SAU INN 2010/006

Inno word

STATE AIRCRAFT UNIT VICTORIA

Night Vision Goggle Evaluation Trial Report - 2010.

Introduction

In January 2009, the Aviation Management Committee approved an evaluation trial of the operational use of Night Vision Goggle (NVG) for Victorian fire suppression and prescribed burning operations.

The NVG evaluation trial was conducted in Autumn 2010. The aim of the trial was to conduct both aerial reconnaissance and aerial ignition (AI) operations at night, to assess the viability of the NVG technology in enhancing night vision for Agency operations.

A helicopter equipped for NVG operations was based at Essendon from March 9-21, 2010 for the evaluation trial.

This Inno Word summarises the final report of the NVG evaluation trial.

Summary of Flights

Four Agency personnel were endorsed as NVG aircrew members, prior to the trial commencing, under Civil Aviation Order (CAO) 82.6.

Between 9/3/2010 and 18/3/2010, a total of 25.8 hrs of flying was conducted for the evaluation trial, with 17.9 hrs of that time “aided” or “on goggles”. The remaining flight time was spent conducting daylight site reconnaissance and positioning ferries.

The following summarises the NVG evaluation flights.

- 2 x NVG navigational flights;
- NVG aerial ignition (AI) (50 capsules) and reconnaissance of the Gooches Lane fuel reduction burn (FRB) near Lancefield;
- NVG reconnaissance of FRBs at Kalorama and Cardinia;
- NVG reconnaissance of the Distillery Ck FRB near Aireys Inlet;
- NVG AI (370 capsules) and reconnaissance of Rocklands FRB (Wimmera);
- NVG reconnaissance of Dairy Ck / Mt Buangor fire;
- NVG AI (500 capsules) and reconnaissance of the Skerry’s Ck FRB north of Noojee.

The trial enabled Agency staff to conduct operational activities, using NVG to assist the pilot / aircrew with navigation and terrain avoidance, over a variety of vegetation/forest and terrain types and fuel reduction burns of varying intensity.

It is worth noting that the conduct of NVG aerial incendiary operations was the first such operation in the world.

Based on the experience gained during these flights, it is the SAU’s belief that NVG technology will enable the safe conduct of aerial reconnaissance and aerial incendiary operations after dark.

There is no consideration by the Agencies of conducting NVG firebombing operations at this time.

NVG Helicopter / Equipment

The helicopter used for the trial was an AS355 Twin Squirrel helicopter supplied by Rotorlift Helicopters of Hobart.

The company is an experienced CASA approved NVG training organisation and holds a CASA Instrument of Approval to conduct NVG operations under CAO 82.6.

ITT F4949 Generation III system NVGs were supplied by Rotorlift for the trial.

To meet Agency requirements for both reconnaissance and aerial incendiary operations the Rotorlift helicopter was modified for:

- fitment of Agency simplex and trunk radios; and
- fitment of the DSE Arlos aerial incendiary machine (AIM) mounting frame, drop tube and auxiliary power outlet.

Aerial reconnaissance

Most aerial reconnaissance flights were conducted during or post the ignition of fuel reduction burns. The Mt Buangor fire was a fuel reduction burn escape not associated with the NVG trial.

Visual fire reconnaissance techniques were adapted quickly and whilst the limited field of view of the goggles caused initial changes to scan technique, the goggles enabled clear vision of the fire edge, fire behaviour and background topography, whilst still being able to maintain adequate situational awareness and separation from terrain.

From an avoidance perspective, embers coming off the fire were encountered down wind and could be clearly identified through the goggles and avoided. Smoke can be seen through the goggles and a flight route above or below the smoke could be determined by the pilot well in advance. Fire edge (light) can be seen through light smoke as can generally occur during daytime operations.

Recording intelligence onto a topographic map ie. mapping, can be restrictive and potentially more fatiguing from an eye and neck strain perspective. There is constant head and eye movement “up and down” – through goggles to under goggles, to see the map to draw accurate lines etc. There is no ability to increase cabin lighting due to its effect on the goggles and the available stalk lights were adequate only for spot location on a map, not accurate drawing of a fire edge.

Constant movement of vision from outside the aircraft to the map may be disorientating for some personnel and reaction time to reorientate once viewing outside, takes longer due to the lack of peripheral vision. If critical mapping is required, then this may need to be in conjunction with accurate recording using GPS.

During the Distillery Ck and Mt Buangor fires, the ability to report directly via radio to the Ops Officer or IMT, “what you see” was excellent and the only restriction at times was the amount of firelight saturating out the background detail. This can be rectified by changing scan techniques.

Flying heights were determined pre-flight. A minimum operational height above ground level (AGL) was determined as a component of each flight planning process. A minimum height of 500ft AGL for any Agency NVG operation was determined in the project plan.

During the Distillery Ck FRB very active fire behaviour was experienced with excessive amounts of fire light. The scan technique used during reconnaissance of this fire was to view off to the side of the active fire / edge to enable clearer vision of background terrain. Only when there was a requirement to locate an operating bulldozer and map the line it was building was their any need to operate below 1000ft AGL but still no requirement to go below 500ft AGL.

An important technique for pilots and aircrew gained through this trial when conducting reconnaissance operations, is to avoid the tendency to become overly focused or fixated on the fire(light) and to use reliable scan techniques to ensure vision of terrain and background topography is constantly maintained.

Aerial Ignition

Aerial ignition is an NVG assisted operation which potentially would realise the biggest gains for the Agencies. It was considered that NVG would provide an opportunity to safely conduct aerial incendiary operations (both backburn and fuel reduction burn), post last light and to broaden existing burning windows into more conducive conditions ie. less wind, lower temperatures, higher fuel moistures.

Ideally burns which may have been difficult or unable to be conducted during the day due to being outside prescription, could be ignited under more suitable night conditions using the NVG to assist the pilot and IOS with navigation and the positioning of ignition lines.

If continuing NVG AI operations are approved by CASA, there is real potential for specific FRBs being identified as a night operation well in advance, enabling more effective rostering of personnel and resources and potentially requiring less personnel to conduct the operation due to less escape risks.

The ability to ignite at night could potentially see backburns conducted during fire suppression operations which are ignited post last light under favourable meteorological and fuel conditions. Conditions which may not be available during daytime operations.

Planning for all AI burns during the trial, required the proposed areas flown "unaided" before last light to ensure the pilot and IOS were familiar with the terrain and could identify burn boundaries. It also enabled face to face meetings with the respective Burn OIC to discuss lighting patterns and the location of ground resources.

The first AIM operation at Gooches Fireline saw only a limited number of capsules dropped. The associated ground lighting operation in the late afternoon in drier than expected fuels, saw the majority of the burn area ignited prior to the helicopter arriving. Only "patching out" operations were able to be conducted. Even with active fire occurring, the IOS had clear vision of the fire through goggles and was clearly able to identify the unburnt areas within the fire requiring treatment and maintain safe separation from terrain and smoke.

The other two FRBs ignited during the trial had little or no associated edge lighting which allowed for 100% of both areas to be ignited unrestricted by ground lighting or associated smoke.

The IOSs commented post the Rocklands and Skerry's FRBs that once the first run of incendiaries had ignited, the line of ignition points provided ample reference and light to ensure the spacing of the next capsule lines could be made without need for the searchlight. At no stage was there a requirement to use GPS to assist with the first run.

A minimum operational height of 500ft AGL was determined for AI operations and no issue existed with maintaining this height, clearly seeing ignition lines and maintaining separation from terrain and building smoke.

Observations from the AIM bombardiers who operated in the rear cabin during ignition operations was favourable. Initially a little unnerved, the bombardiers conducted their task "unaided" and had no spatial awareness problems.

An additional light was provided in the rear cabin for the AIM operator but was not required as sufficient light was available from the AIM control panel and from the aircraft instrument panel for them to safely perform their task.

Limitations

The ability at times to clearly see edge/dozer tracks, drainage lines etc. in close proximity to the active fire edge when increased fire behaviour was occurring, was a limitation. The NVG unit is equipped with an auto-iris capability and compensates for varying light levels.

Whilst the NVG will adjust for bright lights, active fire (firelight) "washes' out" background detail significantly and tends to dominate or "over saturate" vision. The tendency by the user to want to fly lower to attempt to see the edge track in these situations was experienced initially. Experience showed the best technique was to fly slightly higher and view the fire edge not through the centre of the monocle but in the edge - allowing the firelight to diffuse. This was a technique which required some practise.

The use of searchlight/night sun during actual fire reconnaissance operations was not required except when conducting landings and takeoffs. Limited use of the light was made when dropping the first line of capsules.

Viewing scan patterns are different compared to daytime operations and can only be developed with practise. The goggles narrow field of view (40^{O}) dictates a slow methodical pan motion to maximise viewing. Peripheral vision is virtually non-existent and must be compensated by a reliable scan pattern which ensures the user is aware of any increases in possible Instrument Meteorological Conditions (IMC) – either cloud or smoke.

Depth perception is limited when using NVG and confined area outlandings require good searchlight technique by the pilot and reliable and consistent Crew Resource Management (CRM) between pilot and flight crew when landing.

Neck and eye fatigue were experienced after 3.6 hrs and 4 hrs of NVG use on two nights of operations.

The constant orbiting around the fire and NVG scan requirements during both types of fire operations are arguably more fatiguing than that experienced when conducting other NVG operations or non NVG reconnaissance.

NVG flights may become more visually demanding than corresponding daytime operations and pilots and flight crew need to be constantly scanning for changes in flight weather and visual conditions. It is recommended that Agency personnel conducting NVG operations be limited to a maximum of three continuous nights of operations.

Findings

Whilst it was hoped to do more flying during the trial, there were sufficient NVG flights conducted for both types of operations to enable a reliable evaluation of the technology and determine its future for the Agencies.

Each night during the trial, flightcrew experienced different environmental factors and gained valuable experience from these. The atmospheric and night sky conditions varied every night and this significantly affects NVG output quality. Terrain, vegetation type and fire activity were different for every mission and each affected output and ultimately how the mission was conducted to ensure safe operations.

The trial demonstrated that night flying under the NVFR using NVG can be conducted safely to enable the Agencies to perform reconnaissance and aerial ignition operations. Safe operational heights AGL can be maintained which will not restrict either operation.

NVG can only be considered another tool available to the Agencies for fire suppression and fire management purposes. It is not a “silver bullet” but can certainly assist fire Agencies in broadening the available window for safe flight operations past last light.

The Aviation Management Committee has approved the SAU to continue developing an NVG capacity for Victorian operations.

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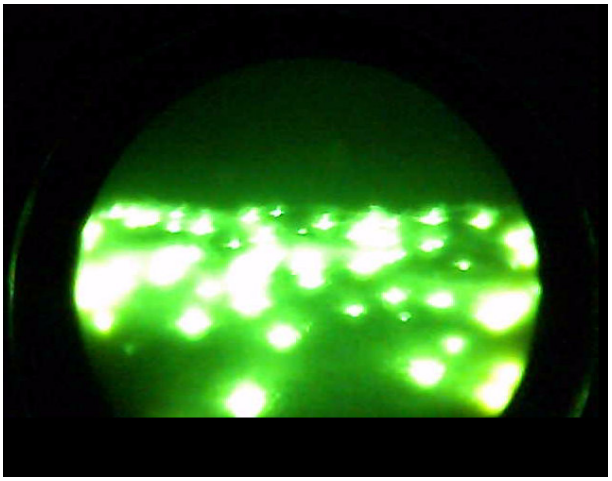
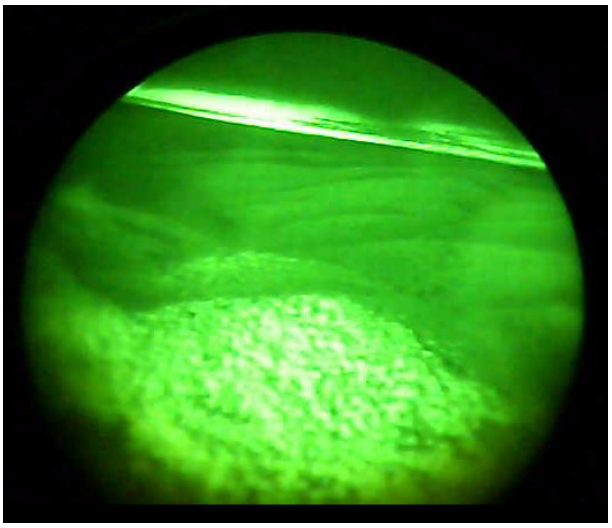
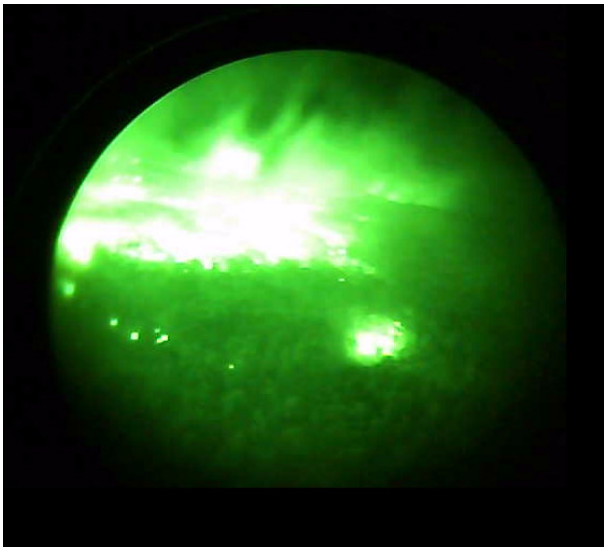


NVG vision of aerial incendiary lines – Rockland FRB – approx 0020 hrs



Example of terrain definition – reflected firelight in foreground – Distillery Ck FRB – approx 2230 hrs



NVG vision of Cobaw FRB – approx 2300hrs