AC 120-91: Airport Obstacle Analysis

Federal Aviation Administration

Presented by: FLIGHT STANDARDS SERVICE

By: AFS-400

Date: June 1, 2017

PURPOSE

- **This AC describes acceptable methods and guidelines (i.e., Takeoff and Initial Climb-out Airport Obstacle Analysis)**
- **Describes Engine Out Procedures**
- **Complies with the intent of regulatory requirements of CFR Part 121, Part 135**
- **Two methods for the development of Engine Out Procedures (EOP)**

APPLICABLE REGULATIONS

- **Sections 121.177, 121.189, 135.367, 135.379, and 135.398**
- **The takeoff flightpath must meet the specified obstacle clearance requirements in the event of an engine failure.**

EOP DEVELOPMENT GUIDELINES

- **Derived from extensive FAA and industry experience.**
  - **Similar methods used by the industry for over 13 years as a DRAFT Document (AC 120-OBS).**
- **Signed by AFS-1 on May 5, 2006.**
  - **Applies to operations conducted under Part 121 and operations of large transport and commuter category airplanes conducted under Part 135 and Part 91K.**
  - **Concepts encouraged for all Part 91 operations.**

TYPES OF PROCEDURES

- **Public IAPs: 14 CFR Part 97 (Regulatory), TERPS, Flight Checked>AFS-1.**
- **Special IAPs: Order 8260.19C (Enabled), TERPS, Flight Checked>AFS-400.**
- **SIDs, STARs: TERPS, Flight Checked> National FLIGHT Data Digest (NFDD).**
- **Charted Visual Flight Procedures (CVFPs): NFDD**
- **Engine Out Procedures (EOPs): Developed By Operator, Accepted By POI.**

WHY AC 120-91 WAS DEVELOPED

- **14 CFR Part 25 provides requirements for establishing the Airplane Flight Manual (AFM) performance data.**
- **14 CFR Part 25 provides detailed instructions for determining vertical obstacle clearance requirements.**
- **14 CFR Part 25 offers little guidance on the lateral or horizontal clearance requirements.**

OEI CRITERIA - VERTICAL

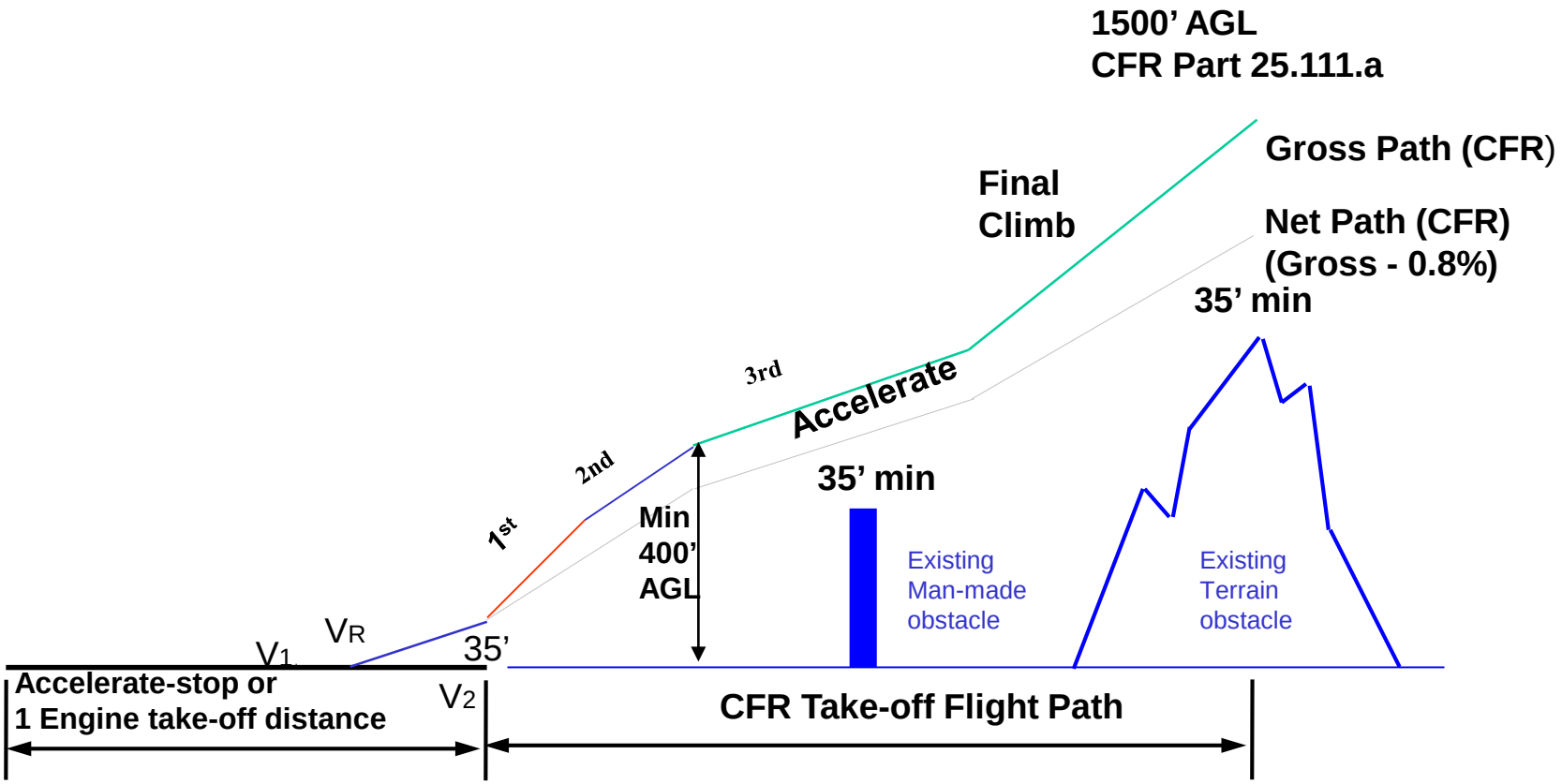
FOR TWO ENGINE TURBOJET AIRCRAFT

- **14 CFR Part 25: Min *Gross* Flight Path: 2.4%**
- **14 CFR Part 25: Min *Net* Flight Path:**

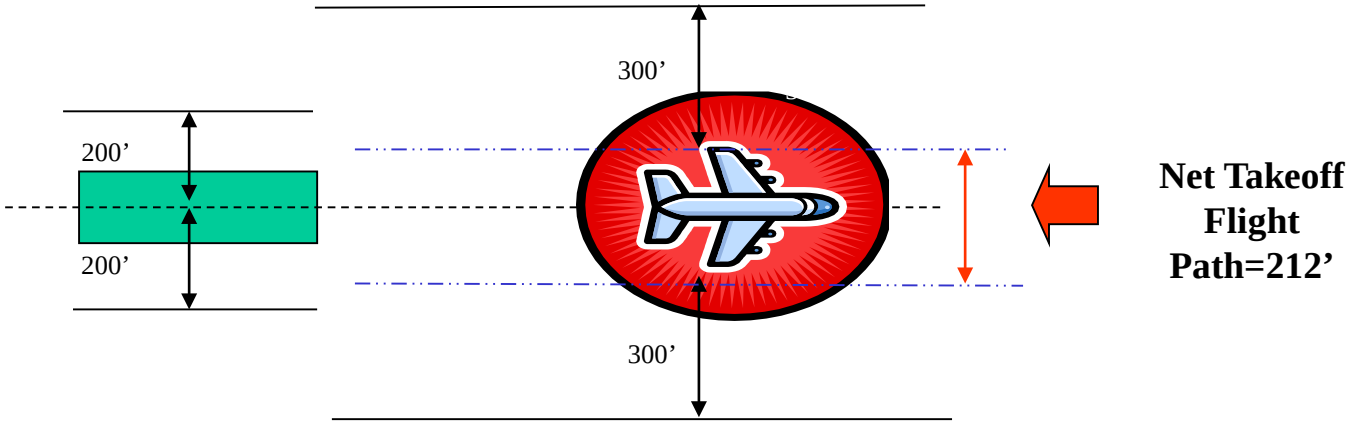
  2.4% - 0.8% = 1.6% (62.5:1 Slope)
- **14 CFR Part 121.189.D (2): *Net* Flight Path must clear all obstacles by 35 feet vertically.**

FAA OBSTACLE EVAL (OE) CRITERIA

One-Engine Inoperative, Vertical (CFR)



CFR Part 121.189
(Some Major U.S. Carriers)

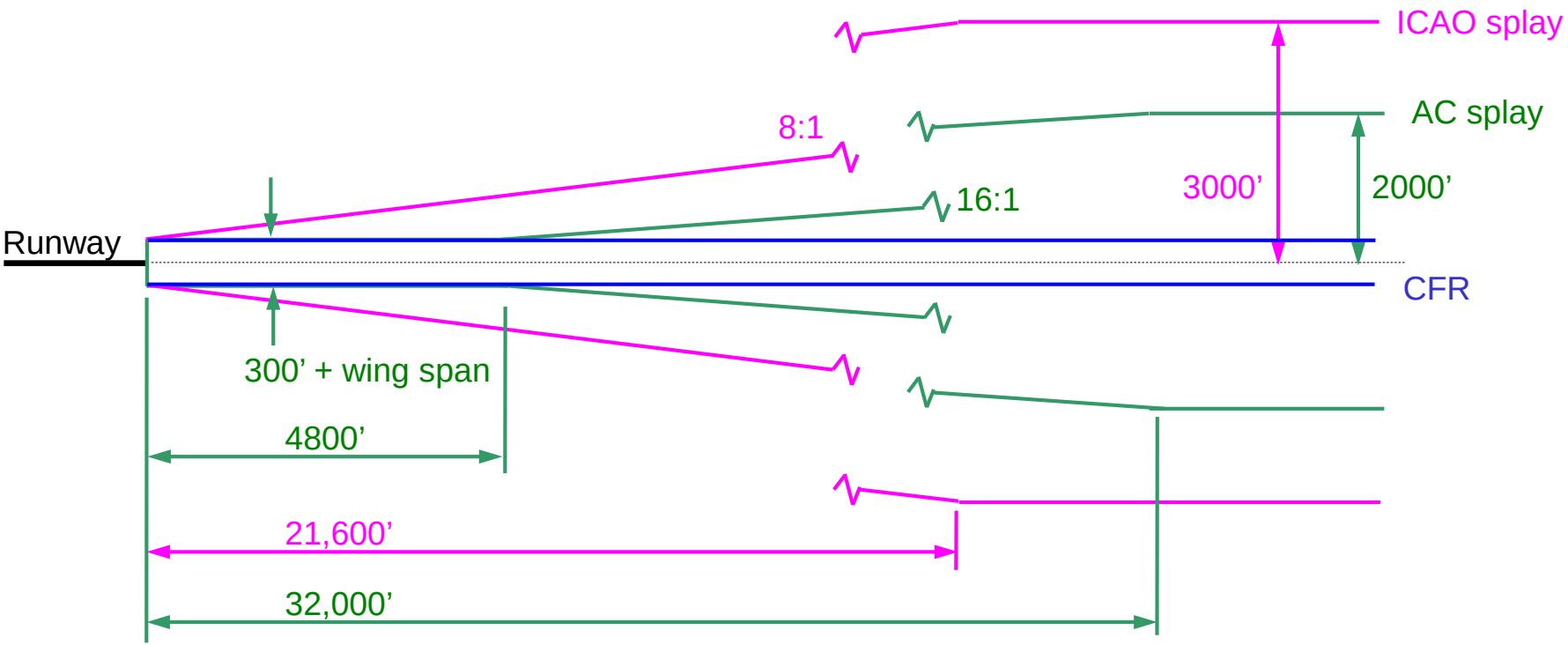


OEI CRITERIA: HORIZONTAL

- **AC 120-91 (Most Major US Carriers)**
  - **Incorporates best industry practices to provide an operationally realistic horizontal clearance plane.**
  - **16:1 ‘Splay’ Reaching Maximum +/- 2000’**
- **ICAO (Some Major US Carriers And CFR 129)**
  - **8:1 ‘Splay’ Reaching Maximum +/- 3000’**

FAA OE CRITERIA

One-Engine Inoperative, Horizontal
(FAR / AC / ICAO)



OBSTRUCTION EVALUATION CRITERIA

All-Engines Operating (OE Criteria)

- **FAA Order 8260.3C (TERPS)**
  - **Various Horizontal and Vertical protection surfaces**
  - **Vertical Surface: 200 ft/NM**
    - **>Obstacle Identification Surface (OIS, Net Surface) Of 40:1**
  - **Horizontal Surface typically ‘Splays’ at a 15-degree angle, typical maximum +/- 2 NM**

TERPS CRITERIA VERSUS ONE-ENGINE-INOPERATIVE (OEI) REQUIREMENTS

- **SIDs or DPs: TERPS or ICAO PANS-OPS as Normal (All Engines Operating) Operations**
  - **Independent and Exclusive**
- **EOP determinations Do Not need to meet TERPS requirements**
  - **Does not assure that OEI obstacle clearance requirements are met**

TERPS CRITERIA VERSUS (OEI) REQUIREMENTS (CONT'D)

- **TERPS: All-Engines-Operating Climb Gradients to an altitude in a Linear fashion**
  - **OEI airplane performance flightpaths are segmented**
- **TERPS: Standard of 200 ft/NM**
  - **Operators must comply with 14 CFR requirements**
  - **Differences between TERPS and OEI criteria**

An Engine Failure during Takeoff is a Non-normal Condition, and therefore takes precedence over noise abatement, Air Traffic, SIDs, DPs, and other normal operating considerations.

ENGINE OUT PROCEDURES ARE NOT

- **EOPs are NOT TERPS Or PANS-OPS criteria.**
- **EOPs do NOT provide takeoff data.**
- **EOPs do NOT provide an ATC departure procedure.**
- **EOPs are NOT routinely "Flight Checked" except to validate course guidance & NAVAID coverage.**
- **EOPs are NOT promulgated under CFR Part 97.**
- **EOPs are NOT "FAA Approved" (although the development process may be) they are "Accepted."**
- **And… if the EOP is associated With a "Special" IAP which involves unique terrain or pilot flight skills the information in next slide is pertinent:**

FAA FORM 8260-7B, Special Authorization

AFS-410, Flight Operations Branch, FAA Form 8260-7B, Special Instrument Approach Procedure Authorization

>>The POI shall not issue OpSpecs for an Operator authorizing this Special IAP until at least the following two conditions are met to the satisfaction of the responsible Flight Standards office:

1. **The Operator shall develop an Engine-out Procedure (EOP) for this Special IAP, and;**
2. **The Operator shall have fully implemented the EOP for this Special IAP in the operator's dispatch system, Flight Operations Manuals, Training Program and Aircraft Maintenance Program (as appropriate)**

WHAT EOPs ARE

- **Utilize CFR performance requirements and concepts**
- **May increase allowable Pax/Cargo load and safety margins**
- **Provide safe, standard, and repeatable "escape routing" (where necessary)**
- **Developed by the Operator or a competent contractor or commercial source for EOPs**
- **At the discretion of POI and/or Operator, validated via simulator to evaluate cockpit workload and control speed characteristics**

ENGINE – OUT DEPARTURE PROCEDURE DEVELOPMENT

- **Should consider that engine failure could occur at <u>Any Point</u> on the departure routing.**
- **Use an EOP routing in the event of an engine failure on takeoff.**
- **Obstacles along this track are used to determine the Maximum Allowable Takeoff Weight for that runway.**

OBSTACLE CONSIDERATIONS

- **Use the best and most accurate available obstacle data for a particular airport at the time of analysis:**
  - **Frangible Structures**
  - **Indeterminate Objects (Objects without recorded height; e.g., trees)**
  - **Operators shall take into account local temporary or transient obstacles**

SOURCES OF OBSTACLE DATA

NOS Airport Obstruction Chart (OC)

- FAA Form 5010
- Topographical Quadrangle Charts
- Jeppesen/Lido Departure & Approach Charts
- National Flight Data Digest
- IFR Supplement (USAF)
- Low Altitude Instrument Approach Charts (DoD)
- Aeronautical Information Publication (AIP)
- ICAO Type A/B/C Charts (TPC)
- USGS 3 Arc Second Terrain Data
- USGS 1 Arc Second Terrain Data
- Digital Vertical Obstacle File (DVOF)
- Digital Terrain Elevation Data (DTED)
- National Geodetic Survey (NGS)
- Area Navigation Approach Survey (ANA)
- NOTAMs

TERMINATION OF TAKEOFF SEGMENT

- **The end of the Takeoff Segment/Flightpath is considered to occur when:**
  - **Reaching the MCA or MEA; or**
  - **Able to comply with en route obstacle clearance requirements; or**
  - **Reaching the MVA.**
- **When determining the *Limiting* Takeoff Weight…the Obstacle Analysis should be carried out to the end Takeoff Segment defined above.**

METHODS OF ANALYSIS

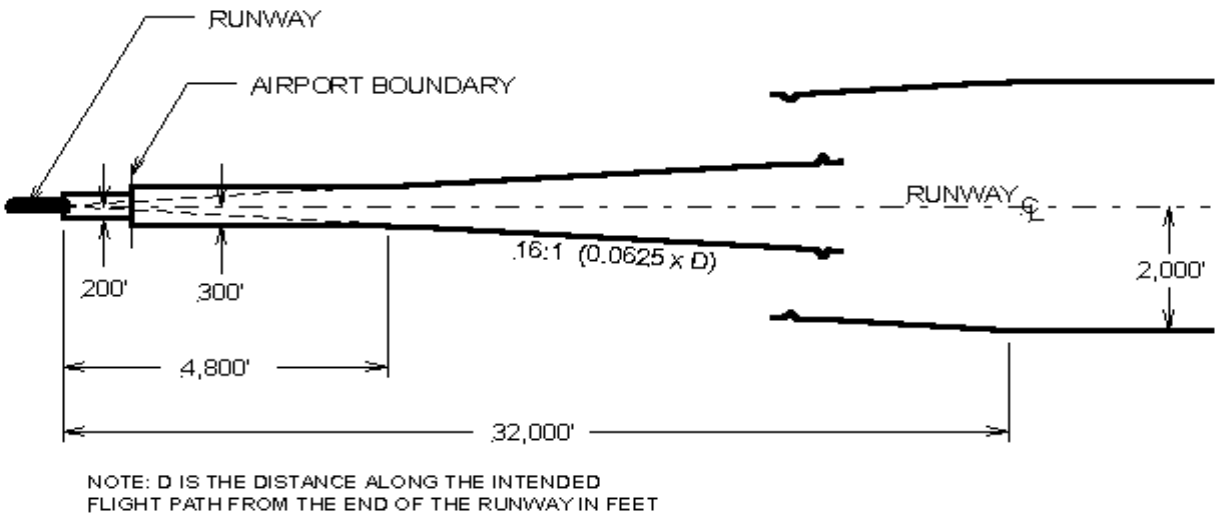
- **The Net Takeoff Flightpath must clear all obstacles by 35 feet vertically or 200/300 feet laterally**
- **This AC focuses on two methods which may be used to identify and ensure adequate clearance of critical obstacles:**
  - **The Area Analysis Method**
  - **The Flight Track Analysis Method**

THE AREA ANALYSIS METHOD

- **Defines an Obstacle Accountability Area (OAA)**
- **The minimum width of the OAA is 200 feet within airport boundaries / 300 feet outside airport boundaries on each side of the Intended Track.**
- **The maximum width of the OAA is 2,000 feet on each side of the Intended Track.**

OAA: STRAIGHT OUT DEPARTURES

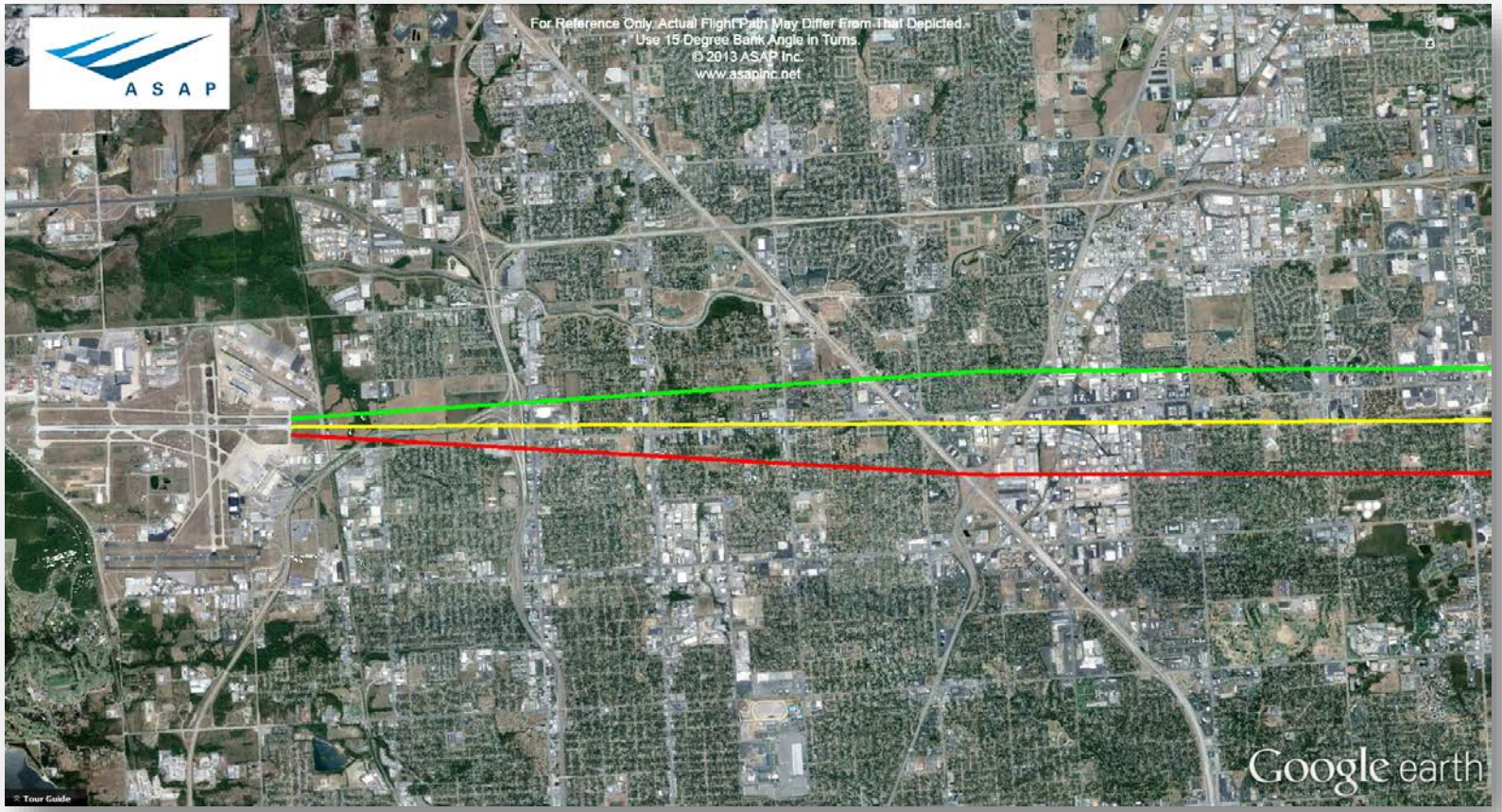
APPENDIX 1. OBSTACLE ACCOUNTABILITY AREA



NOTE: D IS THE DISTANCE ALONG THE INTENDED FLIGHT PATH FROM THE END OF THE RUNWAY IN FEET

FIGURE 1. STRAIGHT-OUT DEPARTURES

AREA ANALYSIS – STRAIGHT-OUT DEPARTURE



THE AREA ANALYSIS METHOD, (cont'd)

- **During *Turns* the following criteria apply:**
  - **The Initial Straight Segment...described above**
  - **The width of the OAA at the beginning of the Turning Segment is the greater of:**
    - **300 feet on each side of the Intended Track**
    - **The width of the OAA at the end of the Initial Straight Segment**
    - **The Maximum Width of the OAA is 3,000 feet on each side of the Intended Track.**

OAA: TURNING DEPARTURES

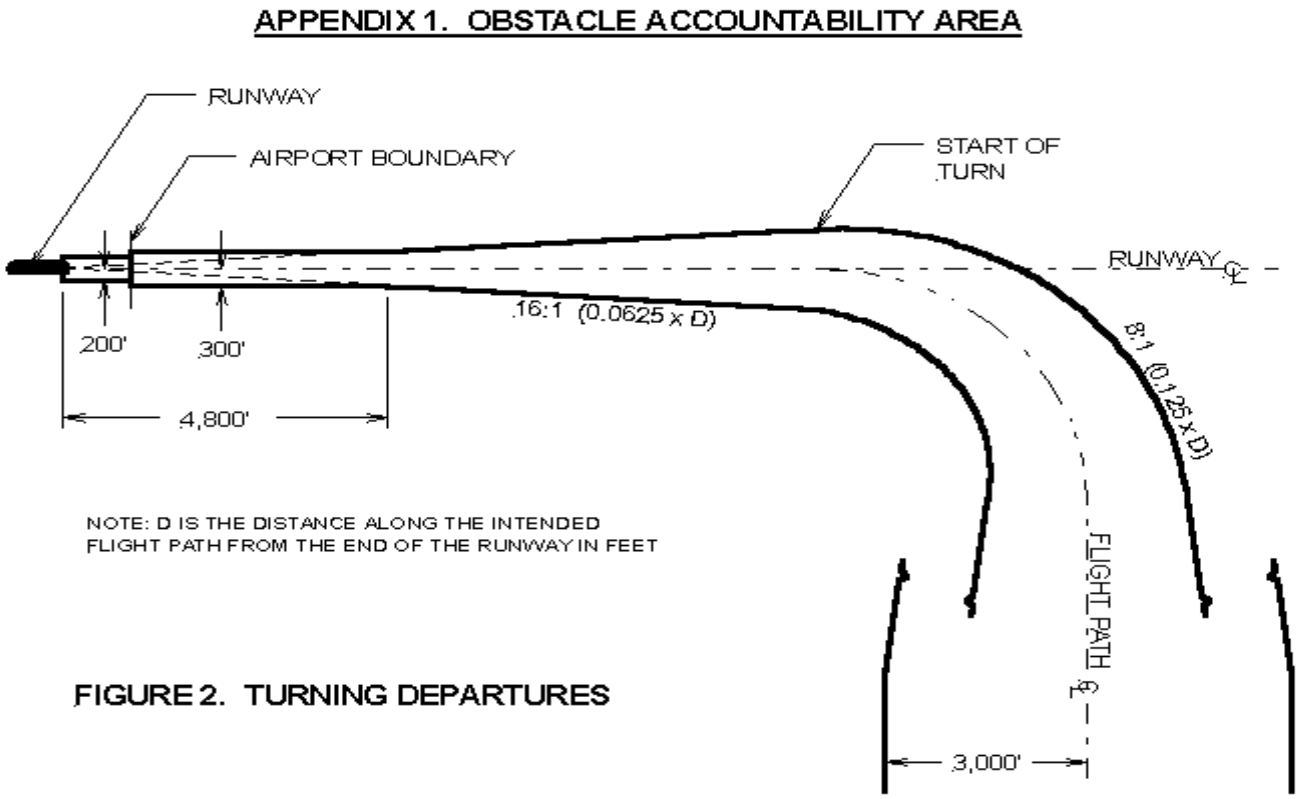
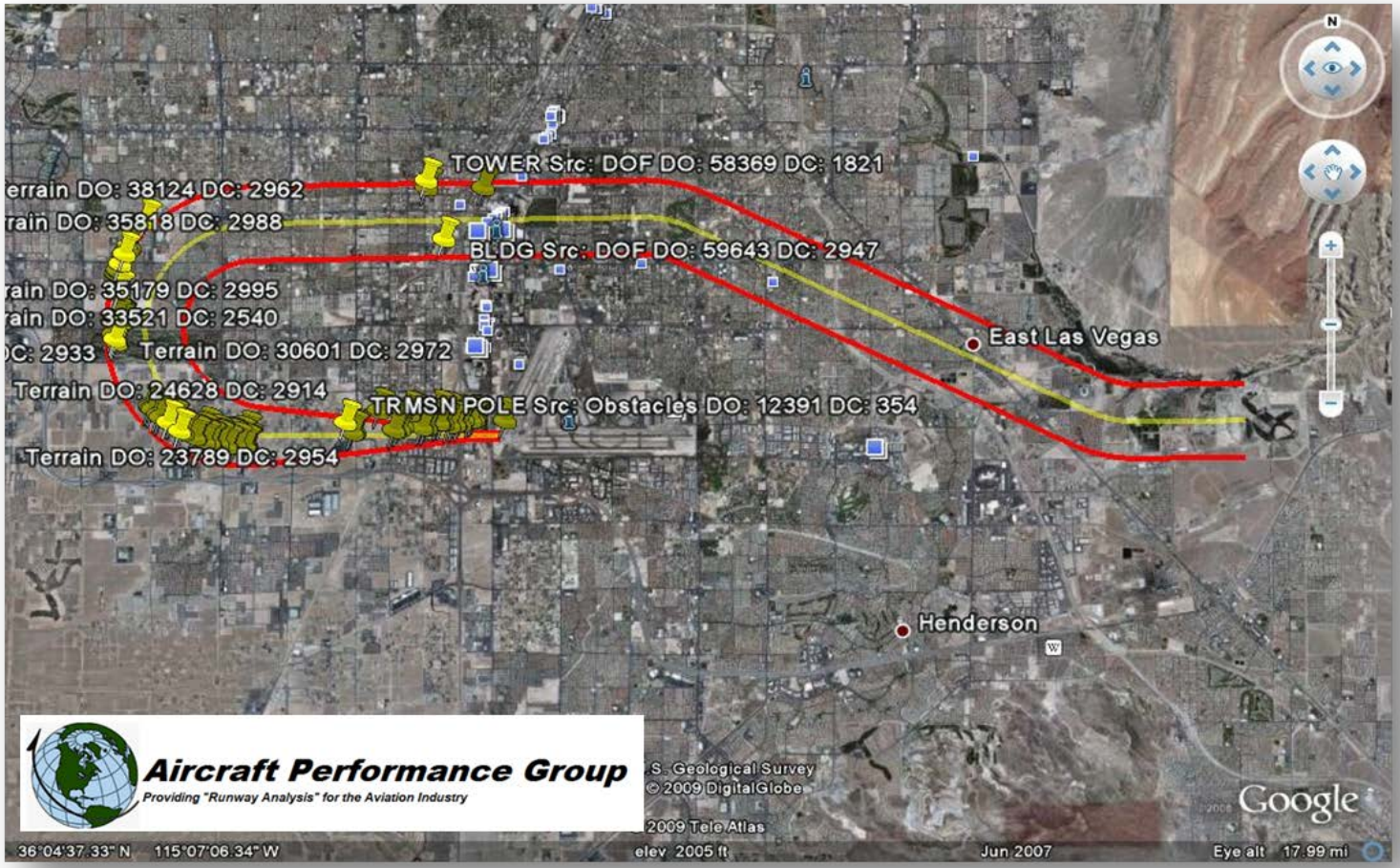


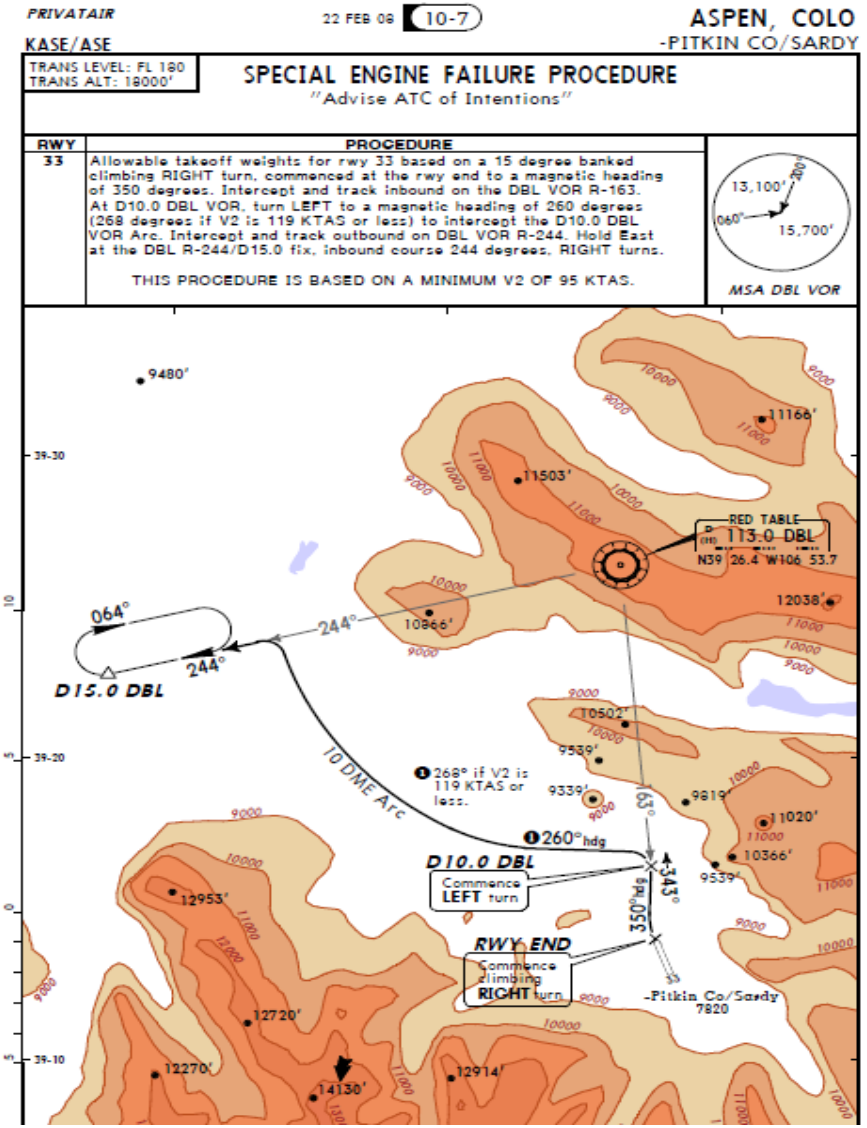
FIGURE 2. TURNING DEPARTURES

AREA ANALYSIS – TURNING DEPARTURE



AREA ANALYSIS METHOD

(KASE)
Aspen – Pitkin
RWY 33
“Special Engine Failure Departure”



FLIGHT TRACK ANALYSIS METHOD

- **The Flight Track Analysis Method involves analyzing the Ground Track of the flightpath.**

- **Alternative means of defining the OAA is based on the navigational capabilities of the aircraft.**

FLIGHT TRACK ANALYSIS METHOD (cont'd)

- **Three factors that the Operator must consider in performing a Flight Track Analysis are:**
  - **Pilotage In Turns**
  - **Winds**
  - **Course Guidance**

COURSE GUIDANCE

- **Operators may take credit for Available Course Guidance**
- **Allowance for ground-based course guidance:**
  - **Localizer (LOC)—plus/minus 1.25 Degree Splay**
  - **VOR—plus/minus 3.5 Degree Splay**
  - **ADF—plus/minus 5 Degree Splay**
  - **DME Fix—plus/minus 1 Minimum Instrument Display Increment but not less than plus/minus 0.25 NM.**

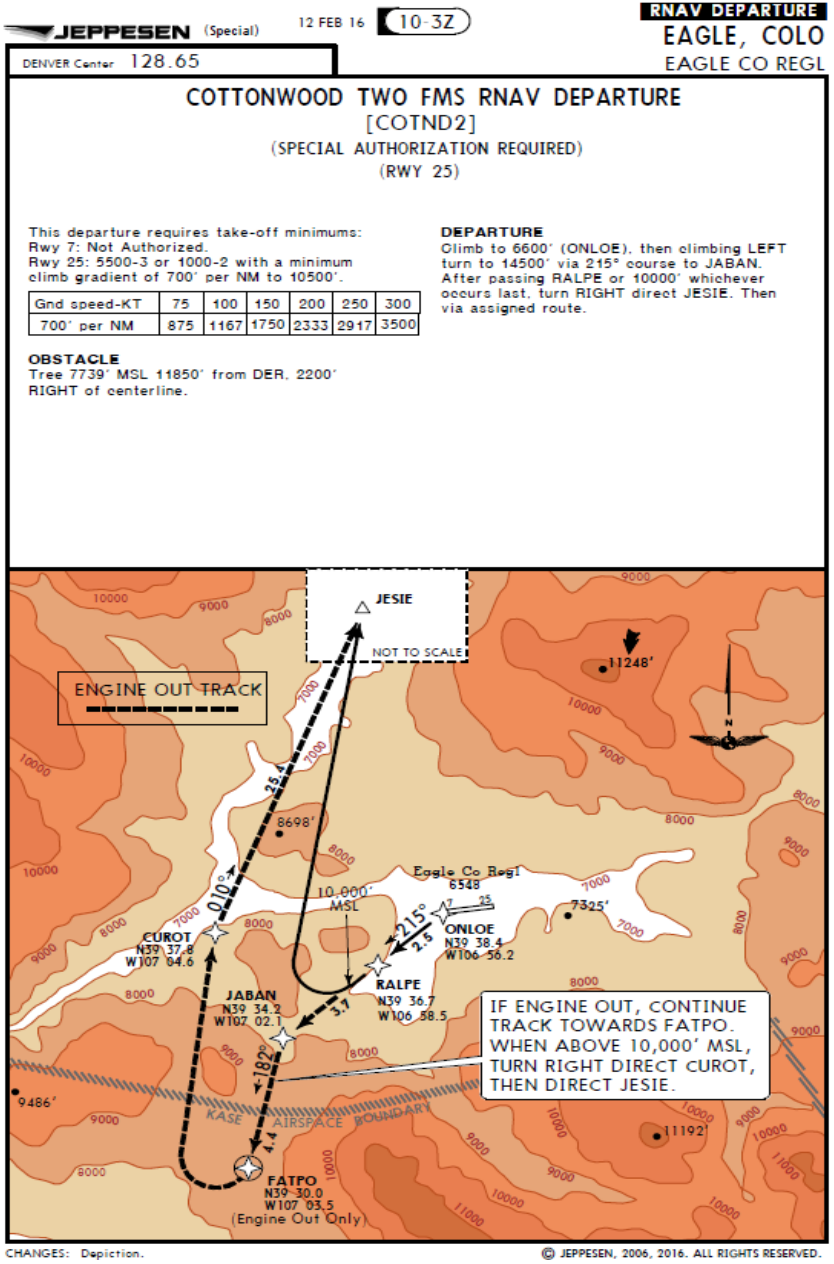
COURSE GUIDANCE (cont'd)

- **Airplane Performance-Based Area Navigation Capabilities (details yet to be defined) – Must be retrievable from database**
- **Area Navigation refers to a system that permits airplane operations on any desired course...**
- **Minimum Allowance is the system's demonstrated accuracy**

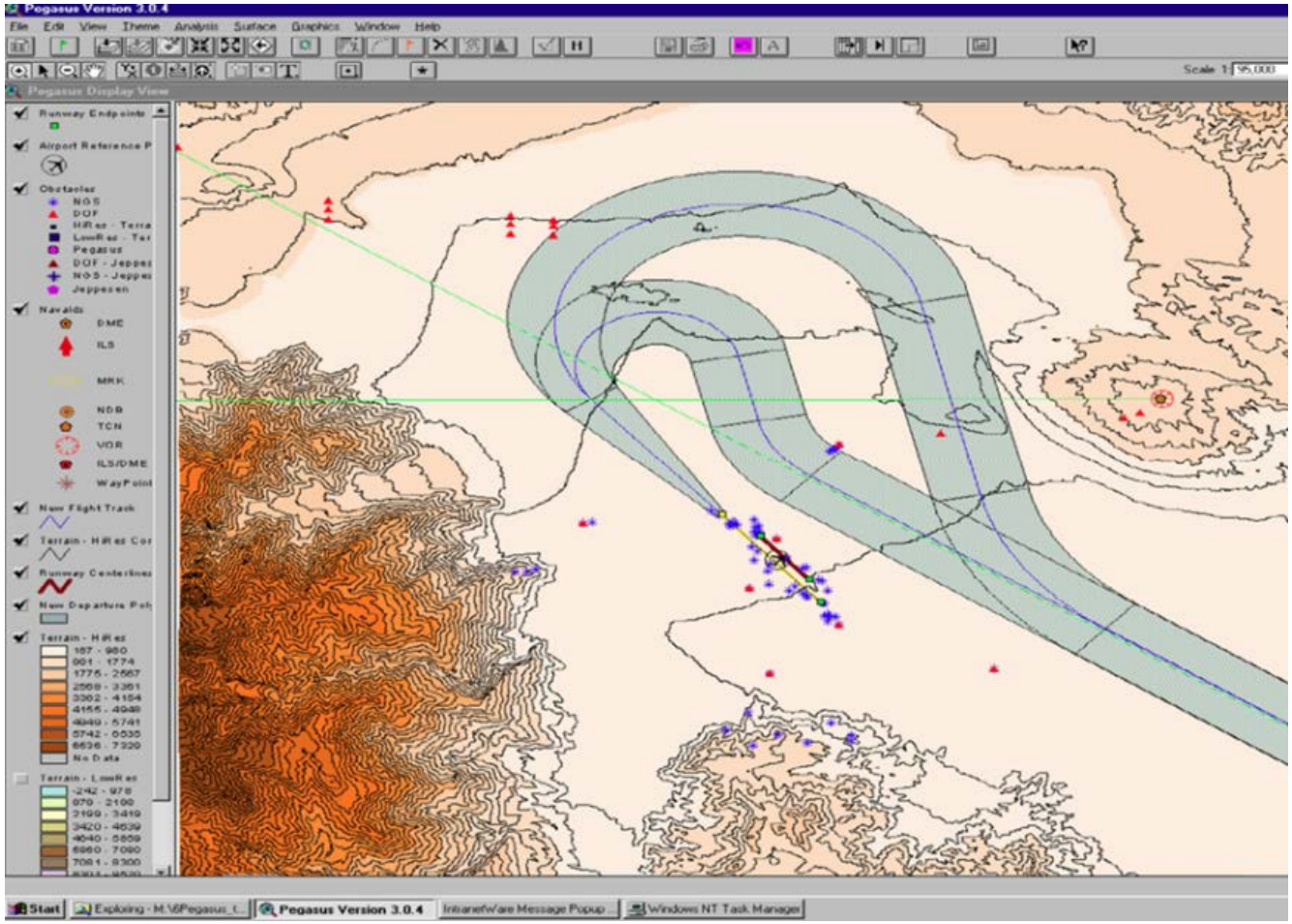
"Note: Under no circumstances can the OAA half-width be reduced to less than the regulatory minimums of 200 feet within the airport boundaries and 300 feet after passing the boundaries."

Course Guidance (cont'd)

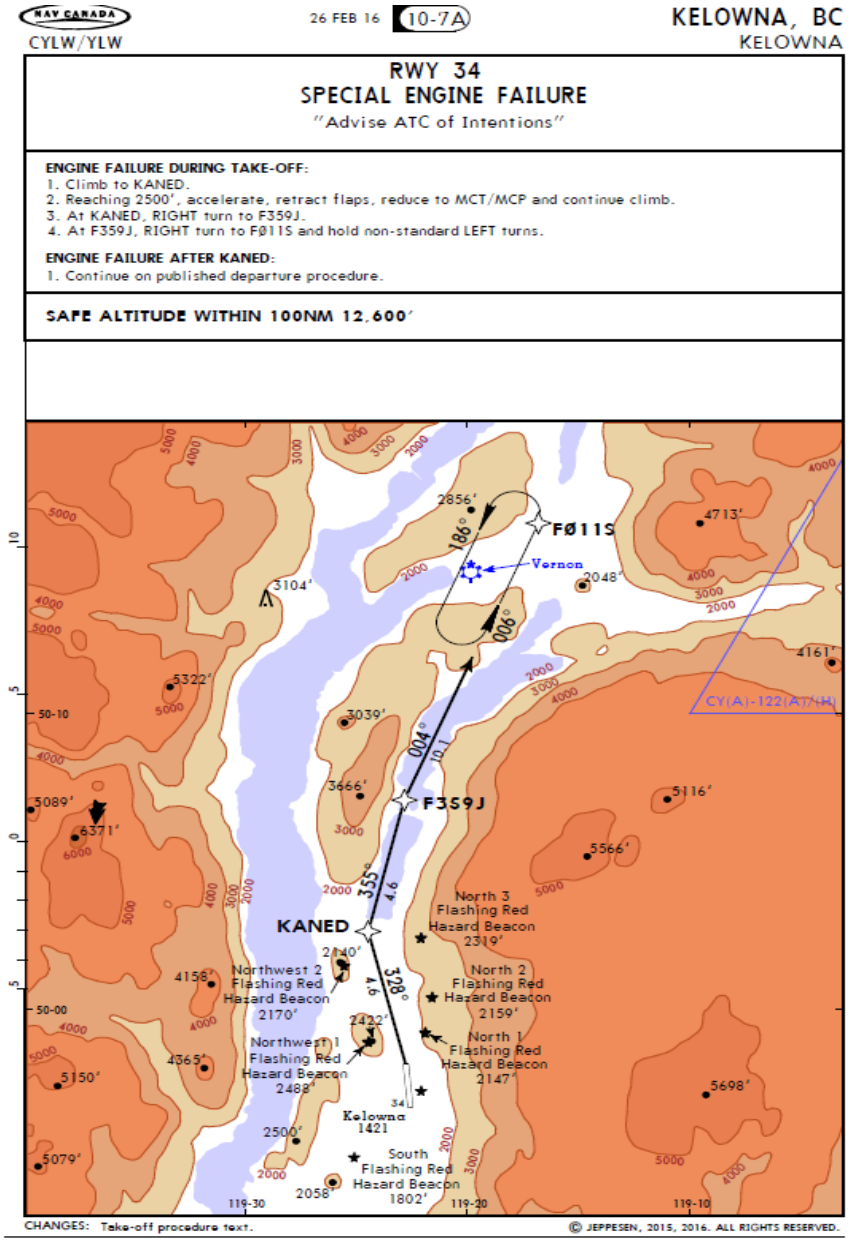
(KEGE)
Eagle County
Cottonwood
FMS RNAV
RWY 25
Departure
"Special"



COURSE GUIDANCE (cont'd)



(CYLW)
Kelowna, BC
RWY 34 RNAV
“Special Engine Failure Departure”



VISUAL COURSE GUIDANCE

- **Visual Ground Reference Navigation is another form of course guidance**
- **To laterally avoid obstacles by visual reference can be *Very* precise**
- **Must Continuously determine and maintain the correct flightpath**
- **Procedure should be well defined**

VISUAL COURSE GUIDANCE (cont'd)

- **An Unambiguous written and/or Pictorial description of the procedure must be provided for crew use**
- **The limiting environmental conditions must be specified for the use of the procedure (e.g. wind, ceiling/vis, day-only, etc.)**

ADDITIONAL CONSIDERATIONS

- **AFM data must be used for One-Engine-Inoperative Takeoff Analysis**
- **Acceptable data in various sources**
- **Terrain and obstacles at certain airports may require a higher-than-standard acceleration and cleanup altitude to be used**

ADDITIONAL CONSIDERATIONS (cont'd)

- **Validation Flights:**
  - **Pre-Validation Flight be conducted in a simulator**
  - **Acceptable techniques used for these flights include:**
    - **A Low Pass**
    - **Power setting representative of one-engine-inoperative conditions**
    - **One engine to flight idle**

FLIGHTCREW INFORMATION

- **Flightcrew instructions**
- **Flight Operations Bulletins, revisions to selected Flightcrew Manuals, EOP Takeoff Charts, NOTAMS, or special ground or simulator training.**
- **Flightcrew Engine-out Briefings (Jeppesen 10-7 or equivalent)**
  - **EOP routings and transition from ATC IFR departure to EOP routing is a critical crew coordination item**

PILOT INFORMATION (cont'd)

- **At a minimum the Operator's Instructions should advise flightcrews of the following:**
  - **Speeds and bank angles required**
  - **Intended Track in case of engine failure**
  - **Flap retraction and thrust reduction initiation point (i.e., acceleration height).**

MISSED APPROACHES, REJECTED LANDINGS, AND BALKED LANDINGS

- **Parts 121 and 135 Do Not address Missed Approaches or Rejected Landings**
- **The *Intent* is to identify the *Best Option* for a safe lateral ground track and flightpath to follow**

MISSED APPROACH VS REJECTED LANDING

- **A One-Engine-Inoperative Missed Approach can frequently be flown following the published missed approach procedure**
- **A Rejected Landing may require some other procedure and/or fight track**

ASSESSMENT CONDITIONS FOR BALKED LANDING

- **Begins at the end of the Touchdown Zone (TDZ)**
- **First one-third of the Landing Distance Available or 3,000 feet, whichever is less**
- **Operators may propose to use a different designation for a TDZ**

SUMMARY

- **Briefing generally describes AC-120-91, *Airport Obstacle Analysis* (Published: 5 May 2006)**
  - **Takeoff and Initial Climb-Out Airport Obstacle Analyses and Engine Out Procedures**
  - **Delineates between TERPS Requirements and CFR Requirements for Engine-Out Planning**
  - **<u>Two</u> Methods which may be used to identify and ensure clearance of Critical Obstacles:**
    1. **The Area Analysis Method**
    2. **The Flight Track Analysis Method**

QUESTIONS AND COMMENTS

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