

## **Visual Warning System (VWS) POSSIBLE QUESTIONS AND ANSWERS**

### **I. OPERATIONAL CAPABILITIES/R&D/TESTING**

#### **Is the VWS a laser?**

Yes, a low-intensity Class I laser that is eye safe at all distances. The VWS is safer than laser pointers and can be directly viewed for extended time (up to eight hours). The system is considered a Class I laser device, that is, the safest class possible. There is no eye hazard associated with viewing the beam. In comparison, green or red laser pointers are typically Class IIIa, which have the potential for causing eye damage if viewed beyond ¼ second.

#### **Why is NORAD doing this now?**

NORAD is employing the VWS now as a way to enhance the safety and security of people and infrastructure in the National Capital Region and to ensure the safe air operations over the NCR. It is intended to warn a pilot who has inadvertently entered the ADIZ and cannot be contacted by radio.

#### **News reports have said terrorists may use lasers to down planes. You say you're also using lasers against planes. What's the difference?**

The basic difference between the VWS laser and the type of laser that could be used by a terrorist is the eye safety of the laser being used. The VWS is a class I system which is completely safe if viewed in all conditions. In contrast, terrorist would typically use class III or IV lasers which can cause permanent eye damage.

#### **How will pilots know if they are being "lit up" by NORAD or a terrorist?**

The VWS uses an alternating RED-GREEN-RED signal to warn pilots. A terrorist most likely would use a single color. This signal will be directed at specific aircraft from a ground station and will be the same for all violators. The signal will illuminate the cockpit and will be visual to the pilot. What the pilot sees is a bright dot of flashing red/green light which stands out among the many city and radio tower lights at night or scenery clutter during the day.

#### **Have lasers ever been used in this capacity before -- to warn aircraft?**

No. FAA Air Traffic Control Towers currently use high powered spotlights with red, green or no lens cover as a means of signaling, alerting and warning aircraft. Spotlights were considered in this application, however, it was found that laser light is much more discrete in ensuring the warning is not seen by other aircraft flying near the offending aircraft.

#### **Where and when? As part the NORAD Atmospheric Warning System or some other militarily operated system?**

No. FAA Air Traffic Control Towers currently use high powered spotlights with red, green or no lens cover as a means of signaling, alerting and warning aircraft. Spotlights were considered in this application, however, it was found that laser light is much more discrete in ensuring the warning is not seen by other aircraft flying near the offending aircraft.

**Are there plans to expand the system beyond the NCR?**

No. At this time, NORAD will only employ the VWS in the NCR.

**What locations in D.C will the laser beam be “fired” from?**

Due to operational security concerns, we will not provide this information but VWS will be employed to enhance the safety and security of people and infrastructure in the National Capital Region and to ensure the safe air operations over the NCR.

**Is more than one laser operational now? How many lasers eventually?**

The system is projected to utilize multiple lasers around the NCR. For reasons of operational security we are not able to specify how many or when each one becomes operational.

**Would you use all lasers at once to illuminate an aircraft?**

The VWS operators will decide upon the most appropriate method of attracting a pilot's attention.

**How does the system track aircraft?**

The reasons of operational security we are not able to discuss precisely how the system tracks aircraft, but it employs the use of radar.

**At what point during flight would an unauthorized plane be lased?**

Only aircraft that are unauthorized or unidentified (e.g. no flight plan, no transponder signal) AND unresponsive to Air Traffic Control will be visually warned. The NAWS radar data provides a cue to point the VWS at the intruding aircraft. The radar data is used to track the aircraft so as to precisely direct the eye-safe red and green light beams at the intruding aircraft.

**Who has responsibility for “lasing” an aircraft? Does NORAD or FAA make the call? Is there an approval chain similar to “shoot down” that must be followed?**

For operational reasons, we do not discuss rules of engagement, but members assigned duties as part of NORAD's layered defense of the NCR will control the VWS.

**How will you notify pilots that you are implementing VWS?**

The FAA will issue a Special Advisory Notice. We will also assist with an education campaign to inform aviators about this new system before it is implemented.

**Can you give a scenario of how the system would work? Is there a sequence of warnings -- fighters, flares, lasers, and then shoot down?**

For operational reasons, we do not discuss rules of engagement concerning interaction of military aircraft patrolling the skies over North America, but VWS will be employed as part of NORAD's layered defense of the National Capital Region.

**Are there restrictions on the use of the laser – i.e. phases of flight (landing, takeoff, en route, etc.)**

While we do not discuss specifics related to the employment of VWS, several safety measures have been incorporated into the design to ensure only aircraft that are unauthorized or unidentified (e.g. no flight plan, no transponder signal) and unresponsive to ATC will be visually warned.

**Would fog, clouds, rain or other atmospheric disturbances render the system useless?** The VWS cannot penetrate clouds and will only be effective in warning pilots during visual meteorological conditions (VMC).

**Can planes near the illuminated aircraft see the VWS lights too?**

We are capable of illuminating the aircraft of interest without affecting nearby aircraft.

**Can people on the ground see the VWS lights?**

On a clear day/night, no. People might see reflections of green and red light on the clouds.

**Why aren't the current fighter/flares procedures adequate to warn pilots?**

VWS will be part of the overall layered defense of the NCR. Using a series of flashing lights, it provides all involved with securing the airspace over the NCR a rapid means of contacting pilots when radio attempts have failed. Should the VWS warning go unheeded, further defensive measures, to include fighters/flares, will be taken.

**How much does this system cost? Please break out into R&D costs and operational costs.**

We cannot provide this answer because of classification.

## **II. HEALTH AND SAFETY**

**Who developed this laser? (Air Force)**

The VWS uses a commercially available but specially configured solid-state green and red laser system and has specific optics to make it eye safe for viewing at all distances. For security reasons, a specific manufacturer and model number cannot be given. The system uses a standard 11" telescope to point the beam at a specific aircraft.

**Is it commercially available so as to be exploited by those with less than honorable intentions?** The lasers used in VWS are commercially available, are typically used in research projects, and are not eye safe as purchased from the manufacturer.

**What kind of testing has been done to prove the safety of this system?**

Both developmental and operational testing including biomedical effects and flight testing. As part of the Air Force Research Laboratory's support in the development of the VWS, AFRL's Air Force Research Laboratory, Optical Radiation Branch (AFRL/HEDO), experimentally determined the safe exposure levels of simultaneous green and red lasers to establish the maximum operational parameters for the system to be safe at all distances. HEDO also conducted experiments to assess the effects on pilot attention, navigation and signaling. After the system was built, HEDO conducted a complete laser emission safety analysis on a system in an operational condition to verify laser energies and the eye safety of the device. The AFRL test results has been reviewed and endorsed by the Air Force Surgeon General's Office.

**Who conducted the tests?**

The Air Force Research Laboratory, Optical Radiation Branch (AFRL/HEDO), located at Brooks City-Base, Texas.

**What did the tests show?**

Both pilots and non-pilots were used in the AFRL tests which showed that the VWS satisfactorily got the attention of test subjects without interfering with their tasks. In addition, the system, as measured, is considered a Class I laser device, i.e. the safest class possible with no eye hazard associated with viewing the beam.

**How does this compare to, say, laser pointers?**

By comparison, green or red laser pointers used in a typical office environment are typically Class IIIa, which have the potential for causing eye damage if viewed beyond ¼ second. The VWS lasers can be projected to longer distances because the beam is larger in diameter.

**How safe is VWS?**

According AFRL/HEDO, the VWS is safer than laser pointers and can be directly viewed for extended time (up to eight hours). Also, according to AFRL/HEDO, the attention properties of the VWS have no adverse affect on a pilot's ability to pilot and navigate an airplane.

**What is the purpose of AFRL's Optical Radiation Branch?**

The purpose of AFRL/HEDO is to investigate laser effects on eyes, establish safe exposure levels, provide guidance on the safe use of lasers, and develop protective equipment against threat and hazardous lasers. AFRL/HEDO also conducts a complete laser safety analysis of all new AF military laser systems prior to acceptance into the Air Force operational inventory.

**Were the results peer reviewed?**

All experiments were reviewed by an independent Institutional Review Board (IRB) to ensure the safety of the experiments. In addition, the safety analysis was reviewed by the Air Force Surgeon General's office.

**Are the results available for public release and where can I get them?**

To obtain a full copy of the experimental results, please contact AFRL/PA office, Ms. Deborah Csutoras at 1.937.656.9876.

**How long was/has VWS been tested?**

The VWS concept for human effectiveness has been under test by HEDO since June 2003, which included laboratory studies of safety thresholds for red/green lasing, attention properties, and effects on pilots.

**Isn't there a danger that pilots or passengers eyes could be damaged?**

No. After the system was built, HEDO conducted a complete laser emission safety analysis on a system in an operational condition to verify laser energies and the eye safety of the device. The system, as measured, is considered a Class I laser device, i.e. the safest class possible which has no eye hazard associated by viewing the beam. In comparison, green or red laser pointers are typically Class IIIa which have the potential for causing eye damage if viewed beyond ¼ sec. The VWS is safer than laser pointers and can be directly viewed for extended time (even up to eight hours).

**Couldn't this affect the planes navigation or communication systems?**

No. Pilot's can safely operate an aircraft at these levels. The laser power is much less than a sun glint and is less than the power for FAA regulated critical flight zones for commercial laser shows. What the pilots see is a bright dot of flashing red/green light which stands out among the many city and radio tower lights at night or scenery clutter during the day. The VWS also does not affect any aircraft systems.

**Is there a danger to people or structures on the ground?**

No. It is a point-to-point system that will be employed skyward. Safety measures have been incorporated to ensure the laser does not operate below the horizon. Research has shown VWS to be safer than your average laser pointer.

**III. APPROVAL PROCESS/POLICY**

**What's the authorization process to implement such a system?**

NORAD made the proposal to the Secretary of the Air Force for inclusion of the VWS in the NORAD Atmospheric Warning System. The SecAF then asked the FAA for its non-objection for use in the NCR. The USAF sent a request to the FAA to operate a laser device in the National Capital Region (NCR) and is awaiting their response.