The view ahead

BY DR BOYD FALCONER AND MELANIE TODD

Human factors aspects of night vision goggle (NVG) operations

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Recent research by CASA and the University of New South Wales (UNSW) identifies the human factor benefits and limitations of night vision goggle (NVG) use in civilian helicopter operations.

The research suggests that while NVGs have the potential to improve the safety of night emergency service (EMS) operations, this improvement is contingent upon a small number of risk countermeasures being implemented and followed, and a thorough understanding of the limitations of NVG use.

What's the problem?

NVGs offering 20/20 visual acuity are just around the corner. But problems associated with NVG usage will hamper safe aviation operations well into the future. A current lack of regulation relating to authorising and guiding NVG use within the Australian aviation community means that operators carrying out night missions using NVGs must fly under night visual flight rules (NVFR). NVFR flight relies on an operator being able to stay 'visual' – free from cloud and obstacles while flying at a lowest safe altitude (LSALT). This problematic state is a challenging issue because existing research indicates that unaided NVFR flight is not as safe as flying NVFR with NVGs.

The void in regulatory guidance is particularly troublesome for the operators in the EMS sector, whose typical operations are well aligned to take advantage of the human factor and safety benefits that NVG usage offers (Todd & Falconer, 2007).

A military technology in civilian hands

Because most NVG research was initially borne from military aviation, it is important to understand the difference between military and civilian NVG use. In accordance with military aviation culture that tends to impart a 'get the job done' message to personnel, military aviation uses NVGs as mission–enabling devices. Such use contrasts with the civilian context, whereby operators use NVGs to supplement ordinary operations.

Missions such as nap–of–the–earth (NOE) flights (flights close to the surface during which airspeed and altitude are adapted to the contours and cover of the ground in order to avoid enemy detection) are clearly military–specific, and current civilian aviation needs would not necessitate this kind of flying.

However, some commonality between military and civil use does exist, including cockpit interface, training, handling of in–flight emergencies, the need to avoid wires and towers en route, and the need to react appropriately to goggle failure. (Hawley, Anoll & Green, 1991)

New generations of goggles: high cost yet high benefit

Currently, the most advanced model NVG available in Australia is the ANVIS 9 (incorporating the Omnibus IV tube), which increases visual acuity to approximately 20/25. This is in contrast to the ANVIS 6 (incorporating an Omnibus II tube), which only increase visual acuity to approximately 20/40.

The ANVIS 9 also has a brighter image in amber colouring – not the traditional green. The amber light is remarkably easier on aircrew eyesight; it's less fatiguing, and assists with some of the depth–perception issues with current NVG models.

The latest NVGs available worldwide come from the USA (which will not be available in Australia for a couple of years) and are referred to as the Pinnacle model. Importantly, the NVGs deliver the long–awaited visual acuity of approximately 20/20.

Operations with NVGs are expensive; the equipment, training, recency requirements and ongoing maintenance requirements have a high cost. If operators are not well–funded, cost cutting may occur, which could be disastrous in the high–risk environment of night flight with NVGs.

Despite the expense, operators must have standardised equipment, as alternating between different generations of NVGs can present integration problems for operational aircrew.

Recommendations – risk countermeasures

NVG use requires currency, recency and training standards that NVFR flying lacks. Further personnel training, radio altimeter use and mandated instrument ratings must be considered as they can mitigate risks associated with NVG operations (see Todd & Falconer, 2007 for a complete description of these risks).

Personnel training: A comprehensive training package is needed to safely integrate NVG use into company operations. Ensure that maintenance is being performed regularly and correctly on the NVG units. Training for crews should cover the limitations of NVGs, mitigating strategies, risk assessment/management, human factors plan awareness, CRM, pre–flight planning and in–flight planning, as well as setting up and testing NVGs to suit the individual.

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Radio altimeter use: A radio altimeter should be fitted to all aircraft conducting NVG operations, preferably with visual and auditory warnings for altitude busts. The importance of the radio altimeter cannot be overlooked and is significant risk mitigation for NVG operations, especially during the initial descent and other high–workload situations.

Instrument rating: It is also prudent to ensure that pilots operating NVG flights hold a current instrument rating. The evidence detailed in the documents reviewed all point to the importance of an instrument rating in the event of the flight entering inadvertent IMC.

Since pilots may not be able to see all the cloud present near or on their route when using NVGs, this requirement is vital. Non–instrument–rated pilots and non–current instrument–rated pilots will find it difficult to recover from Instrument meteorological conditions (IMC) flight and as such this poses an immense safety risk.

Dangers still lie ahead

The dangers of relying on NVGs to complete a flight are clear and care should be taken to ensure that at all times the flight is being conducted to weather standards that permit NVFR flight. It may be tempting for some operators to believe that NVGs enable them to conduct flights they were previously unable to do, but this is not the case. NVGs should be an operational enhancing device, not the sole means to conduct the flight. NVGs are a powerful supplement to safe aviation and specifically have the potential to improve the safety of NVFR EMS operations. However, this benefit will only occur if all countermeasures are implemented and followed, and a thorough understanding of the limitations of NVG use exists within aviation organisations across all personnel levels.

CASA is taking steps towards regulating and guiding NVG use, and good progress is being made. A trial is currently underway, which will allow both industry and CASA to access information on real–world NVG operations and monitor the transition to using this new technology with the emphasis on safety.

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Further reading:

Hawley, R.J., Anoll, R.K., & Green, D. (1991). Rotorcraft Night Vision Goggle Evaluation. (DOT/FAA/RD–91/11). Washington, DC, USA, Federal Aviation Administration.

Todd, M., & Falconer, B. (2007). The human factor benefits and limitations of civil and military night vision goggle operations. Human Factors and Aerospace Safety, 6(1), 71–85. ▪