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PROBLEMS AND SUGGESTIONS ABOUT FLYING WITH NIGHT VISION GOGGLES

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ABSTRACT

Flight with Night Vision Goggles (NVG) will continue to be a capability providing superiority for modern armies in the next century as well. Besides, it will also be possible for helicopters to be in service of humanity 24 hours by NVG flight techniques that has also began to be used in civil aviation. It will be the most widely applied method in night search and rescue operations during natural disasters such as earthquakes and floods.

Besides the advantages it will provide, high flight risks involved and requirement for additional equipment, make this technique special. NVG flights will be more reliable with the technological advances in helicopters and flight instruments, along with transfer of the flight experiences to the future. Experiences gathered from the flights for military purposes until now, will provide guidance for civil aviation.

Key Words: Night Vision Goggles

GECE GÖRÜŞ GÖZLÜĞÜ UÇUŞU SORUNLARI VE ÇÖZÜM ÖNERİLERİ

ÖZET

Gece Görüş Gözlüğü (GGG) ile uçuş gelecek yüzyılda da modern ordulara üstünlük sağlayan bir yetenek olacaktır. Bununla birlikte sivil havacılıkta da kullanılmaya başlanan GGG uçuş tekniği ile helikopterlerin 24 saat insanlığa hizmet etmesi beklenmektedir. Deprem sel gibi tabii afetlerle çeşitli kazalarda ihtiyaç duyulan gece arama-kurtarma faaliyetlerinde en çok kullanılan ve kullanılacak olan uçuş tekniğidir. Sağlayacağı faydaların yanı sıra uçuş riskinin yüksek olması, ilave teçhizat gerektirmesi bu tekniği özel hale getirmektedir. Helikopterler ve gece uçuş teçhizatındaki teknolojik gelişmeler ile uçuş birikimlerinin geleceğe aktarılmasıyla GGG uçuşları daha emniyetli hale gelecektir. Bugüne kadar askeri maksatla yapılan uçuşlardan elde edilen tecrübeler sivil havacılığa ışık tutacaktır.

Anahtar Kelimeler: Gece Görüş Gözlüğü Uçuşu

1. INTRODUCTION

Civil and military flights are made as “Visual Flight Rules (VFR)” and “ Instrument Flight (IFR)” in the daytime and at nights. In addition to night flights made for civil purposes, military night flights have another technique applied with Night Vision Googles (NVG).

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The use of these techniques are not allowed by authorities. However, American Civil Aviation Authority (FAA) allowed aided (NVG) night helicopters flights(Ambulance, Police) on the purpose of civil aimswith a decision taken on January 29, 1999 (Salazar And Nokagawara, 2003: 42). With this decision taken for humanistic reasons, it is seen that NVG flights made for military purposes bring many benefits especially for transporting patients and the wounded.

After permiting NVG flights in civil aviation, The USA have learned so much from the accidents occured during military flights and have taken various precautions in order to prevent smilar mistakes in civil aviation. One of the most important precautions is to develop NVG technology. The second one is improving traning quality. For this aim, The USA established a cooperation with The UK, Europe, Australia civil aviation authorities. On the other hand, Turkey, being a member of Europian Civil Aviation (JAA), is to apply NVG flight standarts to end the studies on this issue. The experiences gained from the military purpose NVG flights can be directed to possible requirements that may be exist in civil aviation.

2. THE HISTORICAL DEVELOPMENT OF THE NVG

The first type NVGs were provided in 1969 for pilots to use during night helicopter operations. In 1971, The USA Armed Forces Army evaluated tactical helicopter use again and reached the result that field flights at nights have vital importance as in the daytime. Firstly AN/PVS–5 was begun to use as the pilots night vision system. These viewing tools, firstly produced for pilotage, and then reached the level in which that can be transferred to command control centres with targeting and digital vision transfer, other air vehicles and the others in need. Second generation vision enhancing tubes were used in the initial AN/PVS–5 series. In order to reduce the limitations of AN/PVS–5 AN/PVS–6 was developed in 1986. In AN/PVS–6 third generation vision intensifying tubes which doubles the light power compared to AN/PVS–5 were used. The first system, called zero generation, was started to be used at the end of 1950s and in the beginning of 1960s. System has sensibilty to 60 photons in lumin and blue-green photocatod (lumin is the quantity of the photon that human eye can receive in a second). To create high voltage electrostatic visible vision, it focuses and reverses the current of electrons before they hit phosphorus screen. Zero generation enhancers have big volumes and geometrical disorder complaints. The NVGs developed as the second generation have nearly the same volume. Although first generation NVGs' performance is better in lower light levels, the complaints about geometrical disorders (bending, curving and shivering) are continuing. As a result of big technological developments, the second generation emerged in 1970s. Microchannel plates that gave better results in lower light levels were utilized. Thanks to the plates the second generation NVGs became smaller and larger. Another benefit of microchannel plates was that they eliminate geometrical disorders. Third generation NVGs were begun to be used in the beginning of 1980s. In this generation of NVGs, ultra-vision intensifier in high resolution were used. As result of those developments, far more exact vision can be obtained in much lower light levels. With third generation NVGs, a vision area upto 40 degree may be gotten. There is some information that there are some studies to increase the vision area upto 100 degree in the USA but they haven't declared the results. Without doubt, getting colour vision is still one of the most important objectives (Korkmaz, 1999: 20–32)

3. NVG FLIGHT

Flying with NVG technique, which makes landing and taking off possible any kind of area that aren't iluminated at night, provides some advantages, but this technique runs the risks such as weak vision, losing depth feeling, causing colour jam. So, this technique requires flight experience. In addition to night flight's being a more difficult and dangerous flight technique compared to daytime flight; night flight, compared to daytime flights, is a flying technique which is more complicated and which requires detailed study, because of precautions such as phsyological and physiological stress, crew resistance, crew formation and coordination, environmental light, special light requirements, inadequate night vision, the aircraft's requirement of additional preparations and maintenance.

As in all the flights, the most important things in NVG flight are having an excellent vision, having information about vision misjudgements and applying them to flight very carefully. So it is required that NVG flight, its risks, education, equipments and precautions are have to be stated and well learned by the flying personnel. Human eye is one of the most developed organ but in terms of sharp vision some birds having only two foveas can see better than humans. Again some animals which are active at nights have better ability to adapt themselves and sensibilty to darkness. And some creatures can perceive the ultra-violet light which is invisible to human eye. In spite of these inadequations in terms of these very special functions, human eye is superior in many respects. For example; human eye has the ability to see far and close clearly. Although it can not persieve ultra-violet light, its ability to see colours is very developed and it is adaptable to light and darkness. Because eyes are situated at the front of head and the half of the neural axons from both retinas crossing, objects can be observed 3 dimentionally as called streoscopic vision. Again human eye, despite many animal eyes' limited movements, has a wide range of movement ability and so wide range of vision area (Fırat, 1980: 63–85).

Cornea is permeable to electromagnetic light between 300 nm and 200 nm from ultraviolet to infrared. Permeability is nearly 80 % in 400 nm. and 100 % between 500–1200 nm. beyond 1200 nm. there are two absorbing areas, but jumpings between these long wave lenght are a lot. Due to the fact that wave lenghts more than 100 nm. aren't absorbed by photoreceptors in retina, sensorial stimulous do not occurred. Those are captured by retina pigment epitel and transformed into heat. Ultraviolets' 365 nm. wave lenght and under 365 nm. partially absorbed by cornea. All the part which passes is absorbed by lens and does not reach the retina.

If the density of light is increased retina can be stimulated with lights at 317 nm. for ultraviolet and 100 nm. for infrared. Cornea is permeable to 100 % of the light between the wave lenghts about 400 nm. and 700nm. which is the visibile part of electromagnetic spectrum.

In order to see, electromagnetic radiation should be perceived. This electromagnetic radiation is consist of rhytmic osilaiton and energy whose speed in vacuum is 186000 miles per second. The wave lenght of electromagnetic radiation can be thousands of metres as radio waves. Also it can be in very small fractions as in gamma lights. Electromagnetic waves can be reflected, absorbed, or transmitted only the energy which is absorbed can form reaction. Many wave lenghts pass through human body without making any physiological width and stimulus (Başaran, 2002: 508-520).

Atmosphere is full of many radio waves. But they are not absorbed or perceived. On the other and the electromagnetic spectrum's part which has 400–700 nm. wave lenght is visible light and it passes through eye's transparent regions and absorbed by photosensitive pigment in stick and conic cells and starts chemical reactions which form seeing impulse (1 nanometre (nm) is 1/1billion of a metre). The energy in wave lenghts at higher and lower frequencies is absorbed by cornea and lens or can be transferred by the the whole part of eye. Those do not lead to a photochemical reaction in retina, and so they are not perceived.

X- rays perceived as a green light for an eye which has been adapted to darkness. Cosmic lights are perceived as mini light sparkles and they are best recognised by the ones who have experianced a space journey. The part of electromagnetic spectrum which is known as visible light (400–700 nm.) is absorbed by conic and stick pigment and transmitted to brain as a neural impulse and a subjective feeling emerges. Vision feeling at the same brightness isn't always emerged with equal quantities of radiant energy in different wave lenghts. By luminous unit it is regarded that the part of radiant light energy which makes observer feel brightness. Photobic or coni lumination function is the sensibility of human eye and maximum sensibility is 507 nm. When looked in faint light, object can be seen as colourless.

There are three different visions according to light level. They are; photopic, mezopic and scotopic visions. Photopic vision is the vision at day light level or intensive artificial light level. colours are visible, there is central vision. The vision is sharp. Mezopic vision is the vision at dawn/sun set light level. full moon continues till the light level. Colours change and sharpness decreases. Rod and cone cells have insufficient use areas. Scotopic is night vision. Full moon is at lighted level lower than light level, there is colour blindness (colours can not be differentiated, comments may be made on difference in contrast). Central blind point extends upto 5–10 degree. Resulotion of this weak vision which requires an environmental vision is 20/200 or worse. Objects can be recognized with their silhouettes. Vision is made by stick cells.

The event that the eye's sensibility to light increases when it is in darkness is called darkness adaptation. This is related to some biochemical factors and some neurological factors which are not commonly well known. Passing from bright light to darkness is a frequently seen event. For instance; the people who go to the cinema in day time or go out of an illuminated room at night have this experience. First they can see very little, after a few minutes they see dark figures and big outlines as the time passes and they are more adapted to darkness they can see more details. Adaptaion to darkness is the process of increasing the eyes' sensibility to lower levels of light. Darkness adaptation of individuals realizes in different degrees and proportions. In the first thirty minutes the sensibilty of light becomes about 100.000 times more. After this period the increase in the sensibility is very little.

The lower the light level in the beginning is the sooner adaptation to darkness exists. For instance, adaptation after getting out of a dark room needs less time than that getting out of an illuminated room.

In minimum light conditions, adaptation to darkness reaches its maximum level in 30–45 minutes. An adapted eye loose its sensibilty depending on the power of light and the perion in which it is affected by a bright light. The effect of the short flashes emerged from the white light in aeroplanes (xeon/strob) to the night vision is very little. If one looks at head

of a car or a flash of lightening, the adaptation is harmed seriously. In this kind of situations, 5–45 minutes are needed to adapt again. Night vision equipments affects adaptation to darkness. If a person who has been adapted to darknes before wears NVG puts of his goggles, reaches 30-minute-adaptation level in 2 or 3 minutes. An additional period of time to adapt to darkness is not needed by people using night vision equipments. The vision provided by these goggles in infact photopic. But the lower level of lights provided by the goggles doesn't make rodopsini fully ineffective, and using the goggles doesn't decrease the adaptation seriously [3]. Owing to the fact that the vision provided by using the NVG is photopic and the central vision is the last one to be affected by hipocsia, over vision is not significantly affected. Close one of your eyes during spontaneous high light level (lightening, and flash light) eyes are independent in terms of adaptation to darkness. Turn of the outer lights of helicopter (according to the instructions). Use red goggles before flight. Adjust cockpit lights to the minimum readable level (Anonymous, 1988: 24-36).

Flying with NVG requires some special arrangements that aren't required in other flight techniques because of the risks and difficulties it involves. Due to being loyal to these arrangements, accident rate is very low. The pilots who are adapted to fly with NVG in any kind of helicopter accomplish all of the specified flight training missions in order to preserve their flying abilities with NVG. Pilots who do not involved in NVG flights, get through a refreshing training according to the time that they do not fly. The pilots that they do not fly with NVG in a period of time can not be sent to flight without getting that training (Anonymous, 1991: 61-137).

NVG flight needs a whole cooperation of crew and a team work. To provide this, the crew should work and be trained together. Especially cockpit speeches are very important. The crew should be chosen carefully. While composing the crew it must be taken into account to macth the inexperienced staff with the experienced ones.

Vision may be affected by special weather conditions. The proportion of clouds affect and light coming from the moon and the other resources. As it is mentioned before, effects that limit the vision such as fog and mist can limit the light needed. It is important to provide enough light and to give required time for pre-flight activities. If it is not needed, doing PFC (PRE-FLIGHT CONTROLS) should be avoided. If it is compulsory, non-filtered white light should be used during PFC. The maintenance of air vehicles which will fly at night should be done very carefully and in detail. Additional time for maintenance should be given and last controls should be done before flight in daytime conditions (Anonymous, 2001: 8-45).

4. CONCLUSION

In near future, civil aviation authorities are expected to give permission to NVG flights. As in many issues, the developments realized for military purposes are known to be a part of civil life in time. If this probability comes into reality, flying safely with NVG in civil aviation depends on transmitting the existing information and experience related to this issue in TSK to civil aviation. Owing to vision limitations night flight is a more difficult and dangerous flight technique compared to daytime flights. A pilot having 200-degree vision sight in normal conditions is forced to fly with a 40 degree vision sight during NVG flight. To fly safely in these conditions in which depth feeling is lost very few precautions

can be taken. These precautions are: having sufficient information related to NVG filght, reaching physical flight standarts and preserving them.

One of the most essential issues is to obey the flight discipline and rules. Psychological readiness to flight and planning are as important as the other issues. Pilots preparing themselves for a flight mission are to prepare in detail. When compared to daytime flights with night flights, in addition to daytime flights, face various difficulties such as a heavier helmet, a decreased visual purity, a narrow angle of sight, mistakes in distance and depth perception.

All these difficulties increases the stress on pilot during flight. No matter do we not eliminate all these difficultties, we can decrease them to the minimum level.

NVG is risky flight tecnique as the big opportunity proportions it provides. Thus, before flight the pilot and the helicopter should be prepared for the flight carefully. In addition to all these, technological developments in NVG will bring positive effects to flight safety.

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