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March 25, 2003

Docket Management System,
U.S. Department of Transportation
Room Plaza 401
400 Seventh Street, SW.
Washington DC 20590-0001

Reference: Docket Number FAA-2003-14449

Max-Viz, Inc. is pleased to offer the enclosed comments to the Enhanced Flight Vision Systems (EFVS) NPRM dated February 10, 2003. We fully support the FAA in recognizing that emerging technologies, such as Enhanced Vision Systems (EVS), can bring numerous operational and safety benefits to operations conducted under 14 CFR Parts 1, 91,121, 125 and 135. By revising the regulations for takeoff and landing under instrument flight rules (IFR) to allow for the use of EVS, aircrews will experience increased situational awareness, improve approach completion rates, reduce operational costs and significantly increase IFR safety margins. In addition, as EVS has been demonstrated to provide significant operational and safety benefits at night and during periods of marginal VMC, EVS in fact can be used to gain additional operational and safety benefits when operating in most environmental conditions. Further, EVS has been shown to be beneficial during both ground and flight operations and is suitable for use throughout the entire mission profile.

This NPRM demonstrates a positive step forward in recognizing the many operational and safety benefits offered by advanced system designs. However we do suggest that the proposed 91.175 retain use of the term “EVS” and be revised to eliminate language that specifically addresses technical or system design specifications (place this removed, but important, language in advisory material) and substitute language that clearly addresses operational requirements. Approval of EVS or other new systems should be based on demonstrating equivalent levels of safety and performance to that of currently approved instrument approach and landing systems. Specific comments and recommendations on the NPRM are enclosed.

Max-Viz stands ready to assist the FAA and/or participate in an industry working group to revise the language contained in the current NPRM. We also support full harmonization with the JAA, and look forward to providing operational and technical assistance to the process.

Original signed

Gregg R. Fawkes
President

encl: Response to NPRM Docket No. FAA-2003-14449; Notice No. 03-03
c: Les Smith, FAA

Response to Department of Transportation

Federal Aviation Administration

NPRM
Docket No. FAA-2003-14449; Notice No. 03-03
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Enhanced Flight Vision Systems (EFVS)

Max-Viz, Inc.
Portland, Oregon
March 25, 2003

1.0 Introduction

Max-Viz, Inc. is pleased to offer comments to the Enhanced Flight Vision Systems (EFVS) NPRM dated February 10, 2003. We fully support the FAA in recognizing that emerging technologies, such as Enhanced Vision Systems (EVS), can bring numerous operational and safety benefits to operations conducted under 14 CFR Parts 1, 91,121, 125 and 135. By revising the regulations for takeoff and landing under instrument flight rules (IFR) to allow for the use of EVS, aircrews will experience increased situational awareness, improve approach completion rates, reduce operational costs and significantly increase IFR safety margins. In addition, as EVS has been demonstrated to provide significant operational and safety benefits at night and during periods of marginal VMC, EVS in fact can be used to gain operational and safety benefits when operating in most environmental conditions. Further, EVS has been shown to be beneficial during both ground and flight operations and is a technology suitable for use throughout the entire mission profile.

Max-Viz EVS research, development, testing, and certification activities to date fully supports the FAA assessment contained in the EFVS NPRM that:

- Pilots…..can use EFVS to have better situational awareness than may be possible without it.
- EFVS…..improves pilots ability to detect objects that otherwise would not be visible.
- EFVS…..allows operations in reduced visibility that would not otherwise be possible.
- EFVS…..allows for increased operational benefits, reduced costs and increased safety.

- EFVS…..may improve the level of safety by improving positional awareness, providing visual cues to maintain a stabilized approach, and minimizing missed approach situations.

This NPRM demonstrates a positive step forward in recognizing the many operational and safety benefits offered by advanced system designs. However we do suggest that the proposed 91.175 retain use of the term "EVS" and be revised to eliminate language that specifically addresses technical or system design specifications (place this removed, but important, language in advisory material) and substitute language that clearly addresses operational requirements. Realization of EVS benefits and other significant technology driven operational and safety enhancements are dependant on structuring language within this NPRM that encourages further technological development and does not specifically limit system design. This will ensure that we achieve the potential operational and safety benefits offered by additional systems integration and/or application of rapidly improving imagers, processors and displays. It will also encourage exploration and certification of other innovative system architectures that may well offer additional economic, operational and safety benefits. It remains important to avoid rule making language that narrowly defines acceptable systems and technologies, which more appropriately should be considered for advisory material. The rule should instead, address fundamental operational requirements. Approval of EVS or other new systems should be based on demonstrating equivalent levels of safety and performance to that of currently approved instrument approach and landing systems. Specific NPRM recommendations are included at the conclusion of these comments.

Max-Viz stands ready to assist the FAA and/or participate in an industry working group to revise the language contained in the current NPRM. We also support full harmonization with the JAA, and look forward to providing operational and technical assistance to the process.

2.0 Max-Viz EVS Background

Max-Viz team members have been actively engaged in researching, developing, testing and certifying the fundamental imaging and display technologies used with EVS for more than fifteen years. In addition to our own proprietary work, numerous Max-Viz team members have participated in virtually all of the EVS programs conducted to date by the FAA, NASA, and the military. Our latest, state-of-the-art, microbolometer based infrared cameras have recently been certified, with additional certification programs in progress. These Enhanced Vision Systems (EVS) are designed to improve aircrew Situational Awareness (SA) by providing a supplemental display of real world "cues" that would otherwise not be visible due to darkness or reduced visibility. Improved situational awareness enhances judgment and decision making, increases operational efficiency, improves aircraft safety margins and directly addresses, among other benefits, three major industry safety concerns: Controlled Flight into Terrain (CFIT), Approach and Landing Accidents, and Runway Incursions.

Current systems consist of a microbolometer based Infrared (IR) camera, supporting hardware, cockpit displays and system controls. The image can be displayed on either a raster capable Head-Up Display (HUD) or on video capable Head-Down Displays (HDD) such as Multi-Function Displays (MFD), Control and Display Units (CDU), Primary Flight/Navigation Displays (PFD/ND) or stand alone dedicated displays mounted within the pilots primary scan or positioned for easy viewing within the cockpit.

IR cameras based on non-cryogenically cooled microbolometers are the current sensors of choice for EVS use. They are small, light weight, reliable, and affordable; and, most important, they satisfy current operational requirements. These EVS IR cameras detect extremely small temperature differences within their fields of view, creating an image that looks very similar to standard black and white video. But unlike video cameras, IR detectors work even in the absence of visible light, making them ideal sensors during periods of darkness or restricted visibility

The IR sensors used have been optimized for maximum penetration through atmospheric obscurants and restrictions to visibility. These sensors are especially effective at night and in dust, smog, smoke, and haze where IR effectively turns night into day. IR can also provide significant improvements over the visible in rain, snow and fog. The long-wave IR sensor was selected for its superior ability to image real world features such as terrain, airports, runways and taxiways, obstacles, and other hazards to safe and efficient ground and airborne operations. The short-wave sensor is specifically tuned to image the peak energy emissions of the airport and runway lighting system. These two sensors effectively allow the aircrew to "see" beyond the visible, thereby providing "early" confirmation of the expected real world visual scene and/or detection of potentially hazardous conditions. Terrain features and significant details such as runways, taxiways, aircraft, vehicles and obstacles are immediately recognizable at night when they would otherwise not be visible and they can be "seen" at considerably greater distances through restricted visibility as when compared to unaided normal visual observations. Based on our technical and operational assessment, EVS operational and safety benefits are as follows:

EVS Operational Benefits

- Improves Situational Awareness (SA) at night or during periods of reduced visibility--fog, haze, smoke, dust, rain, snow, etc.

- Provides for more efficient ground operations--fewer taxi and takeoff delays
  - Improves night and low visibility ground navigation
  - Improves "visual" detection of ground equipment ,obstacles, vehicles, obstructions and other aircraft
  - Reduces taxi clearance errors
  - Reduces taxi and takeoff delays
  - Improves ability to "visually" ensure that the runway is clear of other traffic, obstacles or obstructions

- Improves ability to detect and avoid traffic conflicts

- Improves ability during night operations to see and avoid many isolated thunderstorms and well developed cloud buildups

- Improves ability during night operations to anticipate and perhaps avoid turbulence associated with initial cloud penetration

- Improves ability to see threatening terrain during climb, descent or low altitude maneuvering

- Improves “visual” contact with airport and terrain features

- Provides an independent “visual“ verification of approach path

- Requires minimum initial and recurrent training

- Readily adaptable to multiple aircraft types

- Complements new and emerging cockpit technologies
    - RNP/IRNAV, GPS, SVS, SGS, TAWS, TCAS, etc

- Offers potentially lower operating minima:
    - Lower than standard takeoff minima at non-centerline lighting equipped runways
    - Below 200 ft approach capability at Type I airfields
    - Cat II/Cat III on non-ILS equipped runways (may require MMW radar)

- Provides for higher instrument approach completion rates (fewer missed approaches)

- Provides early “visual” contact with airport, approach and runway lighting system and significant terrain features

- Provides early “visual” confirmation of runway alignment and approach path

- Improves ability to stay on a stabilized profile

- Improves night and low visibility touchdown performance

- Improves ability to detect and avoid traffic conflicts

- Provides a technology growth path offering additional operational and safety benefits

EVS Safety Benefits

- Reduced incident/accident potential through improved cockpit Situational Awareness (SA) at night or in reduced visibility--fog, haze, smoke, dust, rain, snow, etc.

- Increased safety margins at night and in reduced visibility—EVS helps avoid:
  - Ground traffic conflicts
  - Ground obstacles, vehicles, aircraft and equipment
  - Inadvertent departure from paved surfaces
  - Runway and taxiway traffic conflicts
  - In-flight turbulence associated with cloud formations
  - CFIT
  - Approach and landing incidents/accidents

EVS Operations

Operationally, we have found that EVS is used as a supplemental display of "real world" cues where IR images augment the normal visual scan. IR is particularly effective at night, and in smoke, haze and smog. It is also effective in a broad spectrum of rain, snow, and fog. EVS improves the pilot's ability to see ground vehicles, equipment and obstacles; other aircraft on taxi-ways and runways; other traffic during takeoff, approach and landing; the airport, runway and terrain features during climb, descent, and low altitude maneuvering; and, can be used as an aid in ground navigation. The system is designed to be used, at pilot's option, through-out the full mission profile.

EVS use is compatible with current and emerging cockpit technologies, operational philosophies and established crew procedures/responsibilities. System effectiveness has been demonstrated with various combinations of both auto and manual flight control systems, head-up and head-down cockpit displays and both single and multiple imaging sensors. We have found that when in use, the EVS image should be adjusted for optimum brightness and contrast during relatively benign phases of flight and should be cross checked in a manner similar to other cockpit displays, using short dwell times and appropriate cockpit priorities. EVS interpretation is straight forward due to image similarities with standard video. The system is designed to provide improved situational awareness by allowing rapid scene content assimilation from relatively brief image scans. Image use is similar to "out-the-window" visual scanning where general scene observations can be made, followed by specific object examination if required. Both peripheral and fovial scanning techniques are used, in a very conventional and natural way, along with routine, natural, divisions of attention and cognitive switching. The EVS image is used to supplement and augment the normal visual scan and information obtained from the EVS image is used in a similar manner as that of "real world" viewing.

3.0 NPRM Recommendations

Based on the above, Max-Viz recommends that the proposed 91.175 be revised as follows:

3.1 Eliminate reference to "Enhanced Flight Visibility (EFV)" and "Enhanced Flight Visibility Systems (EFVS)" and retain or incorporate "Enhanced Vision Systems (EVS)".

Rational: EVS is the industry recognized standard terminology for forward looking, real time imaging systems which, by their very nature, can be used during both ground and flight operations. The introduction, use, or even adoption of the basic concept of "EFV" will un-necessarily limit technological innovation and/or integration of advanced imaging aircraft systems, thus depriving aircraft operators and the traveling public of the significant economic, operational and safety benefits of EVS.

3.2 Revise the proposed 91.175 to eliminate all language that specifically addresses technical or system design specifications and substitute language that clearly addresses only the operational requirements. Place this removed, but important technical and design language in advisory material.

Rational: Realization of EVS benefits and other significant, technology driven, operational and safety enhancements will be dependant on structuring language within this NPRM that both encourages further technological development and does not specifically limit system design. This will ensure that we achieve the potential economic, operational and safety benefits offered by additional systems integration and/or application of rapidly improving imagers, processors and displays. It will also encourage exploration and certification of other innovative system architectures that may well offer additional economic, operational and safety benefits. It remains important to avoid rule making language that narrowly defines acceptable systems and technologies, which more appropriately should be considered for advisory material.

3.3 Craft specific EVS technical and system design language, along with suggested certification methodologies and place in appropriate advisory material.

Rational: Maintains consistency within established rule making and advisory material practices.

3.4 Add a concluding paragraph to the revision of the proposed 91.175 that states: "Notwithstanding provisions of paragraphs (TBD) above, the Administrator may approve use of Enhanced Vision Systems (EVS) and procedures meeting requirements other than those specified, if:

1) The systems and procedures proposed are shown to have equivalent or better performance than other approved systems, are operationally safe, effective, and

reliable for ground and flight operations including: taxi, takeoff, climb, cruise, descent, approach, landing, roll-out, or missed approach as applicable, and,
2) If visual reference requirements apply, the pilot is able to determine that flight visibility is adequate for safe takeoff or landing.

Rational: Realization of EVS benefits and other significant, technology driven, operational and safety enhancements are dependant on structuring language within this NPRM that encourages further technological development and does not specifically limit system design. It is important to avoid rule making language that narrowly defines systems or technologies, but instead addresses fundamental requirements. Approval of EVS or other systems should be based on demonstrating equivalent levels of safety and performance to that of currently approved instrument approach and landing systems.