Part 23 Synthetic Vision Approval Approach

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Part 23 SV Approval Approach

- Synthetic Vision – Background / Original Part 23 Concept
- How Did We Approve This Technology?
  - Risk Management
  - Synthetic Terrain / Vision
  - Pathway
- Consideration of Part 23 / Part 25 Differences
- Reality Check / Observations

History / Original Part 23
SV Concept

Synthetic Vision – Original Part 23 Concept

- GA was essentially dead in the 1980's
- No new safety innovations being developed – no market
- Large discretionary income group - sell airplanes as personal transportation
- Issues for everyone to address to have a product
  - Airplane must be simple and intuitive – training complexity and cost is obstacle for many people who would like to fly their own airplane and have the money to buy one
  - Safety equivalent to commercial ops; must raise the bar considerably

Synthetic Vision – Original Part 23 Concept

- AGATE Program – Early 1990’s
  - Industry
  - FAA
  - NASA
- What technology is needed to allow a “non-enthusiast” pilot to operate in the IFR system with only 75 hrs of training
  - All operations “DAY/VFR” by using HDD's and HUD's
  - Fly-by-wire to eliminate “stick and rudder” skill needs
  - On-screen simplified flight plan programming
    - Menu driven steps – Current FMS = DOS; need WINDOWS
    - Data-Link with ATC computer to get flight plan

Synthetic Vision – Original Part 23 Concept

Synthetic Vision – Current Results From Our Efforts

Garmin G-1000 in Diamond DA -42 Twin

Cirrus SR22 with FlightMax *Entegra*

How Did We Approve Synthetic Vision and Pathway Technology?

How Did We Approve Synthetic Vision and Pathway Technology?

- Most of the features on both the Chelton and Universal systems were not new, but already covered by existing rules, guidance, or industry standards.
- Features not covered were evaluated using multiple pilots for 1) intended function; and 2) no unsafe condition

Synthetic Terrain / Vision Existing Standards and Guidance

Universal's Vision 1 Good Example

PFD NORMAL FORMAT DISPLAY

SV Issues - Part 23 Position

Display of Terrain

- Does the terrain portrayal adequately reflect the real terrain so as to not mislead the pilot in valid operational scenarios?
- Non-Conformal display may be acceptable if the display non-conformities do not mislead the pilot and/or are transparent to the pilot in all valid operations
- SV presentation will never “look” like the real world. To be useful, the FOV will have to be greater than “unity” to see enough features to correlate terrain picture to moving map or approach plate.
- Because of this we don’t expect any applicant to try and use the terrain for determining a distance or height, or for primary navigation. At least not in the near future.

SV Issues - Part 23 Position

Terrain Data Confidence Issues

- Data base meets TAWS standard - good enough for transports on moving map
- Pilot action decisions still based on TAWS – climb (and turn) only – no additional credit for SV
- Data base standards address a process, not an accuracy validation
- TAWS data base process similar, if not identical, to process used for NAV data base which has been used for years in transport airplanes (with known errors)
- Feedback in US rapidly improving the accuracy of terrain data
- US very good, but international database accuracy questionable

SV Issues - Part 23 Position

Terrain Data Confidence Issues Cont.

- Complete database accuracy impossible to validate
- Everyone gets their data from the same original source
- Manufacturers are doing everything possible to verify the current data is accurate, but that is really just a confidence builder

If accuracy of data base must be validated then SV is unapproveable

SV Issues - Part 23 Position

Risk Management / Mitigation of Terrain Uncertainties

- No operational credit for SV – current minimums still apply
- Significant safety benefits possible – outweighs what we consider minimal risk
- Experience - large data base errors to date have been easy to recognize and report – very visible on PFD and map display
- Small data base errors such as an elevation point are likely to be insolated, so exposure to a misleading information situation is considered small
- Current resolution tends to round-up the elevation data so that small errors are not as significant and on the conservative side

Pathway

Approved based on the following

- Uses existing approved NAV signal
- Uses existing approved NAV database
- Uses standards for “magenta” line on moving map

Pathway

Approved based on the following

- Projects moving map “magenta” line on perspective display – must flight test
- Provides raw navigation data on PFD
- Pathway size acceptable for pilot workload
  - FAA pilot evaluation
  - NASA and CAMI research
  - Owner/operator interviews

Consideration of Part 23 / Part 25 Differences

SV Issues / Differences - Part 23 Position

Intended Function – Current SV technology is basically limited to the following:

- Lowers pilot workload and hence should reduce pilot's mistakes. Pilot does not have to mentally keep up with location on approach map.
- Allows pilot to "see" position relative to terrain and airport. Gets the whole picture instead of a narrow, instantaneous data stream from a FD.
- Provides a strategic "early warning" that terrain may become an issue before actually getting the TAWS warning.
- Provides the pilot with additional position information to crosscheck with VOR / DME / INS / ILS systems. (This is not valid for a GPS only or single sensor system.)
- Could be used in conjunction with TAWS for low-performance airplanes that will need to turn away from terrain because they can not meet the climb performance used in the TAWS TSO (based on King Air 300)

Pathway Issues / Differences - Part 23 Position

- Part 23 pathway concept was to make hand flying IFR easier for the pilot
- Pilot needs direct control of flight path (FPM) to make IFR flying easier – FPM similar to those used on HUDs
- Allows pilots to “see” navigation errors relative to terrain or airport – how often do transport pilots make navigation errors?
- Pathway size based on ease of use (small) and practicality or usefulness (large) – raw navigation data visible and provides limits
- Instead of pilot focusing on following the flight director, the pathway shows the entire approach / course – more time for instrument panel scan

Pathway Issues / Differences - Part 23
Position

Pathway Display

Traditional Display

High and to the right of course

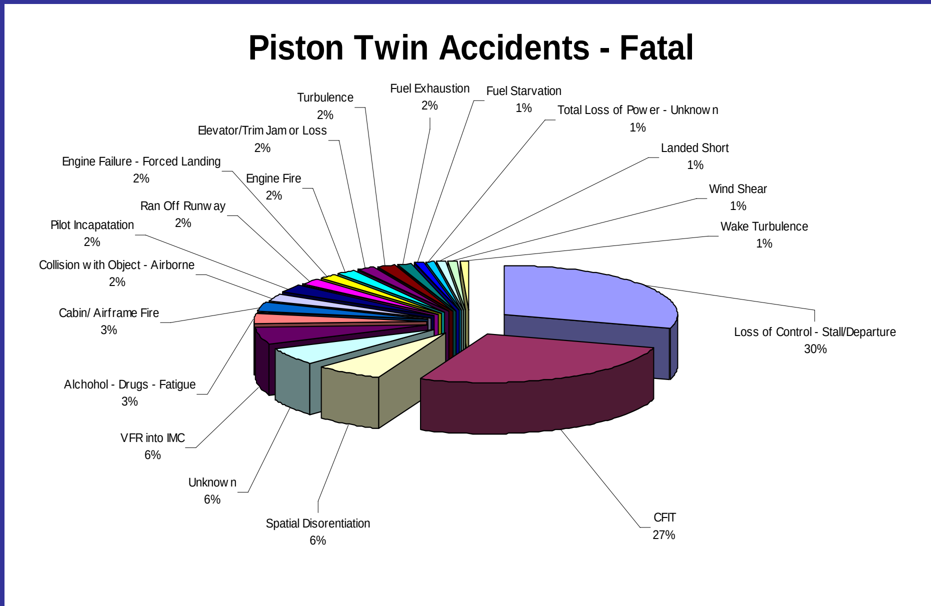
Pathway Issues / Differences - Part 25 Considerations

- Pilot in the loop vs. pilot as system manager – pathway is not needed to reduce pilot workload but can still allow crew to visually see navigation errors
- High time and/or transport pilots will probably have the most trouble using the pathway and will need training
- Two crew should be mitigating if right side uses independent EFIS/conventional displays
- Autopilot modes and integration with pathway
  - May be difficult for retrofit situations using existing autopilot
  - Comparison with existing modes may cause confusion
  - Problems may go away for integrated autoflight systems

Risk Management

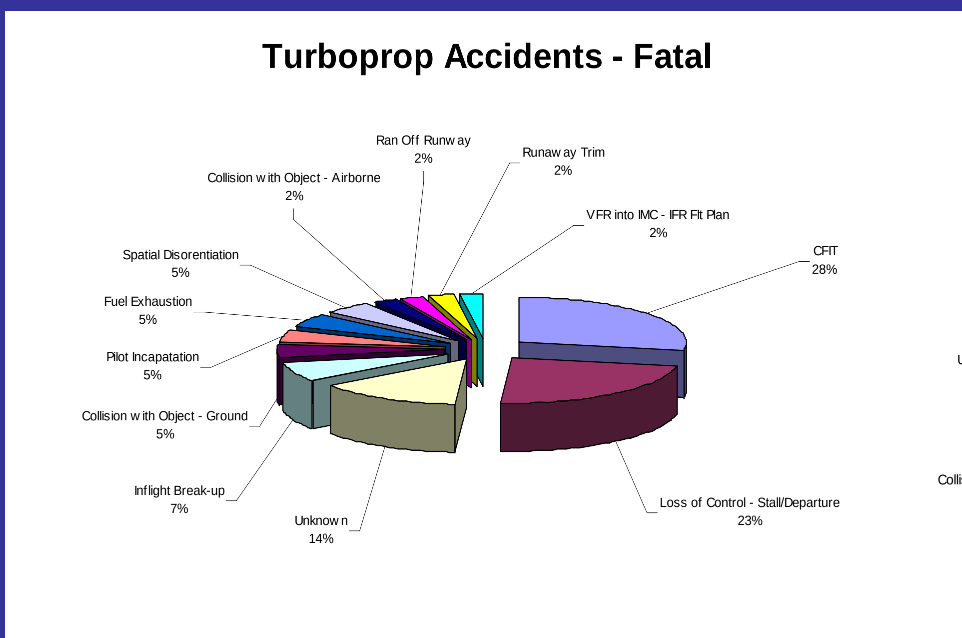
- Reality Check Important
- Will the Benefits of the system prevent most Low Visibility Accidents – CFIT?
- Do the Benefits Outweigh the Risks?

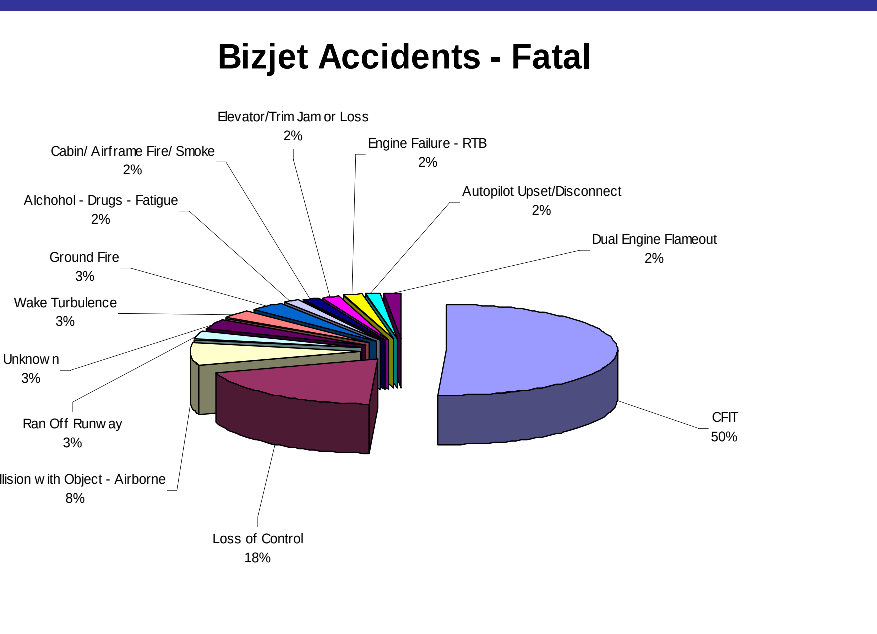
Risk Management



Myth - Controlled Flight Into Terrain is a small airplane problem

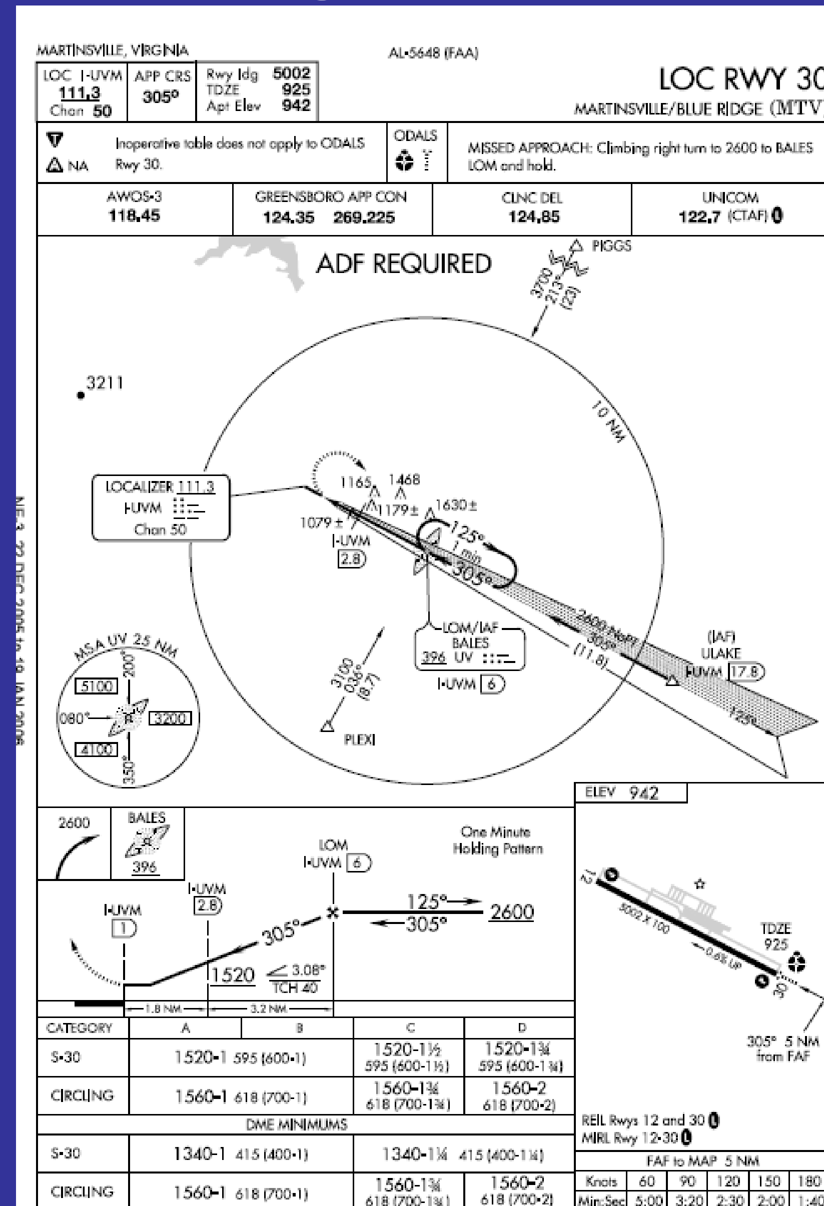
Reality – It is a larger problem

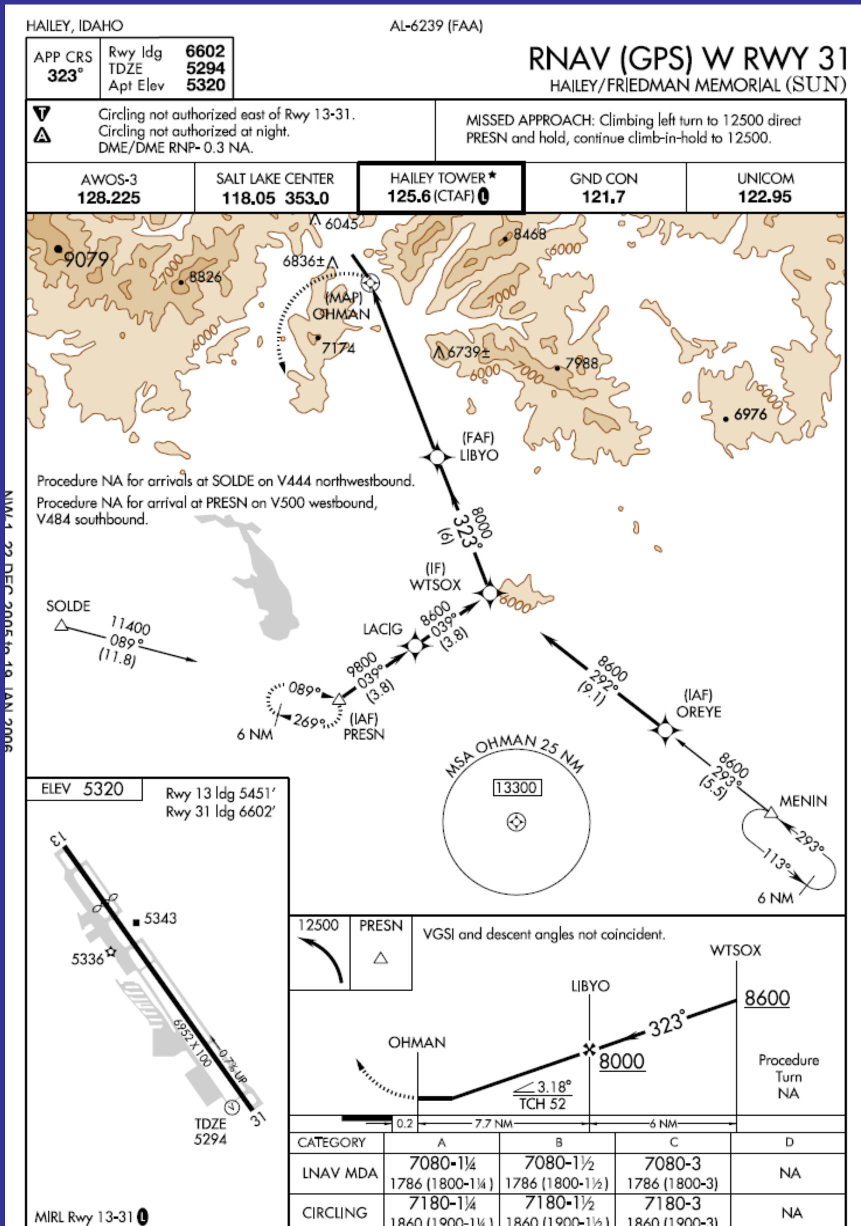




Hendrick Motorsports - King Air 200

- ATP Pilot with 10,600 hrs total w/ 8,600 in B-1900
- Started descent about 1 nm past MAP
- Crew reported “going missed” just before hitting hill





Pathway Benefits

- Good example of several popular destinations served by regional airlines
- Note the missed path
- Only works if missed approach started at MAP

Risk Management / Observations

- Part 91 and 135 Ops: The benefits clearly out weigh the risks
- Part 121 Regional Ops: The benefits probably outweigh the risks for part 121 commuter and regional operations going into small airports that don’t have precision approaches (VNAV capability would mitigate the dive and drive issues)
- Part 121 Ops: large jets operating between major hubs would benefit the *least* from this technology

Personal Observation

Personal Observations

- Synthetic vision and pathway technology don’t benefit large transports already equipped for CAT 2 and CAT 3 autoland capability
- SV is not “real” an therefore can not be used to “see” the runway environment (must be augmented with some real-time sensor to validate the depiction)

Part 135 and 121 Operations Still Flying Non-Precision Approaches

The benefits probably outweigh the risks for part 121 commuter and regional operations going into small airports that don't have precision approaches

Beech 1900D

The benefits probably outweigh the risks for part 121 commuter and regional operations going into small airports that don't have precision approaches

EMB-145