Air Operators, Airlines, Manufacturers and Interested Industry Stakeholders & Aero Chart Forum

Utilizing EFVS technology and incorporating it into FAA NextGen

Presented to: Industry & Interested Stakeholders & Aero Chart Forum

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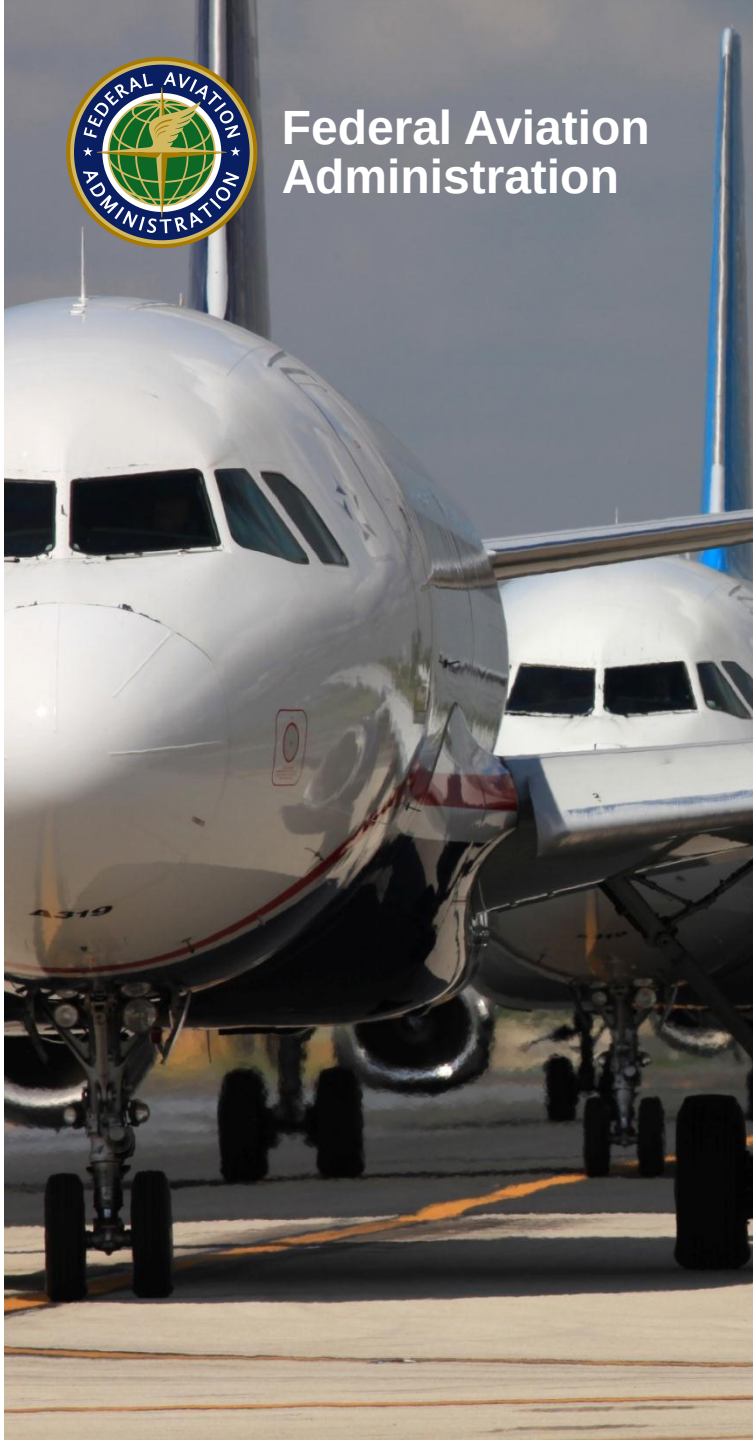


Our Background & Mission

- **FAA Aviation Flight Standards Division (AFS-400)**
  - Flight Ops Branch (AFS) 410 Branch

The Flight Operations Branch – principal directing element of AFS-400 with respect to:

- The direction, control, and execution of all flight operational aspects of instrument flight operations projects and other flight operations applications
- resulting from the introduction of new technologies and concepts.

What AFS-410 Does with LVO

- **FAA AFS-400 Division responsible for Low Visibility Operations/Surface Movement Guidance Control Systems (LVO/SMGCS)**
  - FAA Order 8000.94, signed August 2012
    - Assigned key responsibilities to FAA ATO, ARP and AVS
- **ICAO Harmonization**
  - Harmonizing US & International rules & procedures
- **US LVO/SMGCS**
  - 5 airports that operate down to 300 RVR
- **Boston OSA SMS Evaluation**
  - Lowered level 1 LVO/SMGCS from 1200-600 RVR to 1200-500 RVR
  - Now being implemented nation wide

Examples of AFS-410 Work

- **SA CAT II ILS Procedures**
- **SA CAT I ILS Procedures**
- **With SA Cat I or II ILS relief from RCL or TDS lights requirements**
- **EFVS Notice of Proposed Rule Making**
- **Improvements in LVO/SMGCS NAS operations: Level 1 now <1200 to 500 RVR**
- **Addition of PHL, MSY, AUS to program**
- **Validation of Pilot See and Avoid to 500 ft RVR**

Key Personnel

- **Terry King - AFS-410 EVFS Team Lead**
- **Bruce McGray - AFS-410 LVO/SMGCS Team Lead**
- **Andrew Burns - (AFS-410 Contractor) EFVS ODC Project Manager**
- **Philip Saenger - (AFS-410 Contractor) LVO/SMGCS**
- **Sally Frodge - (Nav Services Engineer), FAA Program Mgr ELVO**
- **FAA All Weather Operations- (NextGen 220 Offices)**
- **FAA Airports- (ANM-620)**
- **FAA ATC –(including NATCA)**
- **Operators (airlines, charters, 91k, others)**
- **Technology Companies**
- **Seattle Airport Authority** **Others You Recommend?**

Where we are right now

FAA Order 8000.94 Low Visibility Operations/ Surface Movement Guidance Control System

- LVO/SMGCS replaces what was formerly SMGCS in the US, that is known internationally as all airport ground operations

- FAA Order 8000.94 LVO/SMGCS now defines " low visibility operations" as all airport operations at less than 1200 ft RVR

Where we are right now…continued

- **Two levels per 8000.94 of visibility "requirements"**
  - Level 1: < 1200-500 RVR
  - Level 2: < 500-300 RVR
  - Level 3: <300 to 000? RVR or as close as possible
- **Clearly outlines primary responsibilities of the 3 Lines of Business (LOB)**
  - ATO, AVS & ARP
- **Provides a means for implementing the use of emerging technologies**

Our Vision for EFVS Project

- **Achieve taxi credit for specific EFVS units on participating operators' aircraft and those provided by OEMs Prove concept of < 300 RVR operations with EFVS/Moving Map**

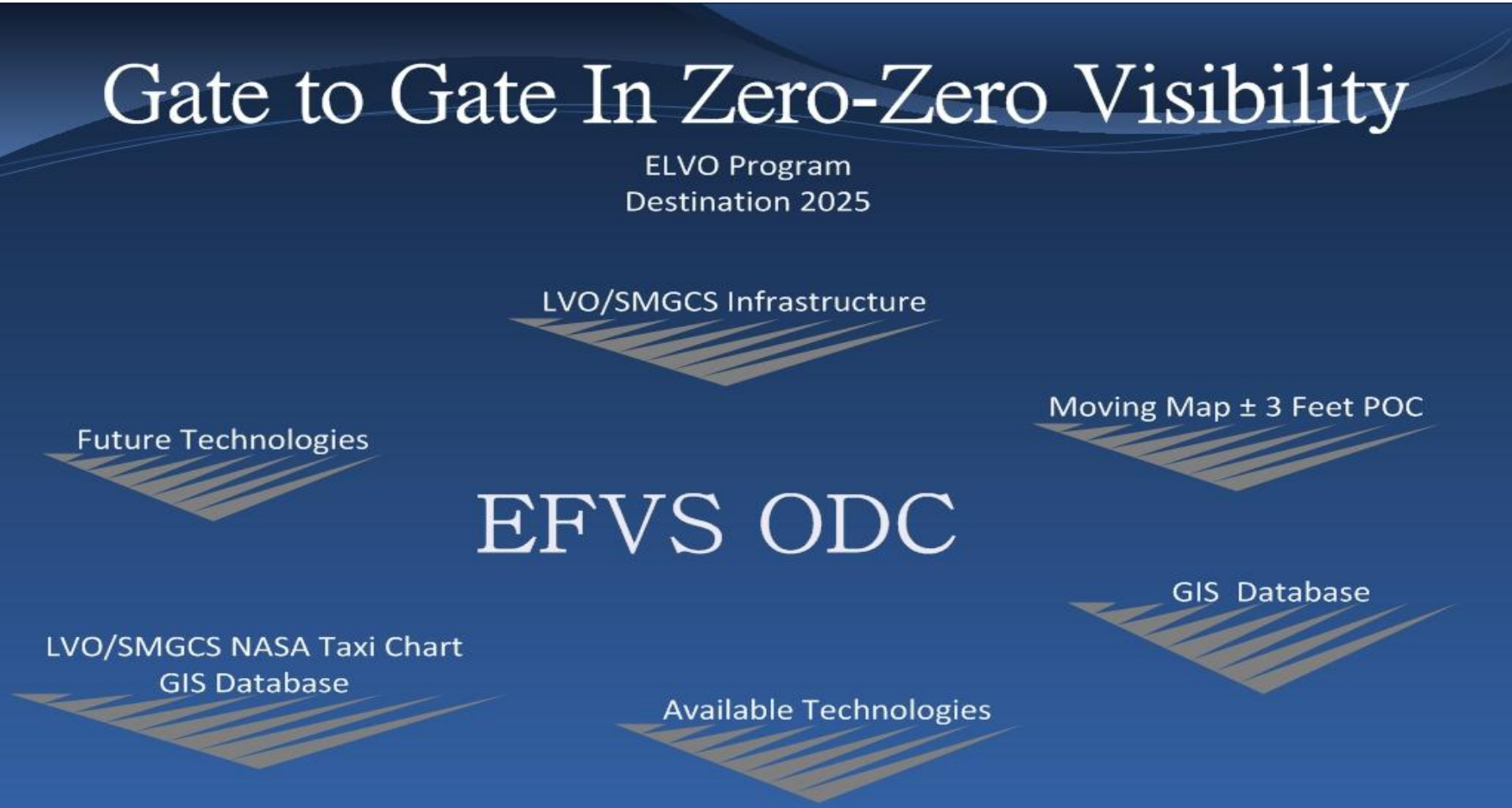
- **Prove EFVS will enable NAS members to taxi in near zero visibility and validate with data in variable weather operational conditions. Set up Level 3 operations < 300 RVR to 000 RVR**

- **Improve outlying airports' access to hubs to eliminate or reduce costly delays with Protected Low Vis Taxi Routes.**

- **Validate moving map's improved accuracy and its use for ground taxi navigation to compliment low visibility operations.**

Gate to Gate In Zero-Zero Visibility

ELVO Program
Destination 2025



Major project underway to accelerate NextGen by exploiting technological advances in support of LVO across the NAS and improve access through innovation.

Basis Of Program Goals - Elbit

- **EFVS has been certified since 2001**
- **EFVS has been certified on over 15 aircraft models**
  1. Gulfstream G150 through G650
  2. Bombardier Challenger 601 – 605 plus Global Express series
  3. Boeing B737, B757, B777, MD10/11, plus others in the works
  4. Airbus A300/310 in the works
  5. Cessna Citation
  6. Dassault Falcon Jet series
  7. Others
- **EFVS has successfully operated for over 13 years without incident**
- **Per FAA rules, EFVS can be legally used in lieu of natural vision**
- **EFVS is proven safe technology as-is today!**

How do we get there?

- **Must demonstrate it is safe**
- **How do we prove it is safe?**
  - ODC (Operational Demonstration of Capabilities) Proving EVS/EFVS taxi over specified routes
    - Use EFVS and other technologies to gather data
    - 4 phase ODC
    - Need participation from both OEMs and Aircraft Operators
    - Complete all SMS safety evaluation requirements

EFVS LVO/SMGCS Program Goal - Elbit

- ***Validate*** **<u>airport</u> movement procedures using EFVS**
- ***Validate*** **<u>aircraft</u> procedures using EFVS**

<u>No need for new rules or equippage, only validation of LVO/SMGCS procedures.</u>

Operational Validation Effort Scope - Elbit

- **Equip a vehicle** with EFVS sensors and taxi around Seattle airport in low visibility conditions replicating aircraft movement from Gate to runway end. This would be operational procedure tests instead of EVS performance assessments.
- **Validate EFVS Operations** in an airport environment – taxiing aircraft ease of use, surrounding ground equipment operating, aircraft movement, airport signage, lighting, and markings visibility, other airport elements

Details about the ODC

4 Phases of the ODC

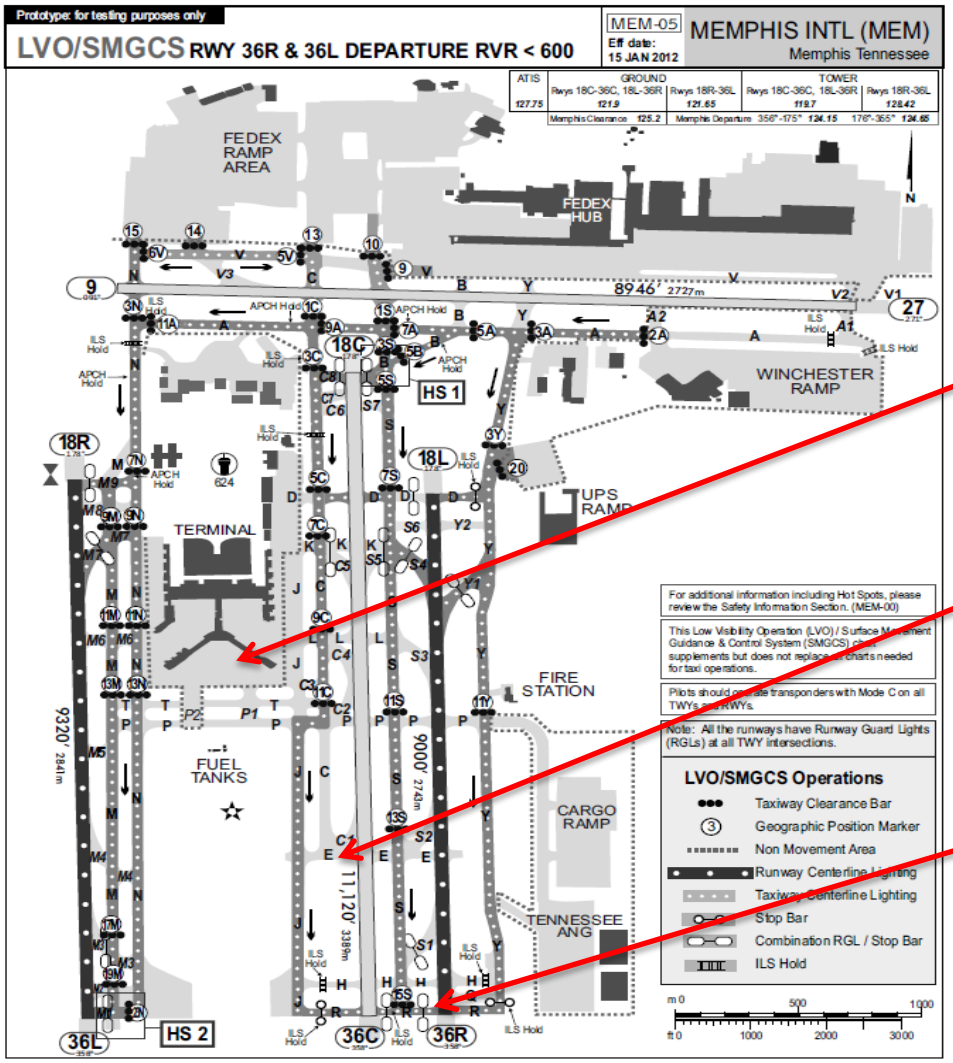
- Phase I
  - Who, what, why, where, when?
  - Prep work for EFVS operational evaluations
- Phase II
  - On site proving trials in Seattle FY16 including Level 3 proving runs < 300 RVR to 000 RVR
  - Sim Research Level 3: < 300 RVR- 000 RVR EFVS/ Moving Map
- Phase III
  - Prioritize developing outlying airports with Protected Low Visibility Taxi Routes (PLOVTR)
- Phase IV
  - Eventual taxi credit for EFVS (By the end of the EFVS ODC)

More details about Phase I

Phase I/ and III are the phases we are currently in

- FAA Human Factors are crafting data collection criteria for the ODC
- Initial data collection at two locations
  - Seattle Tacoma International Airport, WA (West Coast)
  - Otis Research Center, MA (Cape Cod Coast Guard Air Station)
- We need to review historical weather data of Seattle Airport (KSEA)
- Interested stakeholders develop a list of outlying priority airports, effected by low visibilities, that are causing them delays & operations disruptions.
- Develop a detailed planning process
  - Who will be involved
  - Locations
  - Crew training
  - FAA HQ involvement

Airport LVO/SMGCS Environment - Elbit



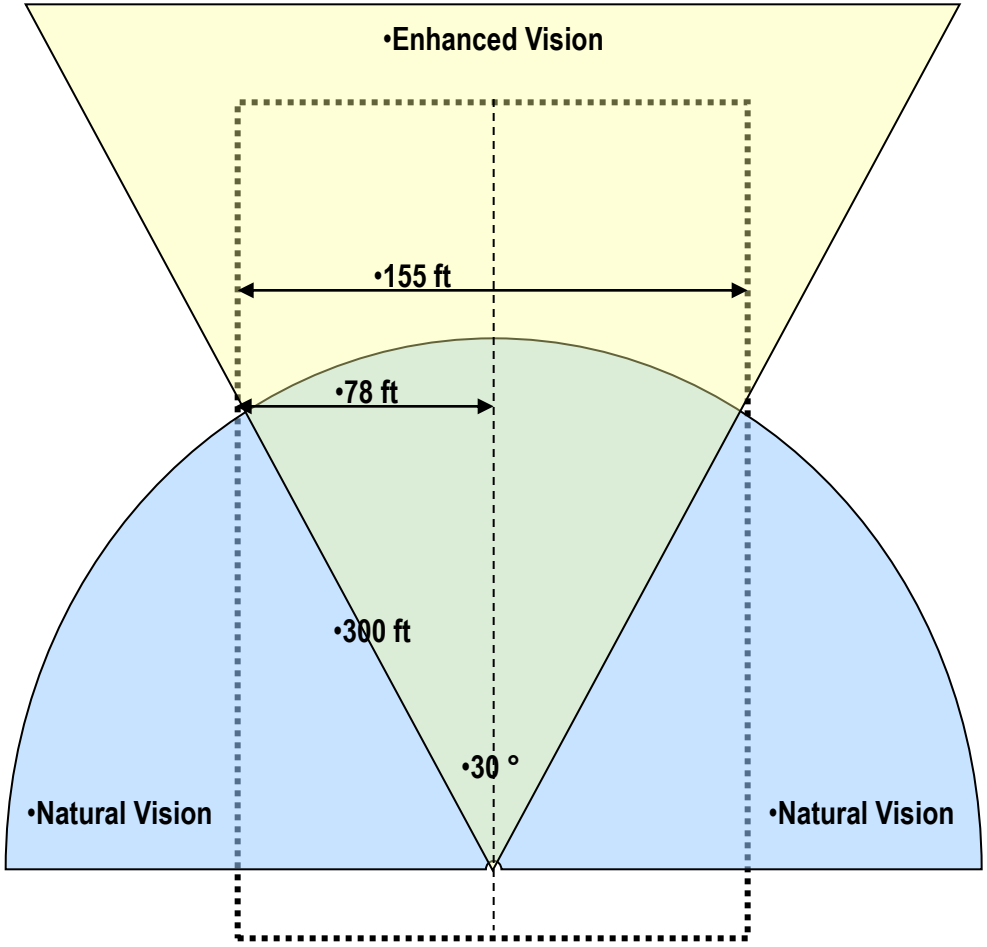
- Terminal/Ramp Area
- Taxi Way/Intersections
- Runway/Thresholds
- Crossing Runways

Operational Procedure Validation Concept Elbit

- **Gate/Ramp Area Movement Procedures**
  - Validate EFVS operations with ground crew, carts, other ramp equipment, vehicles, and aircraft
- **Taxiway/Intersections Movement Procedures**
  - Validate EFVS operations at various speeds.
  - Validate EFVS operations at intersections and with crossing aircraft
- **Runway/Thresholds Movement Procedures**
  - Validate EFVS operations at runway entrance and threshold
  - Validate EFVS operations with Charts, EFBs/Electronic Taxi Aids, signage, lighting, and surrounding infrastructure
- **Validate Operations at < 300 RVR MMEFVS**

Taxi Operations With EFVS - Elbit

- Taxi at normal speeds
- Use currently approved and/or mature design EFVS products
- FOV, EFVS video are same as HUD
- Assume Natural visibility out the front and side windows (300' RVR or Greater)
- Also evaluate < 300 RVR



•The above figure shows the edge transition point at 300 ft RVR. This would allow you to never lose sight of anything on a 155 ft wide taxiway.

Federal Aviation Administration

Martha's Vineyard Example - Elbit

- Date: 7/27/07
- Visibility: 0.2 Statute Miles
- Weather: Fog
- Sky is obscured -- vertical visibility: 200 feet

Federal Aviation Administration

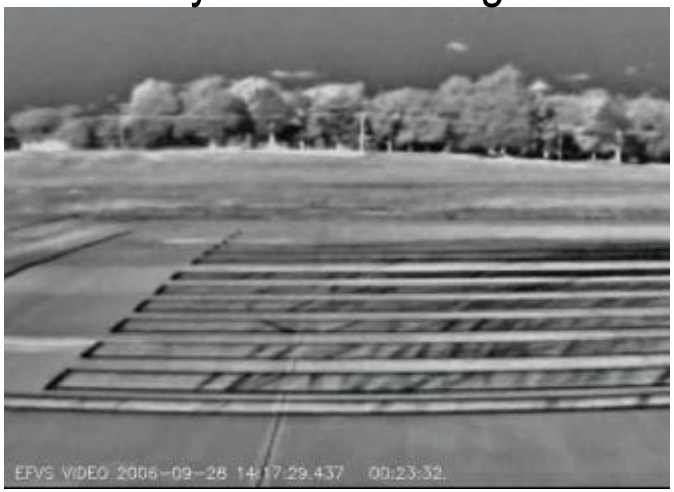
Elbit

•Surface Painted Signs

•Stop Bars at Runway Entrance

•Runway Incursions

•Runway Entrance / Alignment



Federal Aviation Administration

Key Runway Markings Through EFVS - Elbit

Key Runway Markings Seen with EFVS

- **Elbit** Systems/Kollsman to provide a car top mounting assembly with multiple EFVS sensors.
- Enables FAA Support of Operational issues and Company Proprietary work
- Allows economical long term positioning of system at KSEA for operational procedure validation tests in various weather conditions.

•ClearVision EVS

•EVS II

•EVS-SP

Operational Readiness Schedule - Elbit

- **Elbit Systems/Kollsman is ready to provide this car top setup near term starting Q2 2014**
- **In addition, we can provide access to our Cessna 340 flight test aircraft with EVS sensors on board**

More details about Phase II

Phase II will be the opportunity to evaluate EFVS systems in a real operational environment

- Target date for proving runs to begin early winter FY16
- Seattle International Airport (KSEA)
- Possibly use a modified panel truck with camera units from all interested parties in obscurations to Level 3 -- < 300 RVR
- Potentially 60 days of trials
  - Proving runs on ARP/ATO prearranged routes
  - Precise visual measurements (what can you see, what can't you)
  - ANG-C1 data collection criteria
  - Validate proving runs with multiple data points
- Collect weather data and evaluate for correlations
- Evaluate moving map presentations for which operators need accuracy validation

More details about Phase III

- **Beta trials of enhanced vision "Protected Low Visibility Taxi Routes" (PLOVTR) at operator/FAA working group selected locations**

- **Conduct EFVS/EVS proving runs -**
  Determine what airports at which the carriers/operators have the most need for such routes
- **FAA All Weather Operations (AWO) Inspectors lead in Making PLOVTR process criteria**

FAA 8000.94 Guidance for PLOVTR

Any use of emerging technologies as a suitable substitute for established LVO/SMGCS requirements will undergo a specific HQ review and approval to determine whether the technologies meet an FAA determined Equivalent Level of Safety (ELOS).

FAA 8000.94 Provision 11c for PLOVTR

- Any use of emerging technologies as a suitable substitute for established LVO/SMGCS requirements will undergo a specific HQ review and approval to determine whether the technologies meet an FAA determined Equivalent Level of Safety (ELOS).
- For unique situations regarding detection capabilities for LVO/SMGCS, the FAA/regional LVO/SMGCS team is to forward recommendations through the regional Flight Standards division for consultation with and concurrence of ARP, AVS, and ATO.

AC 120-57A 6b Provision for PLOVTR

Airport Evaluation. … no two airports/aircraft alike, LVO/SMGCS working group review the existing:

- airport layout, facilities, IFR restrictions & mins, airport ops procedures

…prior to development of airport LVO/SMGCS plan.

- Compare existing & planned ops capability with guidelines of this AC
- Determine what additional measures are necessary to achieve the desired low vis ops

More AC 120-57A 6b for PLOVTR

- Advanced technologies for below 600 feet RVR operations (e.g., enhanced vision systems (EVS), head-up-display systems (HUD), forward looking infrared systems (FLIR), and global positioning system (GPS)).

More details about Phase IV

- **Achieve taxi credit for EFVS equipped aircraft**
  - Each specific unit
  - Must be safe and cost effective
  - ATC, Airports, airport authority and operators agree on safe operations, rules, and procedures

Next Steps?

- **Your thoughts and inputs today**
- **Who else do we need to engage in this group**
- **Discuss Phase II**
- **Seattle FY16**
- **How participants may be able to assist**

Discussions and Questions?

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