member of a helicopter (other than a supernumerary crew member) assigned by the operator: 1. to assist the pilot in the operation of the helicopter; 2. to operate the winch on the helicopter; or 3. to supervise rappelling or sling-load operations; or 4. to supervise or assist a medical, paramedical or rescue crew member in the performance of his or her duties on the helicopter; or

Term	Definition
	5. to use the auto-hover system to position/reposition the helicopter via inputs through an auto-hover trim control (crew hover).
approved operator	means an operator who has the approval mentioned in subparagraph 1 (c) (iii) of Appendix 1 of CAO 82.6 to use NVIS.
CAR 1988	means the Civil Aviation Regulations 1988.
CASR 1998	means the Civil Aviation Safety Regulations 1998.
conforming HLS	means a HLS that: 1. conforms to the guidelines contained in CAAP 92-2(2) for a Secondary HLS, as if those guidelines applied for an NVIS operation; or 2. under the requirements of a risk assessment prepared by an NVIS operator for a particular operation, has a level of safety at least equivalent to that arising under subparagraph (a).
Class	is a terminology used to describe the filter present on the NVG objective lens. The filter restricts the transmission of light below a determined frequency. This allows the cockpit lighting to be designed and installed in a manner that does not adversely affect NVG performance.
Class A	or 'minus blue' NVG incorporate a filter, which generally imposes a 625 nanometre cut-off. Thus, the use of colours in the cockpit (e.g., colour displays, colour warning lights, etc.) may be limited. The blue-green region of the light spectrum is allowed through the filter.
Class B	NVGs incorporate a filter that generally imposes a 665 nanometre cut-off. Thus, the cockpit lighting design may incorporate more colours since the filter eliminates some yellows and oranges from entering the intensification process.
de-goggle	means the action of transferring from NVIS flight to non-NVIS (unaided) flight by removing the NVIS from a usable position. **Note:** The expression is also used as a command and is opposite to goggle-up.
devoid of surrounding cultural lighting	means that at 500 ft above the terrain, and any object on it, in an area there is insufficient ground lighting to maintain an unaided visible horizon.
emergency medical services	means an operation where transportation is required to facilitate emergency or medical assistance by an aircraft carrying one or more of the following: 1. medical personnel; 2. medical supplies (including equipment, blood, organs or drugs); and 3. ill or injured persons, and other persons directly involved in, or associated with, their retrieval or care.
fatigue	is the dynamic balance between competing forces; forces producing fatigue and forces reversing the effects of fatigue (recovery). There are a number of different definitions of fatigue, including: • 'Weariness from bodily or mental exertion' (Macquarie Essential Dictionary; 1999:282); • 'The consequences of inadequate restorative sleep' (Centre for Sleep Research); and • 'The increasing difficulty to perform physical or mental activities' (Baker, Fletcher and Dawson; 1999:8).

Term	Definition
Generation	refers to the technological design of an image intensifier. Systems incorporating these light-amplifying image intensifiers were first used during World War II and were operationally fielded by the US military during the Vietnam era. These systems were large, heavy and poorly performing devices that were unsuitable for aviation use, and were termed Generation I (Gen I). Generation II devices represented a significant technological advancement and provided a system that could be head-mounted for use in ground vehicles. Generation III devices represented another significant technological advancement in image intensification, and provided a system that was designed for aviation use. Although not yet fielded, there are prototype NVG that include technological advances that may necessitate a Generation IV designation if placed into production. Because of the variations in interpretations as to generation, NVG will not be referred to by the generation designation.
goggle-up	means the action of transferring to NVIS flight by placing the NVIS in a position where it may be used by the crew. **Note:** The expression is also used as a command and is opposite to de-goggle.
head of operations	for a Part 141 operator, has the same meaning as in Part 141 of CASR 1998. **Note:** The head of operations (however described) is one of the key personnel for a Part 141 operator. See regulation 141.020 of CASR 1998.
head of operations	for a Part 142 operator, has the same meaning as in Part 142 of CASR 1998. **Note:** The head of operations (however described) is one of the key personnel for a Part 142 operator. See paragraph 142.025 (b) of CASR 1998.
HLS	means a helicopter landing site.
HLS-NVIS standard	means a HLS that: 1. subject to subparagraphs (b) and (c), is a conforming HLS; and 2. is unlit; and 3. is not required to have a wind direction indicator.
HLS operations	for a helicopter means: 1. take-off or landing at a HLS; or 2. operations at a HLS that do not involve a landing on skids or wheels; or 3. HLS similar operations: a. that are approach to the hover, winching, sling load operations, rappelling, hovering, deplaning, emplaning or similar types of operations; and b. for the conduct of which each relevant crew member is qualified.
human factors	Human Factors aims to optimise the relationships within systems between people, activities and equipment.
incendiary dropping	as a form of aerial fire fighting, means using incendiaries for controlled burning dropped from a helicopter by a person specifically carried for that purpose.
law enforcement	for an operation, means an operation for the enforcement of the laws applying in Australian territory, including, customs, waterways or border protection laws.

Term	Definition
look under	(under view) is the ability of operators to look under or around the NVG to view inside and outside the aircraft.
LSALT, or lowest safe altitude	means not less than 1000 ft above the highest obstacle located within 10 nm of the helicopter in-flight, except when take-off or landing is necessary.
marine pilot	transfer means an operation, in accordance with Civil Aviation Order 95.7.3, to transfer a marine pilot from: 1. land to ship; 2. ship to land; or 3. ship to ship.
minimum NVIS crew	means the minimum number of NVIS pilots and NVIS crew members required for a particular flight or operation. **Note:** CASA approval is not required for a person to use NVIS only for observation or surveillance that is not the primary means of terrain avoidance for safe air navigation using visual surface reference external to the aircraft. However, a person engaged in such unapproved use is not part of the minimum NVIS crew.
Modified Class B	NVG incorporates a variation of a Class B filter and also incorporates a notch filter in the green spectrum that allows a small percentage of light into the image intensification process. Therefore, a Modified Class B NVG allows operators to view a fixed heads up display (HUD) symbology through the NVG without the HUD energy adversely affecting NVG performance.
MOS	means Manual of Standards
Night Vision Goggles	means a self -contained binocular night vision enhancement device that: (a) is helmet-mounted or otherwise worn by a person; and (b) can detect and amplify light in both the visual and near infra-red bands of the electromagnetic spectrum.
NVD, or night vision device	means night vision enhancement equipment fitted to, or mounted in or on, an aircraft, or worn by a person in the aircraft, and that can: 1. detect and amplify light in both the visual and near infra-red bands of the electromagnetic spectrum; or 2. provide an artificial image representing topographical displays.
NVIS, or night vision imaging system	means a self-contained binocular night vision enhancement device, usually including goggles, that: 1. is helmet mounted or otherwise worn by a person; and 2. can detect and amplify light in both the visual and near infra-red bands of the electromagnetic spectrum.
NVIS aircrew member	means a person who: 1. has successfully completed NVIS aircrew member training and is qualified in accordance with this CAO 82.6; or 2. is an NVIS aircrew member instructor. **Note:** An NVIS pilot, NVIS flight instructor, NVIS flight examiner or a CASA FOI may qualify as an NVIS aircrew member or an NVIS aircrew member instructor by complying with the relevant training and competency requirements of Appendix 3 of CAO 82.6.

Term	Definition
NVIS aircrew member instructor	means a person qualified in accordance with CAO 82.6 to instruct air crew members.
NVIS basic HLS	means a HLS that conforms to the guidelines contained in CAAP 92-2(2) for a Basic HLS, as if those guidelines applied to an NVIS operation.
NVIS CCF, or NVIS capability check flight	means a periodic check of the capability of an NVIS aircrew member in accordance with CAO 82.6.
NVIS checking pilot	has the same meaning as in subclause 17.2 in Appendix 3 of CAO 82.6.
NVIS compatible lighting	means aircraft interior or exterior lighting with spectral wavelength, colour, luminance level and uniformity, that has been modified, or designed for use with NVIS, and does not degrade or interfere with the image intensification capability performance of the NVIS beyond acceptable standards.
NVIS competency training	means training undertaken by an NVIS pilot, or an NVIS aircrew member, for NVIS flight in accordance with the relevant training requirements and competency standards mentioned in this Order.
NVIS flight examiner	means: 1. a person who, in accordance with Part 61 of CASR 1998, is the holder of: a. an NVIS rating with an NVIS endorsement; and b. a flight examiner rating with an NVIS flight test endorsement; or 2. a CASA NVIS FOI.
NVIS flight instructor	means a person who, in accordance with Part 61 of CASR 1998, is the holder of: 1. an NVIS rating with an NVIS endorsement; and 2. a flight instructor rating with an NVIS rating training endorsement.
NVIS flight time	means the flight time gained by an NVIS aircrew member or pilot, or a person receiving NVIS flight training, or during an NVIS operation. **Note:** NVIS flight time must be logged in the specialist column of the aircrew flying logbook.
NVIS FOI	means a CASA flying operations inspector appointed in writing to carry out some, or all, of the duties of an NVIS flight examiner.
NVIS initial training	means training to qualify a person for an NVIS aircrew member qualification.
NVIS operation	means 1 or more of the following operations under the VFR using NVIS as the primary means of terrain avoidance for safe air navigation by means of visual surface reference external to an aircraft: 1. search and rescue; 2. law enforcement; 3. aerial fire fighting; 4. aerial fire fighting support; 5. emergency medical services; 6. marine pilot transfer; 7. pilot training for 1 or more of the operations mentioned in paragraphs (1) to (6); 8. an NVIS flight for demonstrating NVIS technology; 9. a positioning flight for an operation mentioned in paragraphs (1) to (6);

Term	Definition
	10. training, testing and proficiency checking in accordance with Part 61 of CASR 1998 for an NVIS rating or endorsement; 11. NVIS competency training for: a. an NVIS pilot conducted by an NVIS operator's TCO or Part 142 operator in accordance with CAO 82.6; or b. an NVIS aircrew member conducted by an NVIS operator's TCO in accordance with CAO 82.6. 12. training and testing for a person to qualify as an NVIS aircrew member in accordance with CAO 82.6 for 1 or more of the operations mentioned in paragraphs (1) to (6); 13. an NVIS CCF for an NVIS aircrew member in accordance with CAO 82.6.
NVIS operator	means an operator approved by CASA under clause 2 of Appendix 1 of CAO 82.6 to conduct 1 or more NVIS operations, and whose approval has not been suspended or surrendered.
NVIS pilot	means a person who is the holder of an NVIS rating with an NVIS endorsement in accordance with Part 61 of CASR 1998.
NVIS proficiency check	means a proficiency check of an NVIS pilot in accordance with the requirements under Part 61 of CASR 1998 for such a check.
old NVG training provider	means an NVIS operator who: 1. immediately before 1 September 2014 — was, in Australia, an "NVG training provider" within the meaning of that expression as defined in subsection 1 of CAO 82.6 as in force immediately before 1 September 2014; and 2. is approved in writing by CASA, on or after 23 December 2016, for this definition.
operator	means an AOC holder, a Part 141 operator or a Part 142 operator.
Part 141 certificate	has the same meaning as in Part 141 of CASR 1998.
Part 141 operator	means the holder of: 1. a Part 141 certificate under which Part 141 flight training for an NVIS rating or NVIS endorsement is approved; or 2. a CASA approval under regulation 141.035 of CASR 1998 for Part 141 flight training for an NVIS rating or NVIS endorsement.
Part 142 authorisation	has the same meaning as in Part 142 of CASR 1998.
Part 142 operator	means the holder of a Part 142 authorisation under which Part 142 flight training for an NVIS rating or NVIS endorsement in multi-crew operations is authorised.
resolution	means the capability of NVIS to present an image that makes clear and distinguishable the separate components of a scene or object.
RTCA/DO-275	means the document titled *Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment*, referenced RTCA/DO-275, dated 12 October 2001, of RTCA Inc., Washington, USA.
search and rescue (SAR)	means an operation by an aircraft to search, locate, rescue, or provide immediate assistance to a person threatened by a grave and immediate

Term	Definition
	danger or a hostile environment.
special fire endorsement	means: 1. for an endorsement issued before 23 December 2016 — an endorsement in the log book of an NVIS pilot, specifying that the holder has satisfied the fire-related requirements of CAO 82.6 as in force before 23 December 2016; and 2. for an endorsement issued on or after 23 December 2016 — a signed certificate of competency that: a. is issued to an NVIS pilot under subclause 16.7 of Appendix 3 of CAO 82.6; and b. certifies that the NVIS pilot has satisfied the requirements of CAO 82.6 for the applicable special fire endorsement mentioned in subclause 16.7 in Appendix 3 of CAO 82.6.
system	for NVIS, means the system in which all of the elements required to operate an aircraft effectively and safely using NVIS are integrated, including NVG and associated equipment, NVIS compatible lighting, other associated aircraft components and equipment, associated training and recency requirements and continuing airworthiness. **Note:** NVIS is synonymous with aviator night vision imaging system, sometimes called ANVIS.
TCO or training and checking organisation	means a training and checking organisation approved by CASA under subregulation 217 (1) of CAR 1988 for this order.
unaided flight	means the NVIS is in a non-operational position when night vision is not being enhanced by any other means. **Note:** Unaided flight is associated with the de-goggle procedure where the crew member places the NVIS in the non-operational position.
use, in relation to NVIS	means use as the primary means of terrain avoidance for safe air navigation by means of visual surface reference external to the aircraft.

2 References

Regulations

Regulations are available on the Federal Register of Legislation website https://www.legislation.gov.au/

Document	Title
CAO	Subsection 3D of section 82.0 of the Civil Aviation Orders (CAOs)
CAO	Section 82.6 of the CAOs
CASA Instrument	CASA 288/07 - Direction - Use of night vision devices prohibited in private operations.
CASA Instrument	132/16 - Helicopter aircrew member - authorisation, exemption and directions

Advisory material

CASA's Advisory Circulars are available at http://www.casa.gov.au/AC

CASA's Civil Aviation Advisory Publications are available at http://www.casa.gov.au/CAAP

Document	Title
Airworthiness Bulletin	AWB 25-031 - Defects with Night Vision Imaging Systems.

2.1 Forms

CASA's forms are available at http://www.casa.gov.au/forms

Form number	Title
1049	AOC Application Form (Initial Issue)
1214	Application for an AOC Variation
538	Application for the Night Vision Imaging System (NVIS) Authorisation. Initial Issue and Variation
61 FEA	Application for CASR 61.040 Approval - Privileges of a Flight Examiner Rating
61 FER	Application for CASR Part 61 Flight Examiner Rating
141-001	Application for CASR Part 141 Flight Training Certificate
142-001	Application for CASR Part 142 flight Training Certificate
61-1516	Night Vision Systems Rating Proficiency Check

3 How to apply

3.1 Application process

3.1.1 NVIS Aerial Work and Charter Operations (excluding flight training for the issue of a CASR Part 61 NVIS Rating)

3.1.2 CAO 82.6 defines the various permitted NVIS operations which are classified as Aerial Work and Charter Operations. To be approved by CASA to conduct NVIS operations applicants will either need to have applied for or hold:

a. An AOC authorising Aerial Work Operations and / or Charter Operations with the relevant authorisations for the proposed operation(s) (i.e. Search and Rescue, Ambulance Functions, Winching / Hoist etc.); and
b. An Instrument of Approval to conduct NVIS operations with the relevant authorisations for the proposed operation(s) (i.e. Search and Rescue, Law Enforcement etc.).

3.1.3 Application to conduct NVIS training for the issue of a Civil Aviation Safety Regulation (CASR) Part 61 NVIS Rating

3.1.4 To apply to CASA to conduct flight training for the issue of a Part 61 NVIS Rating the applicant will need to apply to CASA for:

a. A CASR Part 141 certificate or CASR Part 142 AOC (as applicable); and
b. An Instrument of Approval to conduct NVIS operations with the relevant authorisations for the proposed operation (ie: training, testing and proficiency checking in accordance with Part 61 of CASR 1998 for an NVIS rating or endorsement).

3.1.5 Application information / forms

3.1.6 For more information on how to apply, refer to the CASA website.

3.1.7 Application forms for an AOC, AOC Variation, CASR Part 141 certificate or a CASR Part 142 AOC should be submitted to the CASA Client Service Centre.

3.1.8 Application forms for an Instrument of Approval to conduct NVIS operations should be submitted to the applicants oversighting Regional Office.

Note: A requirement of CAO 82.6 is that all NVIS operators must provide:

a. For pilot competency - a CAR 217 Training and Checking Organisation (TCO), or a Part 142 Organisation or an old NVG Training Provider.

b. For aircrew member competency - a CAR 217 TCO or an old NVG Training Provider.

This should be considered as part of the application.

4 Assessment process

4.1 Assessment and approval

4.1.1 Once the application has been received, it will be assessed in accordance with the requirements of the legislative framework. Inspections and tests may also be required.

4.1.2 If the application and assessment is found to be satisfactory, approvals and / or authorisations will be issued as required.

5 Background

5.1 Overview - history of NVIS application

5.1.1 NVIS technology has evolved from rather primitive (Generations 1 and 2) of the 1970s to later generations with more sophisticated devices (Generation 3 with updates) which have been exploited by the more advanced military forces, including the Australian Defence Force (ADF), for many years.

5.1.2 CASA issued Civil Aviation Order 82.6 (CAO 82.6) in 2007 and established operational and airworthiness standards and approval requirements for the use of NVIS in specialised helicopter operations. CASA airworthiness standards for NVIS are based on the minimum performance specifications of RTCA/DO-275.

5.1.3 The legislative framework has the effect of making unlawful any unapproved use of NVIS as a primary means of terrain avoidance for safe air navigation by means of visual surface reference external to an aircraft.

5.1.4 CAO 82.6 is an interim measure pending finalisation of the relevant Parts of the Civil Aviation Safety Regulations 1998 (CASR 1998). The flight crew training, testing and proficiency legislative framework in the CASRs took effect on the 1st of September 2014, namely:

- Part 61 of CASR which provides the flight crew licensing framework;
- Part 141 of CASR which provides for certain pilot flight training; and
- Part 142 of CASR which provides for integrated and multi-crew pilot flight training and contracted recurrent training and checking.

CAO 82.6 will remain in place providing operational, airworthiness standards until finalisation of the remaining Parts of the CASR's.

6 CASA philosophy NVIS operations

6.1 Philosophy

6.1.1 The CASA philosophy on the civil use of NVIS is that the proper use of NVIS has the potential to enhance the safety of visual flight at night by assisting the crew's ability to see the horizon and terrain, observe much of the in-flight meteorological conditions, and to identify objects that may cause a hazard to flight.

6.2 NVIS use

6.2.1 CASA has determined that the use of NVIS is to be regulated in accordance with Sections 82.0 and 82.6 of the CAOs, Part 61, 141 and 142 of the CASR. Section 82.6 of the CAO places conditions for the use of NVIS by an Air Operators Certificate (AOC) holder, or Part 141 certificate holder. The NVIS operations permitted under CAO 82.6 are:

a. Search and Rescue (SAR);
b. Law enforcement;
c. Aerial fire fighting;
d. Aerial fire fighting support;
e. Emergency Medical Services (EMS);
f. Marine Pilot Transfer;
g. Pilot training for 1 or more of the operations mentioned in paragraphs (a) to (f)
h. An NVIS flight for demonstrating NVIS technology
i. A positioning flight for an operation mentioned in paragraph (a) to (f)
j. Training, testing and proficiency checking in accordance with Part 61 of CASR 1998 for an NVIS rating or endorsement
k. NVIS competency training for:
    i. An NVIS pilot conducted by an NVIS operators TCO or Part 142 operator in accordance with CAO 82.6; or
    ii. An NVIS aircrew member conducted by an NVIS operators TCO in accordance with CAO 82.6
l. Training and testing for a person to qualify as an NVIS aircrew member in accordance with CAO 82.6 for 1 or more of the operations mentioned in paragraphs (a) to (f)
m. An NVIS CCF for an NVIS Aircrew member in accordance with CAO 82.6

6.2.2 The use of NVIS in private operations is prohibited under CASA Instrument 288/07.

6.2.3 The use of NVIS for Aerial Fire Fighting using helicopters with belly tanks is under review by CASA. Operators wishing to conduct this activity should contact their local CASA office for the current CASA policy on this type of operation.

6.2.4 CAO 82.6 and this Civil Aviation Advisory Publication (CAAP) are primarily directed at operators intending to undertake NVIS operations, and crew members who are qualified

or undergoing training in the operation of a helicopter using NVIS, who are to manipulate the flight controls, or providing information for the purposes of safe air navigation, in maintaining terrain avoidance. This CAAP is not directed at the use of NVIS by other operating crew members, where NVIS may be used solely for the purposes of observation or surveillance where those crew members are not directly involved in air navigation or terrain avoidance functions.

6.2.5 However, much of the information in CAO 82.6 and this CAAP will be of some assistance in considering such operations.

7 CASA policy on the concept of operations

7.1 CASA policy and concept

7.1.1 This document expands, where necessary, on the content of CAO 82.6 and provides advice on the CASA concept of operations of NVIS use in civil aviation operations. The focus is on the safe and effective implementation of NVIS during various phases of flight, with the emphasis on improving the situational awareness of crews during night visual flight rules (NVFR) operations or the visual phases of instrument flight rules (IFR) flight where NVIS flight is allowed. The overall premise is that use of NVIS is an adjunct to visual flight at night.

8 Suggested additional reference material

8.1 Additional information

8.1.1 The following documents provide additional information and reference material that may be of assistance when considering NVIS helicopter operations. Further, there is a considerable amount of other material that can be accessed from various sources on the internet that may also be of assistance.

- Australian Transport Safety Bureau – Aviation Research Paper B2004/0152
- RTCA/DO-268 - Concept of Operations, Night Vision Imaging System for Civil Operators
- RTCA/DO-275 - Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment
- RTCA/DO-295 - Civil Operators' Training Guidelines for Integrated Night Vision Imaging System Equipment

9 Acknowledgements

9.1 RTCA

9.1.1 This CAAP contains extracts from certain copyright documents of RTCA. Use of these extracts is made with the written permission of RTCA.

9.1.2 The complete RTCA documents may be purchased from RTCA, using the following contact information:

RTCA
1150 18th NW
Suite 910
Washington D.C. 20036
Ph. 202-833-9339
Fax 202-833-9434
www.rtca.org

9.1.3 The paragraph references and the extract descriptions are as follows:

- Design Considerations - RTCA DO268 - 'Concept of Operations - Night Vision Imaging System for Civil Operators' - 2.1- Design Considerations, Page 34.
- Compatible - RTCA DO295 - 'Civil Operators Training Guidelines for Integrated Night Vision Imaging System Equipment' - 2.2 - Compatible, Page 34.
- Instrument Lighting Brightness Considerations - RTCA DO268 'Concept of Operations - Night Vision Imaging System for Civil Operators' 2.3 Page 35.

Appendix A

Further advice to CAO 82.6

Appendix A contains further advice to CAO 82.6. The numbering of the schedules, appendices and clauses in this appendix align with the numbering in the CAO and should be read as such.

Further advice to CAO 82.6 - Night vision imaging system - helicopters

PART 1 – Preliminary matters

1. Definitions

1.1 In accordance with the requirements promulgated in CAO 82.6 and set out at the beginning of this CAAP.

PART 2 – Directions and exemptions

2. Direction – instruments and equipment

2.1 In accordance with the requirements promulgated in CAO 82.6.

3. Direction – operations manual

3.1 In accordance with the requirements promulgated in CAO 82.6.

3.2 CAO 82.6 provides the directions to operators of the matters that are to be included in the operations manual, including equipment standards, ongoing maintenance requirements, operating procedures and flight crew capability. Operators are at liberty to include additional items or more detail, in regard to their specific specialised NVIS operations or training.

3.3 Operators who are exempt from CAO 48 via a Fatigue Risk Management System (FRMS) should amend this system to include aspects relevant to NVIS operations.

3.4 'Further advice to Appendix 2 of CAO 82.6' of this CAAP (page 28) contains a list of suggested items which build upon the requirements of CAO 82.6 that an operator should address.

4. Specified operators– provision of a training and checking organisation (TCO) or a Part 142 Operator

4.1 High levels of NVIS proficiency, along with a well-balanced NVIS experience base, will assist in off-setting many of the visual performance degradations associated with night operations. NVIS experience is a result of proper training coupled with numerous NVIS operations. An experienced NVIS crew member is acutely aware of the NVIS operational envelope and its correlation to various operational effects, visual illusions and performance limitations.

4.2 This experience base is gained and maintained over time through a continual, holistic NVIS training programme which exposes the crews to NVIS operations conducted under various moon angles, percentage of available illumination, contrast levels, visibility levels, and varying degrees of cloud coverage. A crew member should be exposed to as many of these variations as practical during the initial NVIS qualification programme. Continued exposure during the NVIS recurrent training enhances the experience base.

4.3 Consequently a robust training and checking programme should cater for the broad cross-section of operating exigencies. To ensure NVIS pilots and aircrew members currency

and competency is maintained CAO 82.6 requires a NVIS operator to provide for one of the following:

a. a CAR 217 Training and Checking Organisation (TCO) (this option provides for pilot and aircrew member training and checking); or
b. a Part 142 operator (this option provides for pilot training and checking only); or
c. an old NVG training provider (this option provides for pilots and aircrew member training and checking).

4.4 The determination of recency for NVIS operational sequences such as winching, hover exit, etc, will also need to be considered and incorporated as part of the ongoing training and checking requirements.

4.5 Nothing prohibits the operator placing additional requirements and increasing the minimum checking cycles in line with their particular operation or safety and risk management systems. Indeed, CASA actively encourages operators to consider this in their operations – particularly during the start-up phases of NVIS operations, or where the organisation has little or no experience with the technology.

5. Direction – operations manual

5.1 In accordance with the requirements promulgated in CAO 82.6.

6. Exemption – minimum height for VFR flights at night

6.1 In accordance with the requirements promulgated in CAO 82.6.

6.2 CAO 82.6 makes provision for flight below the minimum altitudes detailed in subregulation 174B (1) of the CAR 1988, but only if operationally necessary. The exemption from compliance with this subregulation does not exempt operators from the requirements of regulation 157 of the CAR - Low Flying.

6.3 The operations manual should establish the conditions, situations and associated procedures for when NVIS operations below the lowest safe altitude (LSALT) may be carried out. Such low flight should be kept to the minimum and limited to manoeuvring that is operationally necessary in the vicinity of the intended landing or area for the operation.

7. Exemption – navigation lights

7.1 In accordance with the requirements promulgated in CAO 82.6.

PART 3 –AOC holders, Part 141 and Part 142 operators

8. AOC Condition and Part 141 Operator direction

8.1 In accordance with the requirements promulgated in CAO 82.6.

9. Conditions for use of NVIS by an AOC holder, a Part 141 operator or a Part 142 operator

9.1 In accordance with the requirements promulgated in CAO 82.6.

Further Advice to Appendix 1 of CAO 82.6 – Use NVIS

1. Restricted use of NVIS

1.1 In accordance with the requirements promulgated in CAO 82.6.

2. Approval to use NVIS

2.1 In accordance with the requirements promulgated in CAO 82.6.

2.2 CASA may issue an approval subject to conditions that are necessary in the interest of safety.

2.3 Operators who are commencing initial NVIS operations with key personnel who have limited NVIS experience (i.e. no experience as they are a first time NVIS operator, or who have a chief pilot (CP) with a newly gained NVIS rating, may not appropriately satisfy the requirements of subparagraph 28 (1)(b)(iv) of the Civil Aviation Act (CAA) 1988.

2.4 CASA and industry acknowledge there is a training and experience gap between the basic NVIS rating and an operator's line qualified NVIS pilot. CASA believes the risk is further heightened in circumstances where, in addition to the operator's pilots, the operator themselves and/or the CP of such an operation has limited NVIS experience.

2.5 CASA will identify those operators to whom the above circumstances apply. The identified operators will have three options to satisfactorily mitigate the risk relating to general NVIS inexperience. They are:

a. The operator employs or contracts an experienced NVIS senior pilot, who is assessed by CASA as suitable to carry out NVIS supervision and training duties and reports to the CP on operational safety matters in relation to the operator's NVIS operations. (The intention of the CAO provision is to provide the operator with a reasonable degree of flexibility in the appointment of the NVIS senior pilot. However, the NVIS senior pilot should have considerable NVIS experience).

Note: If this person is a contract employee the operator will be required to demonstrate to CASA that they will be available to their operation via a service level agreement that outlines this availability.

b. The CP is to receive additional training (by an approved and suitably experienced NVIS training organisation) in line with that required in the operator's operations manual to ensure the CP is at a minimum standard for NVIS line flying and checking, in all of the NVIS related authorisations provided for in the operator's AOC.

c. The operator is to submit an alternate course of action acceptable to CASA that provides an equivalent level of safety and risk mitigation to those detailed above in paragraphs a and b. However CASA will only accept such an alternative if it meets the criteria specified in section 28(1) (b) (iv) of the CAA 1988.

2.6 It is envisaged any one of the above courses of action should effectively ensure an operator's CP is able to carry out his or her responsibilities in regard to the conduct of the

operator's NVIS operations; and may legitimately oversight or conduct the required training/checking to bring the remainder of the NVIS pilots to a competent line flying standard. Such a course of action is also consistent with the revised CASA/industry approach towards bridging the experience and training gap between a basic NVIS rating and being checked to line for NVIS operations."

Note: The NVIS Senior Pilot will be assessed to a CP level in relation to the NVIS element of the operation.

3. Suspension or revocation of approval

3.1 In accordance with the requirements promulgated in CAO 82.6.

4. Reserved

5. NVIS operations

5.1 In accordance with the requirements promulgated in CAO 82.6.

5.2 Logging of NVIS flight time. Regulation 61.080 of the CASR provides a definition of Flight Time which is applicable to pilots. A NVIS pilot or aircrew members flight time should be recorded in the individual's logbook under a discreet NVIS column. Only flight time conducted when 'goggled-up' is to be recorded as NVIS flight time.

5.3 Special Fire Endorsement. Pilots who are required to conduct aerial fire fighting incendiary dropping or aerial fire fighting support involving fire mapping are required to hold an NVIS Special Fire Endorsement in addition to their CASR Part 61 NVIS Rating. Subsection 16 of Appendix 3 of CAO 82.6 provides the pilot qualification framework for a NVIS Special Fire Endorsement.

6. NVIS aircrew member – training

6.1 In accordance with the requirements promulgated in CAO 82.6.

7. NVIS Aircrew member - Pre-requisites for training

7.1 In accordance with the requirements promulgated in CAO 82.6.

8. Reserved

9. NVIS Aircrew member - endorsements

9.1 In accordance with the requirements promulgated in CAO 82.6.

9.2 Log book entries for aircrew members must specify NVIS aircrew member or NVIS aircrew member instructor as relevant.

10. NVIS aircrew members - Endorsements based on recognition of training and experience

10.1 In accordance with the requirements promulgated in CAO 82.6.

11. Requirements before commencing an NVIS operation

11.1 In accordance with the requirements promulgated in CAO 82.6.

11.2 Post-rating requirement for first time use of NVIS

11.2.1 Subregulation 61.1000 (1) of CASR requires the holder of a NVIS rating using NVIS for the first time in a helicopter for which he or she holds a type endorsement to complete an operator proficiency check, in the helicopter before commencing operational use of it.

11.2.2 CAO 82.6 requires the holder of a NVIS rating using NVIS for the first time in a helicopter for which he or she holds a type endorsement to complete NVIS proficiency check within the preceding 4 weeks.

11.2.3 Paragraph 61.1015 (2) (c) of CASR allows an OPC to satisfy a NPC providing it is conducted by a flight examiner who holds a NVIS flight test endorsement.

12. NVIS aircrew members - Competency, recency and NVIS capability check flight (CCF) capability

12.1 In accordance with the requirements promulgated in CAO 82.6.

13. NVIS aircrew members – NVIS capability check flights

13.1 In accordance with the requirements promulgated in CAO 82.6.

14. NVIS aircrew members – flight testing

14.1 In accordance with the requirements promulgated in CAO 82.6.

Further Advice to Appendix 2 of CAO 82.6 – Directions under sub-regulation 215 (3) of the CAR 1988 about the information, procedures and instructions in an operator's operations manual

Part 1 – Preliminary

1. Scope and structure

1.1 In accordance with the requirements promulgated in the CAO 82.6.

2. Directions apply

2.1 In accordance with the requirements promulgated in the CAO 82.6.

Part 2 – Directions about information to be contained in an operations manual for NVIS operations

3. Operations manual

3.1 In accordance with the requirements promulgated in the CAO 82.6.

4. Operations manual directions

4.1 In accordance with the requirements promulgated in the CAO 82.6.

4.2 Additional information that may assist operators in meeting the CAR 215 direction contained in CAO 82.6 is set out below. Operators may choose to develop their own procedures which provide for an equivalent standard. (This does not absolve operators from the requirements of CAO 82.6) Guidance about human factors and physiological limitations are set out in appendix C of this CAAP.

Note: The numbering below does not correspond with CAO 82.6.

1. Night Vision Imaging System (NVIS) Goggle and De-goggle Procedures

1.1 Airborne

1.1.1 The aircraft is to be at a safe height (generally above 500 ft AGL) prior to conducting the procedure. The procedure is to be initiated by the PIC. The PIC will commence by announcing the aircraft parameters (altitude, heading and airspeed). The PIC will then announce 'crew goggle-up' or 'crew de-goggle' as required. At any time only one member of the crew is to be conducting the procedure, as directed by the PIC. Upon completing the procedure each crew member will announce their crew position and the term 'goggled-up' or 'de-goggled' as required. This statement will be the executive command for the next crew member to commence the procedure. The aircraft parameters are to remain unchanged until all crew members have completed the procedure.

1.2 On the Ground

1.2.1 A ground (i.e. not in the hover) 'goggle-up' and 'de-goggle' point is to be briefed prior to the flight. The aircraft must be stationary for the conduct of the procedure. The procedure will be as that for airborne, after the PIC announces 'crew goggle-up' or 'crew de-goggle'.

1.2.2 CASA recommends operators avoid landing or taking off on trolleys whilst ‘goggled-up’.

2. Emergency Situations

2.1 NVIS generally improve situational awareness and facilitate the crew's workload during emergencies. Should an emergency arise requiring an immediate landing, NVIS may provide the crew with a means of locating a suitable landing area to carry out a safe landing. The operator and the pilot-in-command should determine if the use of NVIS during certain emergency situations is appropriate. In some situations, it may be advantageous for the crew members to remove the NVG during the performance of an emergency procedure. In any event, such detail should be included in the operator's operations manual.

2.1 Loss of Visual Reference During NVIS Take-off and Landing

2.1.1 Emergency procedures for loss of visual reference (brownout/whiteout) are to be published in the operator's operations manual. The procedures should involve a restricted visibility vertical instrument takeoff and transition to forward flight, known as a Restricted Instrument Flight Take-off (RIFTO).

2.1.2 The procedures are to be designed to minimise the chance of the helicopter striking obstacles when visibility is inadvertently lost on departure or arrival to an unsealed helicopter landing area. If either of the crew members in the cockpit loses visual reference they are to call 'RIFTO'. The flying pilot shall then conduct the procedure with the non-flying crew member providing regular/cyclical advice regarding:

- Aircraft attitude;
- Aircraft rate of climb;
- Aircraft power;
- When external visual reference is regained; and
- Aircraft position ref the ground and/or obstacles.

2.1.3 When the non-flying crew member calls 'visual' the flying pilot is to look up and regain visual reference before transitioning to forward flight. Prior to operations being conducted to/from an unsealed helicopter landing site the PIC is to ensure aircraft performance that will allow a positive vertical rate of climb, sufficient to expeditiously climb away from any obstacles, to be maintained in the event of the RIFTO procedure being utilised. The RIFTO procedure shall be reviewed by aircrew prior to each NVIS flight when the aircraft will be operated to or from un-sealed landing areas.

2.2 Inadvertent IMC

2.2.1 Despite careful preparation, the potential for inadvertent IMC penetration may exist. It is important that crews are able to recognise subtle changes to the NVG image that occur prior to entry into instrument meteorological conditions (IMC). These include:

- Onset of scintillation;

- Loss of scene detail; and
- Changes in the appearance of halo.

2.2.2 The decision to delay taking avoiding action in deteriorating conditions may reduce safety margins, particularly if at lower altitudes.

3. Risk Assessment

3.1 Operators considering NVIS operations and/or associated training are required under CAO 82.6 to carry out a risk assessment prior to the commencement of operations or training with these devices. This risk assessment will include identifying those risks with reasonable foreseeability that require treatment and this information is to be collated in a risk register accessible to all crew. Flight crews should also endeavour to identify the hazards that are most likely to occur during the specific circumstances of the forthcoming flying task/s, and to establish whether current mitigators are adequate. If an operation falls outside of the operators documented risk profile, the operator should provide guidance for the crew to further manage the risk.

3.2 For example the operator may require the operating crew to discuss the situation, consider further control measures, and seek further advice from the Chief Pilot and/or Operator Management. The crew may also consider cancelling a flight if the pilot/s considers the risk of continuing is too great.

3.3 Operators need to ensure that all hazards identified during a risk assessment are driven down in accordance with ALARP (As Low As Reasonably Practicable). This involves ensuring that the risk is reduced as far as possible, stopping only when the cost of obtaining any further benefit is excessive when compared to the resulting benefits.

3.4 There are numerous sources providing risk assessment process and models to assist in carrying out an assessment. The following resources may be of assistance:

- Australian / New Zealand Standard, Risk management -Principles and Guidelines AS/NZS ISO 31000:2009;
- CASA - Safety management system resource kit.

4. Overwater Operations

4.1 Overwater operations to small offshore islands, ships, decks or offshore platforms are most likely to be conducted in a low contrast environment, which is generally not conducive to the use of NVIS. The suitability of NVIS use for these overwater operations, particularly those below 500 ft above the surface, should not be carried out unless all aspects have been carefully considered and detailed procedures included in the operations manual. If contemplating such operations, the following additional issues should be included for consideration, but not limited to:

- Sea state and wind velocity/direction;
- The ability of the crew to maintain continuous visual contact using NVIS with land or a shoreline, including any illumination levels and potential hover references;
- Any specific training and checking requirements above that required for overland NVIS operations;

- If there is sufficient water surface disturbance and/or surface objects, which may provide adequate visual surface contrast to ensure continuous and sufficient visual cues to maintain depth perception, which may assist the crew in maintaining an accurate and safe height;
- Whether the crew are trained for, and use, a height hold function coupled to a serviceable autopilot/stabilisation equipment; and
- Whether the crew are trained for and use an automatic auto hover function coupled to serviceable autopilot/stabilisation equipment.

5. Flight Planning and Flight Conduct

5.1 Flight Planning and Flight Conduct General

5.1.1 General – This section provides additional information and guidance on planning issues that should be considered.

5.1.2 Departure/Enroute/Destination Weather - The latest terminal and area forecasts should be obtained and analysed with particular emphasis on temperature/dew point spread, cloud cover and visibility, sunset, civil and nautical twilight, moon phase, moonrise and moonset, and moon and/or lux illumination levels for all phases of flight.

5.1.3 Illumination Criteria - The operator should establish minimum illumination criteria and provide a means for determining illumination levels in the operating area. Clear starlight may provide sufficient light for some operations.

5.1.4 Night VFR/IFR - NVIS are intended for use in visual meteorological conditions (VMC), as an adjunct to visual flight at night. It is intended that the flight crew in an IFR category flight may derive an operational advantage from NVIS use under the IFR when conducting a landing (after descending from IFR LSALT) or take-off (with the intent of climbing to the IFR LSALT) in accordance with the requirements detailed in the AIP. All other NVIS operations below LSALT should be NVFR category. The operations manual procedures should be sufficiently robust to ensure that there is a clear delineation between flight under the IFR and the NVFR operations using NVIS.

5.1.5 NVIS - should be confirmed serviceable and adjusted in accordance with the manufacturers requirements. Documentation required by the NVIS manufacturer is to be maintained by the operator.

5.1.6 Aircraft - A pre-flight inspection should be conducted prior to an NVIS flight with emphasis on proper operation of the aircraft and associated equipment lighting. The aircraft windshield should also be clean and free of major defects, which might degrade NVIS performance.

5.1.8 Instrument Functional Checks - Aircraft instrument functional checks are to be carried out prior to NVIS flight being conducted. Details of these checks should be specified in the Operations Manual.

5.1.9 Route Planning - The operator and crew should assess factors that will affect the NVIS operation. A thorough route study of terrain, obstacle clearance, surface contrast, illumination levels, and reflectivity should be considered, as well as a review of applicable Notice to Airmen (NOTAM).

5.1.10 Low Level Planning Considerations - Operators should be aware of the safety advantages of providing guidelines in relation to the reduction of airspeed commensurate with decreasing altitude. (i.e. 'the lower you go the slower you go')

5.1.11 Obstacles/Power Lines - Although night operations under VFR conditions may be flown unaided, use of NVIS should enhance the crew's ability to see and avoid obstacles, and other aircraft. While natural obstacles such as hills and mountains can be seen through NVG, some man-made obstacles such as towers can be difficult to acquire.

5.1.12 Power lines and wires can be extremely difficult to acquire visually until very close, and usually with insufficient time to take avoiding action. However, similar to day operations, visually acquiring the poles or pylons provides a cue that lines and wires are likely to be strung between the poles/pylons which may present a hazard to flight.

5.1.13 Pre–flight Risk Assessment - In addition to risk assessment requirements placed on an operator relating to the consideration of the NVIS operations, a risk assessment should be undertaken by the crew prior to each NVIS operation. The risk assessment should include as a minimum:

- Illumination level;
- Weather;
- Crew recency and experience;
- Operator experience with NVIS operations;
- Crew vision;
- Crew general wellbeing (fitness to fly);
- Windshield/window condition;
- NVIS performance;
- NVIS battery condition;
- Types of operations allowed and to be undertaken;
- External lighting environment;
- Assessment of task duration and consideration given to reasonable alertness assured by the prior sleep wake rule; and

Appendix E of this CAAP is a suggested briefing checklist that incorporates the above issues.

5.2 Departure

5.2.1 Airspace - NVIS operations do not change the requirement to comply with applicable airspace requirements. Operators should include in the operations manual procedures for advising air traffic services (ATS) that NVIS operations are to be undertaken irrespective of any other requirements.

5.2.2 Other Agencies - Operators should include in their operations manual, procedures for the use of NVIS when operating with other agencies that may have little understanding of NVIS and their limitations. This may include the extent of the use of bright and flashing lights which may degrade the NVIS image when aircraft using NVIS are in close vicinity. Such procedures may differ to a degree from unaided operations and could require additional training of and communication with other agencies.

5.2.3 Helicopter Landing Site (HLS) and Unlit/Unprepared HLS Considerations –
A Secondary HLS (as described in CAAP 92-2(2)) or aerodrome can be used either with or

without NVIS. They are usually adequately illuminated as well as the obstacles in the approach/departure paths.

Operations on or in the near vicinity of a lit HLS-NVIS standard, may be conducted with NVIS. There definitions provides that a HLS-NVIS standard does not have to meet the lighting or windsock requirements of CAAP 92-2(2) for a secondary HLS. Extra care should be given to locating any obstacles during approach or departure.

An unlit/unprepared HLS that does not meet the requirements of a Secondary HLS as described in CAAP 92-2(2) is defined as a NVIS basic HLS (see Definitions of this CAAP), and requires that extra care be given to locating any obstacles that may be in the approach/departure path. Consideration should also be given to employing additional personnel to scan the sides and rear areas of the helicopter due to limited field of view (FOV) and field of regard (FOR).

5.3 En-route

5.3.1 Elevated Terrain - Safety should be enhanced by NVIS during operations near elevated terrain at night. The obscuration of elevated terrain is more easily detected with NVIS thereby allowing the crew to make alternate flight path decisions.

5.4 Arrival

5.4.1 Aerodrome and Heliport Landings - Usually there is sufficient light at an aerodrome so NVIS operations are not required. However, NVIS may be used depending on several variables: brightness level of the runway lights; width of the runway; presence of threshold lights; and proximity of brightly illuminated hangers. Whether or not to use NVIS for aerodrome or lit HLS operations depends on the effect of these variables and the affect on the quality of the image viewed through the NVG.

5.4.2 Reconnaissance and Landing at HLS - The reconnaissance phase should involve crew-coordinated use of NVIS and white lights, or an infra-red searchlight if fitted. The aircraft external white lights such as landing lights, searchlights, floodlights and infra-red searchlights, should be used during this phase of flight in accordance with the operator's procedures. The crew should select and evaluate approach and departure paths to the site considering wind velocity and direction, and obstacles or indications of obstacles. An approach without use of white light landing/searchlight or infrared searchlights may be undertaken in accordance with the operator's procedures and following crew assessment of the environmental and other operational conditions.

5.4.3 Sources of High Illumination - Sources of direct high illumination have the potential to reduce the effectiveness of the NVIS. In addition, certain colour lights, such as red, will appear brighter, closer and may display large halos.

Further Advice to Appendix 3 of CAO 82.6 –NVIS Equipment and operations, certain NVIS qualifications and training, and special fire endorsements

PART 1 – Scope and structure

1. Matters to be complied with

In accordance with the requirements promulgated in Civil Aviation Order (CAO) 82.6.

PART 2 – Minimum equipment and aircraft standards for NVIS operations

2. Aircraft lighting standards

In accordance with the requirements promulgated in Civil Aviation Order (CAO) 82.6.

2.1 Design Considerations

2.1.1 As the choice of NVG filter drives the cockpit lighting design, it is important to know which goggle will be used in which cockpit. Since the filter in a Class A NVG allows wavelengths above 625 nanometres into the intensification process, it should not be used in a cockpit designed for Class B or Modified Class B NVGs. However, since the filter in Class B and Modified Class B NVGs is more restrictive than that in a Class A NVG, the Class B or Modified Class B NVG can be used with either Class A or Class B cockpit lighting designs.

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2.2 Compatibility

2.2.1 Compatibility, with respect to a night vision imaging system (NVIS), includes a number of different factors:

2.2.2 Compatibility of internal and external lighting with the NVIS, compatibility of the NVG with the crew station design (e.g. proximity of the canopy or windows, proximity of overhead panels, operability of controls, etc.), compatibility of crew equipment with NVIS and compatibility with respect to colour discrimination and identification (e.g. caution and warning lights still maintain amber and red colours).

2.2.3 The purpose of this paragraph is to discuss compatibility with respect to aircraft lighting. An NVIS lighting system, internal and external, is considered compatible if it adheres to the following requirements:

- The internal and external lighting does not adversely affect the operation of the NVG during any phase of the NVIS operation;
- The internal lighting provides adequate illumination of aircraft cockpit instruments, displays and controls for unaided operations and for 'look-under' viewing during aided operations;
- The external lighting aids in the detection and separation by other aircraft; and

- NVIS lighting compatibility can be achieved in a variety of ways that can include, but is not limited to, modification of light sources, light filters or by virtue of location. Once aircraft lighting is modified for using NVGs, it is important to keep in mind that changes in the crew station (e.g. addition of new display) must be assessed relative to the effect on NVIS compatibility.

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2.3 Instrument lighting brightness considerations

2.3.1 When viewing the NVG image, the brightness of the image will affect the amount of time taken to adapt to the brightness level of the instrument lighting, thereby affecting the time taken to interpret information provided by the instruments. For example, if the instrument lighting is a reasonably bright level, the time taken to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a low level, several seconds may be required to interpret information, thus increasing the head down time and increasing the risk of spatial disorientation.

2.3.2 It is important to ensure that instrument lighting is kept at a brightness level that makes it easy to rapidly interpret information. This will likely be a brighter level than that used during normal unaided night operations.

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2.4 External lighting provisions

2.4.1 The design and location of the lighting components shall optimize visual performance and minimize adverse effects on NVIS performance. The components shall not cause objectionable direct or indirect glare and/or reflections, which interfere with the operators aided or unaided vision.

2.4.2 Position Lights, Anti-collision lights and other exterior lighting may have adverse effects on NVIS utilisation. Exterior lighting may cause energy to enter the cockpit and adversely affect NVIS performance. For example: position lights located near the cockpit, anti-collision light reflections possible from the main rotor blades, reflections off cloud or dust etc may interfere with NVIS performance in the cockpit. Operators should have a thorough understanding as to how the aircraft exterior lighting may be properly modified in accordance with engineering requirements to maximise NVIS performance. Proper instruction on how to use the exterior lighting and methods of shielding/blinking exterior lighting to reduce the adverse effects may vary with individual aircraft type.

3. NVIS equipment

3.1 In accordance with the requirements promulgated in CAO 82.6.

3.2 See also 'Performance Standards for Night Vision Imaging Systems' in Appendix F of this CAAP.

3A Maintenance of NVG and other equipment

3A.1 NVG are equipment not components. However, their maintenance to the highest standards is critical to safety. In CASAs view, therefore, the requirements for successful

operation as regulation 30 of CAR 1988, organisation holding a certificate of approval to carry out maintenance of aircraft or components provide a template against which to measure the suitability of an NVIS maintainer.

3.A.2 To this end, Appendix 3 of CAO 82.6 provides that maintenance of NVIS must be carried out by an organisation that complies with regulation 30 of CAR 1988 or Part 145 of CASR as if the regulation applied to the organisation for the maintenance of NVIS and its related equipment.

3.A.3 It is also necessary that the organisation is endorsed by the original equipment manufacturer (OEM) of the NVIS as an appropriate organisation to carry out maintenance on the NVIS.

3B Helicopter mounting device for incendiary dropping using NVIS

3B.1 In accordance with the requirements promulgated in CAO 82.6.

4. Minimum equipment for NVIS aircraft in NVIS operations

In accordance with the requirements promulgated in CAO 82.6.

4.1 Airborne weather or ground mapping radar systems

4.1.1 The use of airborne weather or ground mapping radar systems can enhance navigation and the operational effectiveness and safety advantages of NVIS. CASA recommends the use of airborne radar systems where available to augment effective NVIS operations by the early detection of environmental hazards relevant to safe NVIS operations.

4.2 Radio altimeter

4.2.1 CASA recommends that the type of Radio Altimeter display used incorporate radio altimeter information on a scale so that it is visually related to the ground position.

4.3 Spare goggles

4.3.1 CASA recommends the carriage of accessible spare NVG units in aircraft for NVIS operations wherever possible.

4.4 NVG battery usage plan

4.4.1 Operators should provide batteries and a battery usage system in accordance with manufacturer's requirements.

4.4.2 The Australian Defence Force and many civilian operators have battery usage systems that ensures a fully charged set of NVG batteries are available in the primary and secondary battery compartments of each crew member's individual battery packs.

PART 3 – Operational limitations for NVIS operations

5. Minimum altitude for NVIS operations

In accordance with the requirements promulgated in CAO 82.6.

The exemption from compliance with subregulation 174B (1) of CAR 1988 contained in CAO 82.6, does not exempt operators from the requirements of regulation 157 of the Civil Aviation Regulations in relation to low flying.

6. Helicopter Landing Site (HLS) – NVIS basic and HLS – NVIS standard operations

6.1 CAAP 92-2(2) describes HLS (Basic HLS and Secondary HLS) that are suitable for helicopter operations day and night. The use of NVIS will allow pilots to use a HLS at night that meet the requirements of a Basic HLS or allow them to operate to a Secondary HLS with reduced requirements in relation to lighting and wind direction indicators. CAO 82.6 has defined the term NVIS basic HLS and HLS–NVIS standard to recognise NVIS operations. (refer to the Definitions section of this CAAP).

7. Carriage of persons

7.1 In accordance with the requirements promulgated in CAO 82.6.

7.2 CAO 82.6 allows the carriage of persons who are not aircrew members but are persons whose presence is essential to the success or completion of the operation. This may include police, fire fighting, rescue or medical personnel, patients with supporting relatives, marine pilots in transfer, and persons who are apprehended, evacuated, rescued or being transported as an integral part of the operation. These persons are not required to be NVIS trained when they are not participating as members of the operating crew.

7.3 CAO 82.6 allows approved operators to carry a passenger on an NVIS flight for the purposes of demonstrating NVIS technology. In applying to become an approved operator for such a purpose CASA would expect the operator to have prepared a safety case. If accepted by CASA the safety case procedures, based on risk mitigation for a NVIS Demonstration flight should be promulgated as an operations manual amendment for inclusion in the operator's operations manual.

7.4 In addition, before the flight, the NVIS operator must give CASA written notification of the intent and conduct of the flight. Prior to conducting the flight, the operator must receive from CASA written acknowledgement of those details.

Note: Subparagrph (7) (g) (ii) of Appendix 3 of CAO 82.6 requires the passenger to read and aircraft placard describing the risks associated with the flight and sign a statement titled "Acknowledgement of risks of NVIS demonstration flight", acknowledging that he or she has read the placard. CASA is reviewing this provision relating to the placard only and operators who cannot comply with the placard provision should contact their oversighting Regional Office.

7.5 To be acceptable to CASA an operations manual would need to be based on the safety case made to obtain the NVIS approval that encompassed such operations.

7.6 The operations manual should make it clear that carriage of such passengers was solely for demonstration purposes and could not be combined with any other operation.

7.7 The operations manual should indicate that when planning an NVIS demonstration flight the original safety case procedures and conditions should be followed and CASA notified of the passengers and the flight plan.

7.8 The safety case, and the operations manual, would be expected to address, and indicate adherence to, the following minimum procedures and safety limitations:

1. The NVIS demonstration flight must be conducted by 2 qualified NVIS crew members.
2. The pilot in command of the NVIS demonstration flight must be the operator's chief pilot (if NVIS qualified) or the NVIS senior pilot.
3. The NVIS demonstration flight may only be conducted in a helicopter, with equipment and with a crew:
    a. which complies with the requirements of CAO 82.6; and
    b. who each comply with all applicable Rating, competency, recency and operational flight requirements of CAO 82.6 and Part 61 as applicable.
4. The flight must be for the exclusive purpose of carrying passengers to observe an NVIS demonstration flight.
5. The NVIS demonstration flight must be conducted at, or above, 500 feet above the highest obstacle, except for the take-off and landing.
6. Except for emergencies, each take-off and landing for an NVIS demonstration flight must be at a helicopter landing site that has been reconnoitred, and operated to, by the pilot in command during full daylight within seven days prior to the intended flight.
7. The operator must ensure that passengers are informed that there are risks associated with NVIS operations (for example flight below LSALT at night) and that passengers sign a statement acknowledging that have been briefed on the risks of the flight and that they accept those risks by signing a statement acknowledging that they have received a brief and intend to continue with the flight.

Note: The operator should retain the signed statement for at least 12 months and, during that period, provide a copy to CASA upon written request.

8. Each passenger on an NVIS demonstration flight must be given a comprehensive passenger emergency briefing in accordance with requirements contained in the operator's operations manual.
9. No operations outside of autorotative distance from land must be carried out unless all passengers have undergone Helicopter Underwater Escape Training.
10. No more than 2 passengers must be carried at any time.

8. Minimum crewing for NVIS operations

8.1 In accordance with the requirements promulgated in CAO 82.6.

8.2 The intent of the requirement for the second crew member is to ensure that NVIS scan sectors are maximised during flight to unlit or unprepared HLS, and to ensure a second set of trained NVIS eyes in the unlikely circumstance of goggle failure close to terrain, or loss of NVIS visual reference due to brown out, white out, etc. The second crew member should, in accordance with procedures detailed in the Operations Manual, assist the pilot-in-command (PIC) as required for obstacle clearance, rates of descent, attitudes, power settings, etc.

8.3 The primary role of the NVIS aircrew member should be to assist the pilot with his cockpit duties, given the increased workload and physical constraints of flying a helicopter using NVIS. An NVIS aircrew members should be trained, and tasked so as to provide assistance to the pilot-in-command in at least the following areas:

- NVIS scan, lookout and obstacle reporting;
- Normal and emergency cockpit administration;
- Monitoring of instruments during flight;
- Navigation;

- Radio communications; and
- Interpretation of instrument flight rules (IFR) departure and approach procedure charts.

Notes:

1. Operators who use NVIS aircrew members to conduct cockpit duties during a flight must also comply with CASA Instrument 132/16 – Helicopter aircrew member – authorisation, exemption and directions.
2. CASA recommends aircrew members hold at least a Radio Operator Licence and a Class 2 medical.

8.4 An operator wishing to operate below 1000 ft AGL without a second NVIS crew member (ie single person/pilot NVIS flight) must submit in writing to CASA a safety case for CASA to accept. If accepted by CASA the safety case procedures, based on risk mitigation, for NVIS flight below 1000 ft AGL shall be promulgated as an operations manual amendment for inclusion in the operator's operations manual. In any case, CASA will not consider procedures for NVIS flight below 500 ft AGL without a second NVIS crew member. In assessing a safety case for NVIS operations below 1000 ft AGL without a second NVIS crew member CASA may take into consideration the following:

- The specific location/routes;
- The location/routes must be surveyed for obstacles by day;
- The location/routes, boundary and obstacles must be marked, mapped and included in the ops manual;
- The aircraft must be equipped with a serviceable 'Nitesun'; and/or
- Before operating in the surveyed area by night the crew must brief on the specific location operations manual requirements.

9. Minimum crewing for NVIS aircrew member training operations

In accordance with the requirements promulgated in CAO 82.6

10. NVIS flight planning for weather minima, alternate aerodromes and fuel requirements

In accordance with the requirements promulgated in CAO 82.6.

10.1 An operator shall carry appropriate fuel reserves in accordance with their night vision flight rules (NVFR) and instrument flight rules (IFR) (as applicable) fuel policy contained in their operations manual.

10.2 An operator may apply for the standard reduced flight planning weather minima (refer paragraph 10.3 and 10.4 below). Or alternatively, an operator may apply for tailored reduced flight planning minima based on specific operational requirements. In all cases, a reduction in flight planning weather minima will be considered when an operator submits in writing to CASA a safety case, based on risk mitigation, for CASA to accept. If accepted by CASA, the safety case procedures for reduced flight planning weather minima shall be promulgated as an operations manual amendment for inclusion in the operator's operations manual.

10.3 The standard reduced flight planning minima for NVFR capable aircraft and qualified crews operating on NVIS will be to have the cloud weather minima altered to the following:

Cloud: No cloud permitted up to 2000 ft AGL within a 2 nm corridor either side of track.

10.4 The standard reduced flight planning weather minima for IFR capable aircraft and qualified crews operating on NVIS under the NVFR will be to have the cloud weather minima altered to the following:

> **Cloud:** No cloud permitted up to 1000 ft above ground level (AGL) within a 2 nm corridor either side of track.

Notes:

1. CASA interprets the above 2 nm corridor requirement as meaning: that for the purposes of flight planning an area forecast will have no more than SCT cloud in the forecast below the 2000 ft AGL corridor level.
2. An IFR capable aircraft and crew is defined as being an aircraft equipped for the IFR and operated with an IFR crew who are qualified and recent for IFR operations.

10.5 In assessing an application for reduced flight planning weather minima CASA may take into consideration the following:

- The type of operation;
- The operators experience;
- The operators geographical constraints;
- The number of spare goggles accessible to the flying pilot;
- Carriage of a 'Nitesun';
- Two goggled up NVIS qualified crew in the front of the aircraft during the entire flight,
- Minimum pilot NVIS experience increased for the pilot-in-command (PIC);
- Increased instrument proficiency or training;
- Carriage of un-aided lighting capabilities such as external lighting sources;
- Specific route requirements in terms of terrain or clear areas for precautionary landings;
- Presence of cultural lighting over area; and/or
- Familiarity with route or area of operations.

11. Visibility

In accordance with the requirements promulgated in CAO 82.6.

11.1 Due to the light sensitivity of NVG, lights can be seen over great distances and through obscuration, therefore in-flight visibility is not to be judged by how far a light source can be seen, but rather how far the terrain is clearly visible.

11.2 NVIS visibility is also significantly affected by illumination levels and not just environmental obscuration such as smoke and moisture, thus illumination (and shadow areas) shall be considered with regard to in-flight visibility.

11.3 Flight into deteriorating weather/visibility can be recognised as a reduction in visual acuity with NVIS. This effect is also described as 'NVG Video Noise' and usually indicates the presence of obscurants in the atmosphere.

12. Close proximity flights

In accordance with the requirements promulgated in CAO 82.6.

PART 4 – Recognised NVIS qualifications for NVIS operations (paragraphs 13 – 18 of CAO 82.6)

In accordance with the requirements promulgated in CAO 82.6.

13. Chief Pilot or head of operations

In accordance with the requirements promulgated in CAO 82.6.

13A Senior NVIS pilot

In accordance with the requirements promulgated in CAO 82.6.

14. Reserved

15. Reserved

16. NVIS Pilot – special fire endorsement

In accordance with the requirements promulgated in CAO 82.6.

Pilots who are required to conduct aerial fire fighting incendiary dropping or aerial fire fighting support involving fire mapping are required to hold an NVIS Special Fire Endorsement (SFE) in addition to their CASR Part 61 NVIS Rating.

The qualification framework for the NVIS SFE is contained within Subsection 16 of Appendix 3 of CAO 82.6.

17. Operators obligation to maintain NVIS pilot competency and proficiency

In accordance with the requirements promulgated in CAO 82.6.

18. Aircrew members and aircrew member instructors

In accordance with the requirements promulgated in CAO 82.6.

Note: Operators who use NVIS aircrew members to conduct cockpit duties during a flight must also comply with CASA Instrument 132/16 – Helicopter aircrew member – authorisation, exemption and directions.

PART 5 – Recency requirements for NVIS operations (paragraphs 19 – 23A of CAO 82.6)

In accordance with the requirements promulgated in CAO 82.6.

1. Recency

1.1 CAO 82.6, establishes the minimum standards that are acceptable to CASA for the operations manual instruction required by the order. However, nothing in those minimums prohibits the operator placing additional requirements, such as increasing the minimum checking cycles in line with their particular operation or safety and risk management systems.

1.2 Operators are encouraged to consider this in their operations – particularly during the start up phases of NVIS operations, or where the organisation has little or no corporate experience with the technology.

1.3 In addition, CAO 82.6 requires a detailed recency requirement for NVIS operations be included as part of the training and checking requirements, but leaves the determination of recency for operational sequences such as winching, hover exit, etc, to the operator. Accordingly, CASA will only accept operations manual instructions that also specifically address such sequences that are particular to the type of operation conducted. It will generally be acceptable to CASA if the operator should require recency levels equal to or in excess of established un-aided levels.

PART 6 – Minimum requirements for NVIS qualification training (Paragraphs 24 – 34 of CAO 82.6)

1. Requirements for training courses

1.1 In accordance with the requirements promulgated in CAO 82.6, Appendix 3.

1.2 Part 61 of the CASR establishes the pilot training and testing requirements for the issue of a NVIS Rating.

1.3 Although aircrew members will only hold a company recognised qualification standardisation of the course through CASA, approval of the minimum competencies of any training should allow for transportability between operators.

1.4 Appendix B of this CAAP provides an example of a flying training course for aircrew members that cover the minimum competencies of CAO 82.6 for a basic NVIS aircrew member qualification on which to build operational competencies if desired. NVIS ground training courses syllabi should be constructed in accordance with CAO 82.6. The operations manual of an operator intending to conduct aircrew member initial NVIS qualification training must contain both NVIS ground and flight training syllabi. All training systems will be assessed and approved by CASA in accordance with the requirements of CAO 82.6

1.5 The operator is responsible for the promulgation of a suitable and appropriate NVIS post rating/induction training programme to satisfy any advanced operational sequences particular to their operation such as winching, rapelling SAR etc. The operator is to ensure that there is specific training for these types of operational roles (as applicable), reduced illumination periods, marginal weather, dust, snow, rain etc.

1.6 There is a recognised experience/training gap that exists between a newly qualified NVIS pilot and a line qualified NVIS pilot with an operator. The purpose of this training is to provide the newly qualified NVIS pilot with NVIS decision making skills suitable for safe pilot in command operations.

1.7 There also is a recognised experience/training gap that exists between a newly qualified NVIS aircrew member and a line qualified NVIS aircrew member with an operator. The purpose of this training is to provide the newly qualified NVIS aircrew member with the NVIS skills applicable for the operators aircrew member requirements.

1.8 CASA will consider an operator's proposed training package in this regard.

Note: For operators intending to use pilot in command under supervision (PICUS), NVIS PICUS can only be logged when a person is flying on NVIS as PICUS. The pilot supervising the PICUS operation is also required to be on NVIS during the flight time. All PICUS operations must be in accordance with Regulation 61.095 of the Civil Aviation Safety Regulations (CASR) – Definition of Flight Time as pilot in command under supervision.

Appendix B

Training syllabus

B.1 Pilot training syllabus for a CASR Part 61 NVIS Rating

In accordance with the requirements contained in:

- Part 61 of the CASR; and
- Part 61 MOS

B.2 NVIS aircrew member training syllabus

The NVIS aircrew member training must, as a minimum, cover the syllabus contained in the tables below. For operations where aircrew members are required to occupy a control seat of a helicopter, CASA Instrument 132/16 Helicopter aircrew member – authorisation, exemption and directions also applies.

B.3 NVIS fly aircrew 1 and 2: NVIS operations

Time (hours)	Content		
2.0 Note: can be done in two one hour training sorties.	1. Assist mission planning and flight planning for the flight. 2. Determine the serviceability of NVIS equipment, including aircraft components. 3. Perform drills including NVG battery switch selection and goggle and de-goggle procedures. 4. Perform crew resource management appropriate to NVIS operations. 5. Perform aircrew member duties for hover, taxi and transit procedures. 6. Perform aircrew member duties for descent, reconnaissance, and circuit operations to and from unlit confined areas located in areas devoid of surrounding cultural lighting. 7. Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). 8. Perform NVIS practice malfunctions and emergency procedures. 9. Accurately recognise, identify, announce, and provide verbal correction (the con) to the pilot for drift, rates of climb or descent, obstacle avoidance, and ground hazards for example dust and debris. 10. Accurately con the aircraft during confined area manoeuvring, slope landings. 11. If an NVIS aircrew member's operational role requires him or her to sit in the front seat of the aircraft and provide assistance to the pilot — assisting the pilot: a. during procedures for flight into deteriorating in-flight visibility situations; and b. during in-flight safe recovery to V.M.C. flight after inadvertent entry to I.M.C.; 2. Perform aircrew member duties during a selection of practice aircraft emergency procedures, under NVIS conditions, applicable to the aircraft type. 3. Perform post-flight shutdown and NVIS procedures.		

B.4 NVIS fly aircrew 3: Flight test

Time (hours)	Content: **Note: The intent is that the unlit HLS operations should be conducted in areas devoid of significant cultural lighting.**		
1.0	As a minimum, trainee to demonstrate competency in: 1. Assisting the pilot in mission planning and flight planning; 2. Determining the serviceability of NVIS equipment, including aircraft components; 3. Performing cockpit drills including switch selection and goggle/de-goggle procedure; 4. Performing crew resource management appropriate to NVIS operations; 5. Performing NVIS practice malfunctions and emergency procedures; 6. Performing aircrew member duties for descent, reconnaissance, and circuit operations to and from unlit confined areas located in areas devoid of surrounding cultural lighting; 7. Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). 8. Provide a timely and accurate con to the pilot for drift, rates of climb and descent, obstacle avoidance, and ground hazards including dust and debris. 9. If an NVIS aircrew member's operational role requires him or her to sit in the front seat of the aircraft and provide assistance to the pilot — assisting the pilot: a. during procedures for flight into deteriorating in-flight visibility situations; and b. during in-flight safe recovery to V.M.C. flight after inadvertent entry to I.M.C.		

Appendix C

Human factors and physiological limitations

C.1 General

C.1.1 Appendix 2 of Civil Aviation Order (CAO) 82.6 requires an approved operator operations manual to contain detailed operational procedures and risk management plans for NVIS operations including fatigue and crew resource management.

C.1.2 This section provides information and guidance on the minimum physiological and associated human factors that should be considered for this purpose. It should be considered that the following human factors and physiological limitations can be exacerbated by increasing fatigue.

C.2 Situational awareness

C.2.1 Situational awareness is 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.' (Endsley, 1998). Basically, good situational awareness is obtained by understanding what is happening around you, and how the situation will develop in the future.

C.2.2 Situational awareness may be diminished due to a number of human factors associated with NVIS operations, especially fatigue impairment of flight crews.

C.2.3 If situational awareness is diminished by these factors, strategies can be put in place to assist in mitigating the effects.

C.3 Crew resource management (CRM)

C.3.1 Due to the inherent limitations of NVIS operations, emphasis should be placed on good communication. This applies to both single-pilot and multiple-crew cockpit environments. NVIS flight particularly requires effective CRM between all crew members, not just aircrew. Therefore, CRM procedures and training should include all crew on board. CRM procedures should be addressed in detail in the operations manual and covered as part of the briefing package.

C.3.2 Operators should produce specific NVIS CRM procedures (including standard crew duties and phrases) involving all aircrew in all phases of flight.

C.4 Threat and error management

C.4.1 Within Threat and Error Management (TEM), a threat is defined as 'an event or error that… [is] outside the influence of the flight crew, increases operational complexity and requires crew attention and management if safety margins are to be maintained' (Merritt & Klinect, 2006).

C.4.2 Error is defined as 'a crew action or inaction that leads to a deviation from crew or organisational intentions or expectations' (Merritt & Klinect, 2006).

C.4.3 As such, TEM is aimed at helping flight crew manage threats and errors that may lead to an undesired aircraft state (the result of threats or errors that go unnoticed by flight crew), and also helping to manage the undesired aircraft state if and when it occurs.

C.4.4 Flight crews should be familiar with the TEM concept because it can help combat complacency and improve situational awareness. For this reason, training in TEM is recommended for all crews involved in NVIS operations.

C.5 Complacency and overconfidence

C.5.1 Compared to other types of flight operations, there may be an increased tendency by a crew member to overestimate the capabilities of both the NVIS equipment, and what this enables pilots to do. This can potentially result in complacency and overconfidence in the equipment. Similar to other specialised flight operations, complacency and overconfidence may lead to an acceptance of situations that would normally not be permitted. For example, attention span and vigilance maybe reduced, important elements in a task series overlooked, and scanning patterns, which are essential for situational awareness, break down. Critical but routine tasks can often be skipped or overlooked.

C.5.2 Consequently, both operators and individual crew members should remain vigilant to the onset of any overconfidence and/or complacency during operations. This may be achieved by regular flight checks and refresher training and during flight operations by crew monitoring and CRM procedures that allow all crew members to query the actions of the pilot flying. Examples of such procedures include Threat and Error Management (such as the three strike rule).

C.6 Depth perception and distance estimation

C.6.1 It is important for crews to be able to accurately employ both depth perception and distance estimation techniques. To accomplish this, NVIS users utilise both binocular and monocular vision.

C.7 Instrument lighting brightness considerations

C.7.1 When viewing the NVIS image, the brightness of the image will affect the amount of time taken to adapt to the brightness level of the instrument lighting, thereby affecting the time taken to interpret information provided by the instruments. For example, if the instrument lighting is a reasonably bright level, the time taken to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a low level, several seconds may be required to interpret information, thus increasing the head down time and increasing the risk of spatial disorientation. It is important to ensure that instrument lighting is kept at a brightness level that makes it easy to rapidly interpret information. This will likely be a brighter level than that used during normal unaided night operations.

C.8 Dark adaptation time from NVIS to unaided operations

C.8.1 When viewing an NVIS image, both the eyes rods and cones are being stimulated (mesopic vision), but the brightness of the image is reducing the effectiveness of rod cells. If the outside scene is bright (urban area, bright landing pad), both rods and cones will continue to be stimulated. In this case there will be no improvement in acuity over time and the best acuity is essentially instantaneous. In some cases (rural area with

scattered cultural lights), the outside scene will not be bright enough to stimulate the cones and some time will be required for the rods to fully adapt, possibly taking up to two minutes for the rods to fully adapt for the best acuity. If the outside scene is very dark (no cultural lights or moon), it may take up to five minutes to fully adapt to the outside scene after removing the NVG. The preceding are general guidelines and the time to fully adapt to the outside scene on removing NVG depends on many variables; the length of time NVIS have been used, whether or not the crew member was dark adapted prior to flight, the brightness of the outside scene, the brightness of cockpit lighting, and variability in visual function among the population. It is important to understand the concept and note the time requirements for any given operation.

C.9 Monochromatic adaptation

C.9.1 Upon re-entering a high ambient light environment, after wearing the NVG for an extended period of time, the operator may experience a brownish tint or discolouration of objects viewed with the unaided eye. This is a normal physiological phenomenon, it causes no discomfort and it will disappear after a few minutes.

C.10 Fatigue management

C.10.1 Human biological limitations that are prevalent during the hours of darkness, along with the limitations associated with NVIS, may have an impact on the level of risk associated with an NVIS operation. Some of these limitations are the effects of fatigue, stress, eyestrain, and working when crews are biologically predisposed to sleep (circadian rhythm). Early onset of fatigue may be caused by increased helmet weight or NVG mounting device, scanning techniques associated with NVIS operational use, or various ergonomic factors that may have a direct influence on how the particular crew member works in the aircraft while wearing NVGs. These risks must be mitigated through proper training, recent experience, personal adaptation to night flying, prior sleep, risk treatment strategies, and crew rosters that recognise the propensity for sleep of individuals during the day.

C.10.2 CASA legislative flight and duty limitations remain unchanged when using NVIS.

C.10.3 Operators may find that as part of their risk management process, there is a need to be more restrictive than current flight and duty limitations require.

C.10.4 Various workload factors common to the use of NVIS by low experience crew members (less than 100 hours for NVIS pilots and less than 50 hours for NVIS aircrew members), may introduce the early onset of fatigue. Accordingly operators should consider reducing flight limits for low experience NVIS crew or those lacking in recency.

C.10.5 Operators should give guidance via the operations manual, in limiting NVIS flight time per duty period for low NVIS experienced crew or single pilot operations for operations below 500 ft above terrain or obstacles. For example, it may be appropriate for activities where NVIS use only occurs in the arrival phase of flight to have a limitation on sectors flown, or to limit the overall flight time for NVIS operations that occur wholly below LSALT. Notwithstanding any prescriptive limitations an operator may impose, further flight time reductions must be considered should crews feel fatigue impaired or exhibit behavioural indications consistent with fatigue impairment.

C.11 Human factors / fatigue recommended training

- A Human Factors Plan, to address any human factors issues associated with NVIS flight that limits the performance of a flight crew member. This may include ergonomic issues, interface/coordination issues, crew communication and fatigue resulting from NVIS operation.
- Chief Pilot/Safety Manager training
  - How to investigate adverse events and determine contributing factors
  - How to determine and monitor the effectiveness of corrective action as necessary
- Crew training
  - How to effectively forward rotate a roster and minimise fatigue
  - How to assure alertness via the prior sleep wake rule
  - How to recognise behavioural patterns in-flight crew members due to increasing fatigue
  - How to manage sleep debt
  - How to manage sleep hygiene
  - How to assess physical and mental wellbeing with fatigue as a context
  - to provide information regarding internal company reporting system

Appendix D

NVIS - General information

D.1 System description-night vision imaging systems (NVIS)

D.1.1 Night vision goggles (NVG)

D.1.1.1 NVG are head-worn (helmet or other approved mounting device), and consist of a binocular imaging assembly, a mounting interface, user controls, a power module and a low-power indicator. The binocular imaging assembly is attached to a head-borne platform (usually a flight helmet) via the mounting interface. Generally, the mounting interface allows the binocular to detach during adverse gravity (G) loading conditions. Controls enable the user to position the binocular for optimum line of sight, field of view and focus. A battery power module provides sufficient electrical power for operation of the binocular and includes both primary and secondary sources. Each source is capable of independently operating the binocular for equal duration and may also include provisions to interface with an external power source. In this case, the power module supplies uninterrupted power to the binocular in the event of failure of the external power source. A low-power indicator signals the user to select the spare power module source when primary power is insufficient to operate the binocular. The low-power indicator is visible to the user.

D.1.1.2 The binocular consists of two independent channels, with each channel presenting collimated scene information directly to one eye. Filters designed to facilitate the compatibility of cockpit lighting are provided in each channel. Channels contain one (or more) objective lens(es), image intensifier tube(s) and eyepiece lens(es). Binoculars may include other optical components, including: combiners, prisms, beam-splitters, cameras, and displays. In addition to scene information, binoculars may present injected head up display (HUD) information. Each channel contains one (or more) image intensifier tube(s). The image intensifier consists of a photo-cathode, micro-channel plate, phosphor screen and power supply. The power supply automatically adjusts gain for optimized performance. In some cases the image intensifier power supply is remotely located with the image intensifier not susceptible to electromagnetic interference.

D.1.2 NVG Head Up Display (NVG HUD)

D.1.2.1 The NVG HUD provides critical, real-time, flight, navigation, and aircraft data in the field of view of the NVG. The NVG HUD enables the crew to obtain flight information while using NVG, minimising the requirement to look under the NVG. This further improves situational awareness and spatial orientation while reducing workload during NVIS operations.

D.1.3 NVIS capabilities - general

D.1.3.1 NVIS generally provides an image of the outside scene that is enhanced compared to that provided by the unaided, dark-adapted eye. However, NVIS may not provide an image equal to that observed during daylight. Since the user has an enhanced visual capability, situational awareness is generally improved.

D.1.3.2 Forward looking infra red (FLIR) devices, synthetic vision devices and aircraft head up displays (HUD) can also provide imagery and information useful during night operations. However, the scope of Civil Aviation Order (CAO) 82.6 and this Civil Aviation Advisory Publication (CAAP) concentrates on NVIS.

D.1.3.3 **Critical Elements** - The following critical elements are the underlying assumptions in the system description for NVIS:

(a) Aircraft internal and external lighting has been modified or initially designed to be compatible, and the NVIS have been properly maintained in accordance with the manufacturer approved data;
(b) Environmental conditions are adequate for the use of NVIS (e.g. sufficient illumination is present and favourable weather conditions);
(c) The NVIS has been properly maintained in accordance with the minimum operational performance standards;
(d) A proper check has been performed on the NVIS confirming operation in accordance with the continued airworthiness standards and training guidelines;
(e) The crews involved have been properly trained and meet recency and experience requirements; and
(f) Organisations utilising NVIS have in place strategies to limit, as far as practical, impairment to crews as a result of fatigue and other human factors.

D.1.3.4 Even when insuring that these conditions are met, there remain many variables that can adversely affect the safe and effective use of NVIS (e.g. flying towards a low angle moon, flying in a shadowed area, flying near extensive cultural lighting and flying over low contrast terrain). It is important to understand these limitations when considering the capabilities of NVIS.

D.1.3.5 The typical unaided eye with a daytime visual acuity of 20/20 may yield a night-time unaided visual acuity to 20/200 or worse. The improved resolution capability of later generation NVG may allow for a comparative visual acuity of 20/30 or better under optimal conditions.

D.1.4 Detection and identification of obstacles

D.1.4.1 An advantage of using NVIS is the enhanced ability to detect, identify, and avoid terrain and most obstacles that present a hazard to night operations. Correspondingly, NVIS assists in night navigation by allowing the aircrew to view waypoints and features.

D.1.4.2 Being able to visually locate and in some cases, identify objects or areas critical to operational success will also enhance operational effectiveness. NVIS also may allow crew members to readily detect other aircraft.

D.2 NVIS limitations

D.2.1 NVIS design characteristics

D.2.1.1 While there are certain limitations inherent in current NVIS design, the enhanced visual capabilities generally outweigh the disadvantages.

D.2.2 Visual acuity

D.2.2.1 Visual acuity with NVIS is less than normal daytime visual acuity, however visual acuity is greater using NVIS than otherwise under unaided night flight. However it is

reasonable to expect, given the scope of operation of these devices, that concentration of crews will be greater, giving rise to an earlier onset of fatigue.

D.2.3 Field of view

D.2.3.1 Field of View (FOV) in current NVG systems is approximately 40 degrees. This reduction can increase the likelihood of susceptibility to misperceptions and illusions. As such, proper scanning techniques must be employed to mitigate against this outcome.

Note: As the FOV is diminished when using NVGs it is anticipated that pilot workload will increase. This may give rise to work induced fatigue.

D.2.4 Field of regard

D.2.4.1 The NVG has a limited FOV but, because it is head-mounted, that FOV can be scanned when viewing the outside scene. The total area that the FOV can be scanned is called the field of regard (FOR). The FOR will vary depending on several factors: physiological limit of head movement, NVG design (e.g. protrusion of the binocular assembly, etc.) and cockpit design issues (e.g. proximity of canopy or window, seat location, canopy bow, etc.).

D.2.5 NVG weight and centre of gravity (CG)

D.2.5.1 The increased weight and forward CG projection of head supported devices may have detrimental effects on user performance due to neck muscle strain. Any physical stressors place on a flight crew member will give rise to the earlier onset of fatigue. There maybe an increased risk of neck injury in the event of an accident.

D.2.6 Monochromatic image

D.2.6.1 The NVG image appears in shades of green or white, termed 'monochromatic'. Colour differences between components in a scene helps one discriminate between objects and aids in object recognition, depth perception and distance estimation. The lack of colour variation in the NVG image will degrade these capabilities to varying degrees.

D.2.7 Ambient or artificial light

D.2.7.1 The NVG requires some degree of light (energy) in order to function. Low light levels, non-compatible aircraft lighting and poor windshield/window light transmissivity, diminish the performance capability of the NVIS. The pilot-in-command is ultimate responsibility to determine when to transition from aided to unaided flight, due to unacceptable NVIS performance in accordance with the company operations manual.

D.2.8 Daytime use for NVIS

D.2.8.1 NVIS are intended to be used at night; are not designed for daytime use and are unlikely to aid a user in decreased daytime visibility conditions. Further, exposure to bright daylight sources for extended periods may damage or significantly reduce the life of the intensifier tube.

D.3 Scanning procedures

D.3.1 Scanning

D.3.1.1 When using NVIS there are three different scan patterns to consider and each is used for different reasons:

a. instrument scan;
b. aided scan outside; and
c. unaided scan outside.

D.3.1.2 Normally, all three are integrated and there is a continuous transition from one to the other depending on the mission, environmental conditions, immediate tasking, flight altitude and many other variables. For example, scanning with the NVG will allow early detection of external lights. However, the bloom caused by the lights will mask the aircraft until fairly close or until the lighting scheme is changed. Once close to the aircraft, visual acquisition can possibly be made unaided or with the NVG. Whether to use the NVIS or unaided vision depends on many variables. A proper scan depends on the situation and variables present, and that scanning outside is critical when close to another aircraft. For a multi-crew environment, coordination of scan responsibilities is vital.

D.3.2 Instrument crosscheck scan

D.3.2.1 It is important to predict conditions under which an instrument crosscheck scan will be required. This should commence during planning when critical phases of flight can be identified and prepared for. For example, it may be possible when flying over water or featureless terrain to employ a good instrument crosscheck. However, the most important task is to make the appropriate decision during flight as conditions and events change. In any event, experience, training and constant attention to the situation are vital contributors to the operator assessment of the situation.

D.3.3 NVG scan

D.3.3.1 To counteract the limited field of view, crews should continually scan throughout the FOR to build a mental image of the surrounding environment. The rate at which the outside scene is scanned to update the mental image is determined by many variables. For example, when flying over flat terrain where the highest obstacle is below the flight path, the scan may be fairly slow. However, at low altitude in mountainous terrain, the scan should be more rapid due to the presence of more information and the increased risk. How much of the FOR to scan is also determined by many variables. For example, if a crew is anticipating a turn more attention may be placed in the area around the turn point, or in the direction of the intended heading or track. In this situation, the scan will be limited briefly to only a portion of the FOR.

D.3.3.2 As with an instrument scan, it is important to anticipate and plan ahead. It may be possible to determine when the scan may be interrupted due to other tasks, or when it is possible to become fixated on a specific task, or when it is important to maximize the outside scan. An important lesson regarding the NVG scan is when not to rely totally on visual information.

D.3.3.3 It is easy to overestimate how well one can see with NVIS, especially on high illumination nights, and it is vital to maintain a constant awareness of ones own limitations. This should be continually emphasised during training and should be reinforced as an item when briefing NVIS flights. Distance estimation may be difficult when relying solely on NVIS, especially when remote cultural lighting is being viewed.

D.3.4 Unaided scan

D.3.4.1 Under certain conditions, unaided scan may be as important as aided scan. For example, it may be possible to detect distance and/or closure to another aircraft more easily using unaided vision, especially if the halo caused by external lights is masking aircraft detail on the NVG image. Additionally, there are other times when unaided information can be used in lieu of or may augment NVIS and instrument information.

D.3.5 Scan patterns

D.3.5.1 Environmental factors may influence scan by limiting what may be seen in specific directions or by degrading the overall image. If the NVG image is degraded, aircrew may scan more frequently in a subconscious attempt to obtain more information, or to avoid the chance of missing information that suddenly appears and/or disappears.

D.3.5.2 The operation itself may influence the scan pattern. Scanning for another aircraft, HLS, or aerodrome may require focusing the scan in a particular direction. In some cases, the operation may require aircrew in a multi-place aircraft to assign particular crew members responsibility for scanning of specific sectors.

D.3.5.3 The restrictions to scan and the variables affecting the scan pattern are not specific to night operations or the use of NVIS, but due to the NVG limited field of view, the degree of impact is magnified.

D.4 Environmental considerations

D.4.1 Weather and atmospheric obscurants

D.4.1.1 Any atmospheric condition, which absorbs, scatters, or refracts illumination, either before or after it strikes terrain, may reduce the usable energy available to the NVIS.

D.4.2 Weather

D.4.2.1 During NVIS operations, users can see areas of moisture that are dense (cloud, thick fog), but may not see areas that are less dense (thin fog, light rain showers). The inability to see some areas of moisture may lead to hazardous flight conditions during NVIS operations and will be discussed separately in the next section.

D.4.2.2 The different types of moisture will have varying effects and it is important to understand these effects and how they apply to NVIS operations. For example:

a. It is important to know when and where fog may form in the flying area. Typically, coastal, low-lying river, and mountainous areas are most susceptible.

b. Light rain or mist may not be observed when conducting flights using NVIS, but will affect contrast, distance estimation, and depth perception. Heavy rain is more easily perceived due to large droplet size and energy attenuation.
c. Snow occurs in a wide range of particle sizes, shapes, and densities. As with clouds, rain, and fog, the denser the airborne snow, the greater the effect on NVIS performance. On the ground, snow has mixed effect depending on terrain type and the illumination level. In mountainous terrain, snow may add contrast, especially if trees and rocks protrude through the snow. In flatter terrain, snow may cover high contrast areas, reducing them to areas of low contrast.
d. On low illumination nights, snow may reflect the available energy more effectively than the terrain it covers and thus increase the level of illumination.

D.4.2.3 All atmospheric conditions reduce the illumination level to some degree and recognition can be difficult. Thus, a thorough weather briefing, familiarity with local weather patterns and an understanding of the effects on NVIS performance are important for successful flight.

D.4.3 Deteriorating weather

D.4.3.1 Crews should remain cognisant to changes in the weather when using NVIS. It is possible to 'see through' some areas of light moisture when using NVIS, thus increasing the risk of inadvertently entering instrument meteorological conditions (IMC). Some ways to assist reducing this possibility include:

a. Be attentive to changes in the NVG image. Halos may become larger and more diffuse due to diffraction of light in moisture. Scintillation in the image may increase due to a lowering of the illumination level caused by the increased atmospheric moisture. Loss of scene detail may be secondary to the lowering illumination caused by the changing moisture conditions;
b. Obtain a thorough weather brief with emphasis on NVIS effects;
c. Be familiar with weather patterns in the area of operations; and
d. Occasionally scan the outside scene. The unaided eye may detect weather conditions that are not detectable to the NVIS.

D.4.3.2 In the event of inadvertent IMC penetration, crews should quickly resort to operations manual procedures to recover the aircraft.

D.4.4 Thunderstorms

D.4.4.1 Thunderstorms should be avoided by a safe distance to avoid the hazardous effects such as lighting, turbulence etc.

D.4.4.2 Distances from thunderstorms may be difficult to estimate visually when using NVIS. Consequently, operators should consider the fitment of airborne weather radar or other electronic detection devices to their aircraft. In addition, it should be noted that the NVG image may be adversely affected by lightning flashes. Given that CAO 82.6 also requires the flight to be capable of being conducted by night vision flight rules (NVFR)

or instrument flight rules (IFR) if capable, the presence of thunderstorm activity may affect the ability to conduct the mission at all.

D.4.5 Airborne obscurants

D.4.5.1 Apart from weather, there may be other obscurants in the atmosphere that may block energy from reaching the NVG, such as haze, dust, sand, or smoke. As with moisture, the size and concentration of the particles will determine the degree of impact. Examples of these effects include:

a. High winds during the day can uplift considerable dust in the air that may still be present at night;
b. Bush or forest fires produce heavy volumes of smoke that may cover areas well displaced from the fire source;
c. The effects of rotor wash may be more pronounced when using NVIS depending on the type of material, such as sand, snow or dust; and
d. Air pollution in and around major cultural areas and cities may have an adverse effect on NVIS performance.

D.4.6 Winter operations

D.4.6.1 Winter conditions provide unique issues and challenges to crews.

D.4.7 Snow

D.4.7.1 Due to its reflective nature, snow presents crews with significant visual challenges both enroute and in the area of operations or intended landing area. During the enroute phase of a flight snow may cause distractions to the crew if any aircraft external lights (anti-collision beacons/strobes, position lights, landing lights) are not NVIS compatible . In the area of operations or landing area, the hazards associated with 'whiteout' landings using NVIS is not diminished, and may be more disorienting due to lights reflecting from the billowing snow around the aircraft during the landing phase. Any emergency vehicle lighting or airport lighting in the landing area may exaggerate the effects.

D.4.8 Ice fog

D.4.8.1 Ice fog presents the pilot with hazards normally associated with IMC in addition to problems associated with snow operations. The highly reflective nature of ice fog will further aggravate any lighting problems. Ice fog conditions can be generated by aircraft operations under extremely cold temperatures and the right environmental conditions.

D.4.9 Icing

D.4.9.1 Airframe icing is difficult to detect while looking through NVG. Crews should develop a proper crosscheck to ensure airframe icing does not exceed operating limits. Crews should already be aware of icing indicator points on their aircraft.

D.4.10 Low ambient temperatures

D.4.10.1 Depending on the cockpit heating system, fogging of NVG may arise which could significantly reduce goggle effectiveness. There is potential for reduced battery duration associated with low temperatures which may require additional battery resources.

D.4.11 Illumination

D.4.11.1 NVIS require illumination, either natural or artificial, to produce an image. Although current NVIS technology has significantly improved low light-level performance, some illumination, is required.

D.4.12 Natural illumination

D.4.12.1 The main sources of natural illumination include the moon and stars. Other sources can include sky glow, the Aurora Australis, and ionisation processes that take place in the upper atmosphere.

D.4.13 Moon phase

D.4.13.1 The moon provides the greatest source of natural illumination during the night. Moon phase and elevation determines the amount of moonlight which will be available, while moonrise and moon rise and set times determine when it will be available. Lunar illumination is reported in terms of percent illumination; 100% illumination being full moon. It should be noted that this is different from the moon phase (25% illumination does not mean the same as a quarter moon). Percent lunar illumination may only be obtained from limited sources.

D.4.14 Lunar azimuth and elevation

D.4.14.1 The moon can have a detrimental effect on night operations depending on its relationship to the flight path. When the moon is on the same azimuth as the flight path and low enough to be within or near the NVG FOV, the effect on NVIS performance will be similar to that caused by the sun on the unaided eye during the day. The brightness of the moon drives the NVG gain down, thus reducing image detail. This can also occur with the moon at relatively high elevations. For example, it is possible to bring the moon near the NVG FOV when climbing to cross a ridgeline or other obstacle, even when the moon is at a relatively high elevation. It is important to consider lunar azimuth and elevation during planning. Shadowing, another effect of lunar azimuth and elevation, is discussed separately.

D.4.15 Shadowing

D.4.15.1 Moonlight creates shadows during night-time just as sunlight creates shadows during daytime. However, night-time shadows contain very little energy for the NVIS to use in forming an image. Consequently, image quality within a shadow will be degraded relative to that obtained outside the shadowed area. Shadows can be beneficial or can be a disadvantage to operations depending on the situation.

D.4.16 Benefits of shadows

D.4.16.1 Shadows alert crews to subtle terrain features that may not otherwise be noted due to the reduced resolution in the NVIS image. This may be particularly important in areas

where there is little contrast differentiation, such as flat featureless deserts, where large dry expanses and high sand dunes may go unnoticed in the absence of contrast. The contrast provided by shadows helps make the NVIS scene appear more natural.

D.4.17 Disadvantages due to shadows

D.4.17.1 Within a shadow area, terrain detail can be significantly degraded, with objects in or around shadowed areas subject to loss of terrain detail to NVIS users. During flight under adequate illumination, users expect to see a certain level of detail.

D.4.17.2 Flight into a shadow area while the operator is preoccupied with other matters (communication, radar), may result in possible loss in terrain detail which is immediately detected. A user may perceive the reduced detail is due to an increase in-flight altitude and begin a descent - even though at a low altitude. Consideration during mission planning to factors such as lunar azimuth and elevation, terrain type (mountainous, flat), and the location of items significant to operation success (ridgelines, pylons, targets, waypoints), will assist in predicting the location of shadows and potential adverse effects.

D.4.18 Sky glow

D.4.18.1 Sky glow is an effect caused by solar light and continues until the sun is approximately 18 degrees below the horizon. When viewing in the direction of sky glow there may be enough energy present to adversely affect the NVG image.

D.4.18.2 For the middle latitudes the effect on NVIS performance may last up to an hour after official sunset. For more northern and southern latitudes the effect could be for extended periods of times during seasons when the sun does not travel far below the horizon. Unlike sky glow after sunset, sky glow associated with sunrise does not have an obvious effect on NVIS performance until close to official sunrise. The difference is related with the length of time the atmosphere is exposed to the suns irradiation, which causes ionisation processes that release near- ice on runway (IR) energy. These effects should be taken into account during planning as they have most significance when looking west around sunset and may extend for a period of time.

D.4.19 Artificial illumination

D.4.19.1 The NVG are sensitive to any source of energy in the visible and near infrared spectrums, and there are also many types of artificial illumination sources (flares, IR, searchlights, cultural lighting). As with any illumination source, these can have both positive and detrimental effects. For example, viewing a scene indirectly illuminated by a searchlight may enable the user to more clearly view the scene; conversely, viewing the same scene with the searchlight near or within the NVG FOV will reduce the available visual cues. It is important to be familiar with the effects of cultural lighting in the area of operations to avoid adverse effects, but to be able to make use of the advantages. Also, it is important to know how to properly use artificial light sources (i.e. 'Nitesun', searchlights etc.). As artificial light sources may not always be available or dependable, this should be taken into consideration.

D.4.20 Terrain contrast

D.4.20.1 Contrast is one of the more important influences on the ability to correctly interpret the NVG image, particularly in areas where there are few cultural features. Any terrain that contains varying albedos (forests, cultivated fields) will likely increase the level of contrast in a NVG image, thus enhancing detail. The more detail in the image, the more visual information aircrews have for manoeuvring and navigating. Low contrast terrain (flat featureless desert, snow-covered fields, water) contains few albedo variations, thus the NVG image will contain fewer levels of contrast and less detail.

Appendix E

Night vision imaging systems/night vision goggles (NVIS/NVG) - Suggested pre-flight briefing checklist

Item	Subject	Considerations
1	Weather	• Area/aerodrome forecast duration • Cloud cover/dew point spread/precipitation/thunderstorm activity/other adverse conditions/visual meteorological conditions (VMC)
2	Operational issues	• Notice to airmen (NOTAM) • all publication including maps, charts and other documentation • NVG adjusted in accordance with manufacturer's instructions • NVG serviceability checks • personal equipment, including flashlights, lip/finger lights/spare batteries • area of operations, including daylight reconnaissance of the area as applicable • known or expected hazards at the destination/area of operations and enroute, including terrain • recovery plan in the event of instrument meteorological conditions (IMC) penetration • alternate requirements • fuel planning and requirements • other potentially conflicting traffic • use of landing lights/search lights applicable to the operators operations manual • environmental issues enroute, at the destination/area of operations that may affect the NVIS
3	Ambient Light	• moon rise/set/phase/position/elevation • % illumination for the duration of flight • other anticipated ambient light sources
4	Mission/Flight planning	• mission/flight plan profile • terrain appreciation/area of operation • detailed manoeuvres/specialised operations • light timings (lunar)/ambient light conditions • start/airborne/debrief • airspace coordination for NVIS (if required) • obstacles/ hazards/lowest safe altitude (LSALT)/minimum altitude to be flown • NVG goggle procedures/phases of flight • return to base (RTB) procedures • post-flight debrief
5	Crew considerations	• crew names/pilot-in-command (PIC)/co-pilot/aircrew member • crew recency/currency • crew duty limitations/fatigue • crew experience for the mission • crew resource management (CRM) issues • crew position equipment • NVG spare set if required • crew duties, including lookout/clearance calls/crew scanning techniques • calling of hazards/movements/other traffic • transfer of control terminology (handover take over drills) • below 500 ft non flying pilot ready to assume control
6	Aircraft	• aircraft serviceability for NVIS flight • aircraft configuration for the mission, including specialised equipment • fuel & centre of gravity (CG) considerations

Item	Subject	Considerations
7	Emergencies	• NVG failure/malfunctions during flight above and below LSALT • inadvertent IMC penetration and recovery to VMC • RTB recovery or to alternate • aircraft emergencies – critical and non-critical

Appendix F

Performance standards for night vision imaging system

F.1 References

- Civil Aviation Regulations (CAR) 1988, regulation 207
- Civil Aviation Safety Regulations 1998 (CASR) Part 21, 23, 25, 27, 29,
- Civil Aviation Order (CAO) 82.6
- RTCA Document RTCA/DO-275 dated 12 October 2001
- FAA TSO C164a dated 10 February 2015 or later revision

F.2 Purpose

This CAAP appendix is intended to provide guidance on the minimum operational performance standards acceptable to CASA for the selection of NVIS for use in Australia.

F.3 Background

The RTCA developed a minimum operational performance specification in 2001. The United States Federal Aviation Administration (FAA) issued a Technical Standard Order (TSO) C164a referencing the RTCA document. Further technological advances have been made improving the performance significantly.

F.4 Applicability

This CAAP appendix is applicable to operators intending to utilise NVIS in accordance with Civil Aviation Order 82.6. It provides guidance on the minimum acceptable performance standards considered necessary to conduct approved operations in Australian airspace.

F.5 Related reading materials

RTCA/DO-268 Concept of Operations, NVIS for Civil Operators.

F.6 Minimum operational performance standards

The specifications in RTCA/DO-275, dated 12 October 2001, as modified by column 3 of Table 1 of this CAAP appendix, are endorsed by CASA as an appropriate minimum performance standard for NVIS. The modifications have been incorporated to reflect the developments within the night vision industry since the release of RTCA/DO-275 and are representative of current commercially available equipment.

CASA has published a list of NVG that are approved or otherwise accepted by CASA in AWB 25-031.

Note: Copies of RTCA/DO-275 may be purchased via the RTCA website: http://www.rtca.org/.

Table 1: Amendments to RTCA/DO 275 MOPS

RTCA/DO-275 Minimal Operational Performance Standard (MOPS) Reference		Amended Performance Requirement
Para 2.2.1.1 System Resolution	1.0 cycles per milliradian (cy/mr). At 14º off axis = 0.81 cy/mr With a variable focus @ through infinity = 0.49cy/mr	1.3 cy/mr
Para 2.2.1.2 System Luminance Gain	= 2,500 foot-Lamberts (fL) per fL at an input light level of 1 x 10-4 fL	= 5500 foot-Lamberts (fL) per fL at an input light level of 1 x 10-4 fL = 1750 cd/m2/lx at an input light level of 1.1 x 10-3 lx
System Luminance Gain – Filmless Autogating		=16 000 cd/m2/lx at an input light level of 2 x 10-5 lx
Para 2.2.1.3 Field-of-View	38º vertical and horizontal	40º
Para 2.2.1.4 Magnification	1:1 +/- 2%	1:1
Para 2.2.1.7.1 Spectral Transmission	Meet Class B filter requirements	Class B filter
Para 2.2.1.10 Eyepiece Diopter Range	Adjustable +1.0 to –2.0, or Fixed –0.5 and –1.0	+2 to -6
Para 2.2.1.12 Objective Focus Range	Adjustable from beyond infinity to no greater than 45 cm close range	25 cm close
Para 2.2.13 Exit Pupil/Eye Relief	Type I - 25 mm, Type II - 20mm	25 mm
Para 2.2.2.3 Flip-Up/Flip Down	Required capability	Push button
Para 2.2.2.4 Fore-and-Aft Adjustment	Sufficient to align with users eyes	27mm total
Para 2.2.2.4 Tilt Adjustment	Sufficient to align with users eyes	10 degrees
Para 2.2.2.5 Interpupillary Adjustment	Desired but not required. If not installed, exit pupil must be large enough to see full FOV	51 to 72mm
Para 2.2.2.6 Voltage Required	2.7 – 3.0 V DC 50mA nominal Backup power supply required	2.7 – 3.0 V DC 50mA nominal Backup available
Technology	Intensifier tubes not specified	Not specified
Photosensitivity filmed non-autogating	Not specified	1800 μA/lm
Photosensitivity filmless autogating		800 μA/lm
Tube Resolution	Not specified	64 line pairs per millimetre (lp/mm)

RTCA/DO-275 Minimal Operational Performance Standard (MOPS) Reference		Amended Performance Requirement
Signal to Noise Ratio filmed non-autogating	Not specified	21:1
Signal to Noise Ratio Filmless autogating		25:1