ICAO FPFM Overview, flight planning, Fuel Monitoring, Performance Based Contingency Fuel

ICAO ESAF Workshop

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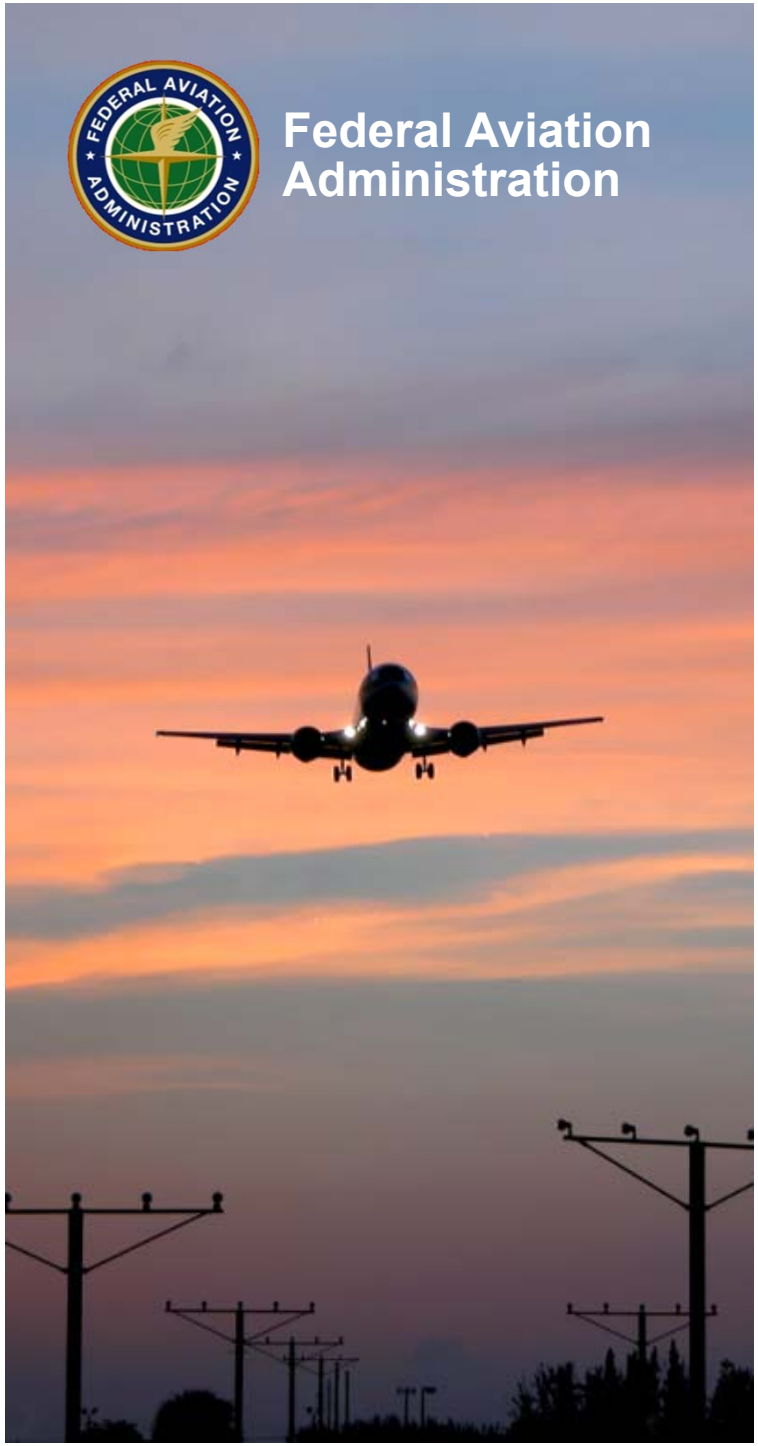

Agenda

- History of the development of the FPFM
- FPFM Prescriptive Fuel Planning
- FAA Performance based Fuel Planning
- Inflight Monitoring

Avianca Flight 52

- **Avianca Flight 052 from Bogotá to New York City, that crashed on January 25, 1990. The Boeing 707 ran out of fuel after a failed attempt to land at John F. Kennedy International Airport (JFK), and crashed onto a hillside in the exclusive village of Cove Neck, New York, on the north shore of Long Island. Eight of the nine crew members and 65 of the 149 passengers on board were killed.**

Avianca Flight 52 (cont.)

- The National Transportation Safety Board (NTSB) determined that the crash occurred due to:
  - The flight crew failing to properly declare a fuel emergency.
  - failure to use an airline operational control dispatch system,
  - inadequate traffic flow management by the Federal Aviation Administration (FAA),

- And the lack of standardized understandable terminology for pilots and controllers for minimum and emergency fuel states

Fuel System Management Cycle

FPFM Prescriptive Planning

a) sufficient alternate aerodromes are designated, when required;

b) operations into isolated aerodromes are planned such that a safe landing can be made at the destination or en-route alternate aerodrome at the estimated time of aerodrome use;

FPFM Basics

c) flights are conducted in accordance with the flight rules and **operating minima appropriate for the meteorological conditions anticipated** at the estimated time of aerodrome use;

d) flights are planned such that an **adequate margin of safety** is observed in determining whether or not an approach and landing can be carried out at each **alternate aerodrome**;

e) flights are planned and, when applicable, re-planned in flight to ensure that the **aeroplane carries sufficient fuel, including final reserve fuel**, to complete the planned flight safely;

f) **sufficient fuel is carried to allow for deviations from the planned operation** and that the pre-flight calculation of usable fuel required includes: taxi fuel, trip fuel, contingency fuel, final reserve fuel, and when required, alternate fuel, additional fuel, and discretionary fuel; and

g) **in-flight fuel checks are performed and fuel is managed in flight** so as to ensure a flight can proceed,

Airline Policy and Procedure Should include

- Variations in fuel **policy to account for unforeseen occurrences**;
- Flight planning **policies that use decision point planning** to a destination;
- Aerodrome and **runway condition monitoring** variations in exposure time to potential runway closures that affect the flight;
- **Meteorological conditions monitoring including** the potential for phenomena other than ceiling and visibility to affect the successful completion of the flight (e.g. thunderstorms, dust storms, wind);
- **Multiple approach and landing options** and adjustments to landing minima to ensure, to the greatest extent practicable, that an approach and landing can be accomplished at the destination or alternate aerodrome, as applicable;
- The designation of emergency aerodromes not suitable for designation as alternates during flight planning or for use in normal operations but available in the event of an emergency; and (Narsarsuaq, Sondrestrom Greenland), FAA review of ETOPS Adequate and Alternate airport. Company Definition of “suitable”
- What drives suitability of an alternate aerodrome?
  - Aircraft Performance! NEVER allow operations with Alternate Aerodromes unsuitable for the operation.

Analysis of the State ATM system

- The ANSP system review which affect company fuel plan should include:
  - optimize the use of available airspace and aerodrome capacity;
  - monitor flight progress and control flights safely and efficiently;
  - improve the navigation of aeroplanes by providing direct, optimum or preferred aeroplane routing;
  - safely and efficiently separate aeroplanes, reduce delays and reduce fuel consumption;
  - access advanced communication systems; and
  - access technology that can reliably fix an aeroplane's position en route and display real-time meteorological conditions.

Operational Fuel Planning

- The operational flight plan is the most important document in the flight deck. It documents the preflight planning and allows the pilots to assess the fuel as the flight progresses. The following slides outline the important elements of fuel planning.

Fuel Ladder

Fuel Ladder Term	Description
1. Taxi Fuel	Fuel to account for departure from the Gate, Start up, and Taxi to the runway. This should be adjusted for airport congestion and take into consideration any Deicing/Anti icing operations.
2. Trip Fuel	Enroute Burn, fuel from start of the takeoff run, climb, cruise, descent, approach and landing and the intended destination airport.
3. Unplanned Contingency Fuel	Fuel to account for unforeseen deviations to the Trip Fuel. Typically this is a percentage of the Trip Time. (United States this is 10 %) (ICAO 5% of the Trip time, but never less than 5 minutes of fuel calculated at 1500 feet at holding speed) ICAO allows for Performance Based planning
4. Planned Contingency Fuel	Fuel for KNOWN delays, ATC Programs runway closures, Weather delays that are known to exist prior to departure.
5. Alternate Airport Fuel	Fuel to account for Destination Alternate IAW recommended Standards
6. Final Reserve Fuel	30 minutes of fuel planned at 1500 feet, at holding speed.
7. Additional or Discretionary Fuel	Additional Fuel, fuel for MEL CDL and some operators will use this for Captain discretion fuel addition
Minimum Fuel Required	Sum of rows 2-8, This is required at the start of the takeoff run from the departure airport
8. Tanker Fuel	Fuel for cost saving, carried from Departure to Destination to allow reduction in cost from the Destination to the next intended airport.
Departure Fuel Required	Sum or rows 1-8, Fuel required at start of Pushback or departure from the gate.

Taxi Fuel

- Annex 6, Part I, 4.3.6.3 a) defines *taxi fuel* as the amount of fuel expected to be consumed before take-off which typically takes into account “local conditions” at the departure aerodrome and auxiliary power unit (APU) fuel consumption. Practically speaking, this includes the fuel required for engine start and to move an aircraft under its own power considering the route to the departure runway based on known taxi times (when available) for specific airports and runway configurations.
- 4.19.2 For the purpose of taxi fuel calculations “local conditions” must typically also be taken into account and refer to conditions or occurrences that would contribute to increased fuel consumption prior to take-off including but not limited to foreseeable” occurrences such as:
  - a) ground holding;
  - b) ATC metering programs;
  - c) remote de/anti-icing;
  - d) aircraft engine and wing anti-ice use;
  - e) single runway operations; and
  - f) any other occurrence with the potential to increase taxi time.

Trip Fuel

- *Trip fuel* is simply defined by Annex 6, Part I, 4.3.6.3 b) as the fuel required to fly from the departure aerodrome or from the point of in-flight re-planning to the destination aerodrome, taking into account the aeroplane specific or manufacturer data specified in 4.3.6.2 a) and operating conditions of 4.3.6.2 b). In actual practice, however, the calculation of trip fuel is typically a complex process that is dependent on numerous underlying and interdependent activities. In the end, however, the intent of every trip fuel calculation is to ensure, to the greatest practical extent, that the planned fuel burn is equal to or greater than the actual fuel burn

Unplanned Contingency Fuel

- United State Federal Aviation Administration regulations requires the Pilot in Command and Aircraft Dispatcher to account for both planned and unplanned contingency fuel. For International operations unplanned contingency fuel is 10 percent of the total time from departure to destination. This can be reduced through 3 different approaches, unplanned fuel protects deviations to route and altitude, weather forecasts, actual trip burn versus planned trip burn. the 3 approaches to reduce the percentage are described later in the presentation.

Contingency Fuel, Planned

- Fuel for known delays and deviations which may delay the landing of the aircraft. An example of this are;
  - Runway Closures
  - IFR weather
  - Convective weather affecting the destination airport Air Traffic
  - Known ATC initiatives
  - Enroute delays, ATC closures, Volcanic activity etc
  - Convection enroute and possible reroute

Alternate fuel Calculation

- **Where a Destination alternate aerodrome is required, the amount of fuel required to enable the airplane to:**
  - Perform a missed approach at the destination aerodrome;
  - Climb to the expected cruising altitude;
  - Fly the expected routing;
  - Descend to the point where the expected approach is initiated, and;
  - Conduct the approach and landing at the destination alternate aerodrome, or:

Alternate Fuel Calculation (cont.)

- Where two destination alternate aerodromes are required, the amount of fuel as calculated above required to enable the aeroplane to proceed to the destination alternate aerodrome which requires the greater amount of alternate fuel; or
- Where a flight is operated without a destination alternate aerodrome the amount of fuel required to enable the aeroplane to fly for 15 minutes at holding speed at 1500 feet bote the destination aerodrome in standard conditions; or

Isolated Aerodromes

- **Where the aerodrome of intended landing is an isolated aerodrome: (e.g.Tahiti)**
  - For a reciprocating engine aeroplane, the amount of fuel required to fly for45 minutes plus 15% of the flight time planned to be spent at cruising level, including final reserve fuel, or two hours whichever is less; or
  - For a turbine-engine powered aeroplane, the amount of fuel required to fly for two hours and normal cruise consumption above the destination aerodrome, including final reserve fuel. (US does not require final reserve for isolated aerodrome operations)

Isolated Aerodrome PNR

- A Point of No Return (PNR) calculation should be provided for Isolated aerodrome operations;
- The PNR is the latest point along the route of flight where a pilot can divert to an enroute alternate aerodrome.
  - a flight to be conducted to an isolated aerodrome shall not be continued past the point of no return unless a current assessment of meteorological conditions, traffic and other operational conditions indicate that a safe landing can be made at the estimated time of use.

Discretionary Fuel

- Annex 6, Part I, 4.3.6.3 g) defines *discretionary fuel* as an extra amount of fuel to be carried at the discretion of the PIC. While *contingency fuel* is typically defined early during pre-flight fuel planning in order to account for unforeseeable occurrences, *discretionary fuel* may be loaded later in the process by the PIC, Flight Operations Officer (if applicable), or as directed by the operator.

Final Reserve Fuel

- Annex 6, Part I, 4.3.6.3 e) defines the *final reserve fuel* amounts for turbine and reciprocating engine aeroplanes. This amount of fuel, calculated during pre-flight planning, is based on the estimated aeroplane mass on arrival at the destination alternate aerodrome or the destination aerodrome (when no destination alternate aerodrome is required). Additional criteria upon which this calculation is based include the time, speed and altitude conditions specified under 4.3.6.3 e) 1) or 4.3.6.3 e) 2), as applicable.
- In addition to the precise calculation of final reserve fuel for the purposes of pre-flight planning, Annex 6, Part I, 4.3.6.4 recommends that operators determine approximate final reserve fuel values for each aeroplane type and variant in their fleet.

Inflight Re-planning

- An inflight re-plan is one way to reduce the amount of unplanned contingency fuel, which in the United States is 10% of the time from departure to planned destination. A re-dispatch (US term) allows the operator to reduce the fuel and corresponding takeoff weight.
- The following requirements must be met for a redispatch in the United States.
- Long Haul Aircraft frequently utilize this option to reduce the unplanned contingency fuel.

Redispatch requirements

(3) The flight plan must be prepared prior to departure from the origin airport to the initial destination airport and from the redispatch or rerelease point to the intended destination airport. The flight plan must contain an operational analysis that includes the following:

(a) The total fuel listed in subparagraph b(2)(f) of this operations specification paragraph.

(b) Routes to be flown, including the flight levels. The portions of the routes that are common to both the route from the origin airport to the initial destination airport, and the route from the origin airport to the intended destination airport, may be combined in the body of the flight plan.

(c) Estimated times en route; and

(d) Alternate airports for both the initial destination airport and the intended destination airport in accordance with §121.621 or §121.623.

Redispatch Requirements

The dispatch or flight release must contain the following:

a)A release to the initial destination airport;

b)A plan for redispatch or rerelease from the planned redispatch or rerelease point to the intended destination airport. The planned redispatch or rerelease point must be a point that is common to both the route from the origin airport to the intended destination airport, and the route from the origin airport to the initial destination airport.

c)Alternate airports for both the initial destination airport and the intended destination airport, in accordance with §121.621 or §121.623;

d)The fuel required to fly from the origin airport and land at the initial destination airport;

e)The fuel required to fly from the redispatch or rerelease point and land at the intended destination airport; and

f)The total fuel required to fly from the origin airport and land at the intended destination airport based on the redispatch or rerelease. In determining these fuel requirements, the certificate holder must comply with § 121.647.

g)The appropriate weather reports, forecasts, and NOTAMs affecting the route to be flown, and the facilities at all airports specified in the dispatch or flight release.

United States Performance Based Fuel Planning in detail

- **Origins - Regulatory history of Unplanned Contingency Fuel**
- **Guidance - B343 Ops Specs and 8900.1**
- **Performance Measures**
- **Getting Started**

Origins

- **Regulatory Background: Unplanned Contingency Fuel for International Flights**
- **ICAO Standardization Efforts**
- **B343 History / Proof of Concept**

Regulatory Background

- **CFR121.645 (b)**
  - Establishes requirements for fuel planning for international turbojet operations
  - Establishes prescriptive fuel allocations (Fuel Buckets)
    - Paraphrasing 121.645(b) – any certificate holder conducting flag or supplemental operations outside the 48 contiguous United States … may not release an aircraft unless it has enough fuel to
      - (1) ….. fly to the airport it is dispatched to or released …..
      - (2) After that, to fly for a period **of 10 percent** of the total time required to fly from the airport of departure to, and land at, the airport to which it was released;
  - We will refer to this 10% as “unplanned contingency fuel”, to make it clear that it is not meant to satisfy the fuel need for known delays

ICAO Standardization Efforts

- **ICAO Annex 6 Part 1**
  - Established recommendations for prescriptive fuel calculations
  - Standardizes terminology
    - 10% fuel requirement was historically known as an enroute reserve, is now unplanned contingency fuel
    - Per the ICAO standard, the unplanned contingency fuel is 5% of total time
  - Clarifies calculation of International fuel planning
    - Deviations to ICAO standard allowed by Redispatch (B044), Special Fuel Reserves (B043), or
    - a **state approved Performance Based Fuel Program (B343)**
  - Deviation to the standard allowed through state approved PBCF Program [~2012] with a minimum of 5 minutes calculated at 1500 feet at holding speed

Guidance (B343)

- **B343 revised through N8900.383**
  - OpSpec B343 allows part 121 flag operators to deviate from the fuel requirements of part 121, § 121.645(b)(2).
  - This OpSpec was modified to harmonize with International Civil Aviation Organization (ICAO) Annex 6, Part I, and take advantage of scheduled air carriers' considerable investment in fuel-planning, tracking, and communication capabilities.
  - The statistical method calculates a required unplanned contingency fuel, which is specific to each unique airplane make and model, departure airport, arrival airport, and arrival time window combination.
  - This notice amends all Operations Specification (OpSpec) B343, Performance-Based Contingency Fuel Requirements for Flag Operations, templates
  - This is a mandatory change to OpSpec B343.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **A.3 The Performance Based Contingency Fuel Program (PBCF)**
  - Allows participating air carriers to set an unplanned contingency fuel requirement based upon their demonstrated fuel-planning performance
  - This value will be specific to
    - airplane make and model,
    - city pair route (direction dependent),
    - and arrival time window at the destination airport.
    - *Example: B767 SFO-NRT 11:00 AM Arrival +90/-30 minutes*
      - *Each flight used to establish the historical performance must be of same MM, City Pair (direction dependent), and within the arrival window envelope.*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **A.4 Performance Based Contingency Fuel**
  - applies to normal day-to-day variations, to include:
    - weather,
    - air traffic,
    - winds aloft forecasting,
    - and terminal area traffic patterns

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **A.4 Performance Based Contingency Fuel**
  - does not cover deviations due to:
    - closed runways *(except long-term closures)*;
    - minimum equipment list (MEL)/Configuration Deviation List (CDL) items;
    - significant enroute issues such as volcanic ash concerns;
    - airspace restrictions;
    - turbulence;
    - icing;
    - and convective activity, which may affect the normal planned route and altitude profile
  - The air carrier and dispatchers must account for the additional **known** planned contingency fuel requirements from events such as these in accordance with § 121.647.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

C. Performance Fuel Calculation Requirements

Required fuel supply: Each airplane dispatched under the authority of Ops Spec B343 shall have enough fuel on board, considering the requirements of § 121.647, to:

1) Fly to and land at the airport to which it is dispatched.

2) After that, unplanned contingency fuel (i.e., PBCF) to fly for a period of time, restricted to no less than 5 minutes of unplanned contingency fuel (calculated at 1,500 feet holding speed), based on the statistical burn deviation specific to each airplane make and model/city pair/arrival time window combination authorized in the reference document in Table 1.

- **When no PBCF value is available**, the unplanned contingency fuel value shall not be less than 10 percent of en route time, or, for operators with an approved minimum landing fuel program, it shall be not less than 5 percent of the en route time.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **C.2 continued) The PBCF fuel must meet the following requirements:**
  - For each combination of MM/City Pair route/Arrival time window, the air carrier must demonstrate, based upon past fuel-planning performance, that the probability of burning all contingency fuel meets the following requirement:
    - **2.a)** Option 1: For air carriers with an approved minimum landing fuel program,
      - the probability of burning all unplanned contingency fuel is no greater than 1 in 10 in forecasted non-convective conditions at the destination airport,
      - or 1 in 100 when thunderstorms are forecasted or can reasonably be expected in the vicinity of the destination airport.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- ***What is a minimum landing fuel program?***
  - *A minimum required level of expected remaining fuel onboard at touchdown, independent of source/allocation/fuel bucket*
    - *Fuel is added if the sum of all other fuel buckets does not meet a minimum planned fuel on arrival*
  - *This option allowed in deference to workforce culture that may not be willing to accept small amounts of unplanned contingency fuel based upon "statistics" alone*
  - *There is no formal guidance on minimum landing fuel program*
    - *75 minutes is what has been accepted to-date by AFS-200*
  - *Despite lack of formal guidance, FAA and industry need to understand this is a critical component of the overall safety level of Performance Based Fuel*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **C.2 continued) The PBCF fuel must meet the following requirements:**
  - **2.b)** Option 2: For air carriers without an approved minimum landing fuel program,
    - the probability of burning all PBCF is no greater than 1 in 70 in forecasted non-convective conditions at the destination.
    - When thunderstorms are forecasted or can reasonably be expected in the vicinity of the destination airport, the unplanned contingency fuel value shall be no less than 10 percent of the total time required to fly from departure to the intended destination airport.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **C.2 continued) The PBCF fuel must meet the following requirements:**
  - *The criteria for performance based fuel (without a minimum landing fuel program) in convective conditions – defaults to 10%*
    - *The sample size required for the rank order percentile method becomes very large under these conditions*
    - *Part of our reasoning here is that flying into convective conditions is only 3-6% of all flights, and*
    - *defaulting back to 10% more likely acceptable to participants than trying to obtain large data sample*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

C.3) Where a destination alternate airport is required, the amount of fuel required to enable the airplane to:

a) Perform a missed approach at the destination airport;

b) Climb to the expected cruising altitude;

c) Fly the expected routing;

d) Descend to the point where the expected approach is initiated; and

e) Conduct the approach and landing at the destination alternate airport.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

C.4) When no alternate is required:

a) The certificate holder must carry additional fuel to account for a possible missed approach and return to land at the destination airport.

b) The fuel planned when no alternate airport is required must include a minimum arrival fuel to divert to an airport with a runway that meets the requirements of § 121.197 and has an operable instrument approach. Planned arrival fuel at the intended destination must allow the flight to divert and land with not less than the minimum arrival fuel specified in § 121.645(b)(4). (This is for planning purposes only.)

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **C.5)** After that, to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the destination airport if no alternate is required) under actual or forecasted temperatures and conditions.

- **C.6)** The fuel required accounting for known delays (planned contingency fuel), PBCF (unplanned contingency fuel), and missed approach fuel (if no alternate is required) or alternate fuel and final reserve fuel must be included in the minimum fuel calculation.
  - *i.e. this is "above the line" fuel*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D. Approved Airplanes and Areas

- The certificate holder is authorized to conduct these operations using the approved airplane make and model/ city pair / arrival time window combination(s) as listed in the approved document referenced in Table 1 and with provisions of this Op Spec.

Figure 3-197. Sample Table 1 – Approved Document and Revision

Document Name and Location	Revision Status
Airline Performance-Based Tracking Tool / Flight Operations Manual	Original

- *What are we looking for here?*
  - *the Operator maintains a current list of MM / City Pair / Arrival Time Windows that meet the requirements of their PBCF program, and*
  - *that the current listing (and any historical listing) can be provided upon request to the administrator or administrators representative*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.1) Minimum data requirements for PBCF

a) Quantity. The minimum data points for each airplane make and model/city pair/arrival time window combination shall be:

1. For PBCF 1 in 10, a minimum of 60 data points; and

2. For PBCF 1 in 70 or 1 in 100, a minimum of 120 data points

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.1) Minimum data requirements for PBCF (cont)

b) Seasonality. Data gathered must be over a period of time that reflects the seasonality of the proposed operation. The data should reflect the variability for two seasons; for example, if the arrival city experiences both winter and summer weather variability, those operations must be evaluated prior to operation.

- *We want to capture the variance introduced by seasonality in the PBCF values*
- *Seasonality may be the long hurdle when gathering sufficient data sample size*
- *Its up to the carrier to determine the impact of seasonality on **arrival airport** (e.g. winter/summer or hurricane/non-hurricane season)*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.1) Minimum data requirements for PBCF (cont.)

c) Recency. The required data must include data gathered during the equivalent seasonal period in the previous 12 months

- *If you want to use PBCF values for this upcoming July, your data sample used to calculate PBCF should have data from the previous July*
- *You can use data gathered from a historical period greater than 12 months, however FAA is not likely to approve programs proposing to use data going back too far in time on the grounds that that data may no longer reflect the current NAS environment*
- *United Airlines uses 24 months of data*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.2) City Pairs

City pair is directional in nature

- e.g., for 1 in 10 performance threshold,
  - Chicago O'Hare International Airport (ORD) to London Heathrow Airport (LHR) would require 60 data points, and
  - LHR to ORD would require an additional 60 data points

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.3) Arrival Windows

- Arrival time window should not be greater than 2 hours total unless the air carrier has established statistical data to substantiate a larger arrival time window.
- For arrival time windows greater than 2 hours, any 120-minute period within that arrival time window must contain the minimum number of data points required in subparagraph D1(a).

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **D.4) and D.5)**

  4) Operators must have procedures to alert the dispatcher when a departure delay would cause the flight to arrive outside the original planned arrival time window.

  – *Arrival Window must be the same for both the data sample and for flight tracking/notification purposes*

  5) In cases where planned delays would push the arrival into a timeframe beyond the original planned arrival time window, the operator must establish procedures and controls to have the dispatcher and pilot in command (PIC) review the § 121.647 conditions, to include reanalyzing the en route burn for fuel planning.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

- **D.6) – D.9)**

  6) When no PBCF value is available, the unplanned contingency fuel value shall not be less than 10 percent of en route time, or, for operators with an approved minimum landing fuel program, it shall be not less than 5 percent of the en route time.

  7) The PBCF values (airplane make and model/city pair/arrival time window) must be accessible by the flightcrews and dispatchers, even if automation populates the required field in the flight planning system.

  8) The supporting data and final PBCF values must be accessible to the Administrator on request.

  9) A recalculation of the PBCF data must be made a minimum of once a month.

  - *United Airlines is updating their PBCF Values weekly*

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

D.10)

10) For a new airplane make and model/city pair/arrival time window combination that the air carrier has not previously flown, PBCF values will not be used until the data requirements of subparagraph D1(a) through (c) are met either via automated calculations and controls or by approval of the CHDO.

NOTE: Additions/deletions of airplane make and model/city pair/arrival time window combinations do not require HQ review and concurrence after initial issue. These changes to the data are coordinated between the CHDO and air carrier and amendment to Table 1 may be required. Any changes to the PBCF statistical methodology, alerting, or reporting system must be evaluated by the CHDO and HQ.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions

- The certificate holder shall conduct operations that use the fuel supplies authorized by this OpSpec in accordance with all of the following conditions:

  1) As applicable, the flight shall be dispatched in accordance with § 121.621, Alternate Airport for Destination: Flag Operations. Additionally, if the destination airport has only one usable runway, an alternate airport must be listed on the dispatch release.

  2) The provisions of this OpSpec may not be used in conjunction with the provisions of OpSpec A012, B043, or B044.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (cont.)

3) The certificate holder must have a fuel consumption bias program to maintain a hull-specific performance monitoring system that continuously monitors, analyzes, and compares the fuel performance calculations to the actual performance for each individual airplane used under this deviation.

4) Accurate meteorological data, including upper wind information equal to or more accurate than 1.25 degrees (1.25 degrees of latitude by 1.25 degrees of longitude grid over the globe) gridded model winds must be utilized for the entire flight plan route.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (cont.)

5) All flight deck fuel quantity indicators must be operational at dispatch. Any en route failure of these indicators must be reported as soon as practical to the aircraft dispatcher.

6) Fuel requirements of this authorization must not be lower than the requirements of § 121.193(c) or the Extended Operations (ETOPS) critical fuel requirements of § 121.646, as applicable.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (continued)

7) The certificate holder must have approved policies and procedures to maintain a flight monitoring system that generates alerts and requires the flightcrew to alert the dispatcher of any significant deviations from the flight planned route, altitude, and speed and any shortfalls in fuel on board compared to flight-planned fuel. If the flight reports any significant deviation or shortfall of fuel while en route, the PIC and aircraft dispatcher must agree upon a course of action and document the decision.

– This reinforces the requirements of 14CFR 121.535, but does not add any additional requirement

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (cont.)

7) Continued - Significant deviations from the plan are defined as:

a) If actual estimated time of arrival (ETA) will exceed planned ETA by more than 15 minutes;

b) Fuel on board shortfall compared to flight planned fuel over a flight plan fix (or abeam fix as appropriate) exceeds 15 minutes of endurance;

c) When no alternate is required and the total contingency fuel(s) (for the purpose of this requirement, total contingency fuel includes planned and unplanned) is less than 15 minutes, the PIC will alert the dispatcher when the ETA is planned to exceed the contingency value in minutes;

d) Cruising altitude varies by more than 4,000 feet from the flight plan;

e) Current route exceeds 100 nautical miles from the flight plan route; or

f) Cruise speed deviates by greater than .02 Mach.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (cont.)

8) The air carrier must have a primary and secondary method of communication between the flightcrew and the dispatch department. These systems must be available for the entire route of flight.

9) The air carrier shall establish performance measures and process controls to ensure the equivalent level of safety to § 121.645 is maintained. Performance measures must include measures of complete PBCF fuel burns, both expected and actual, for each airplane make and model/city pair/arrival time window and in aggregate.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

E. Special Limitations and Provisions (cont.)

10) The air carrier may operate a supplemental charter operation in accordance with OpSpec A030 to a destination where PBCF program data is available.

11) The provisions of this OpSpec may not be used when any system outage would affect the monitoring or alerting of the fuel.

12) If the flight reports any significant deviation or shortfall of fuel while en route, the PIC and dispatcher must agree upon a course of action and document the decision.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

F. Reports Required by this OpSpec

1) The air carrier must record and identify the root cause for any flight that consumes all of the [unplanned] contingency fuel required by this OpSpec and arrives with less than 60 minutes of fuel remaining (calculated at 1,500 feet holding speed). For the purpose of determining PBCF burn-in, the following is the defined fuel hierarchy:

a) Taxi fuel;

b) En route burn;

c) MEL fuel penalty (does not include unusable fuel (e.g., fuel pump inoperative; 3,500 pounds must be carried in tank));

d) Planned contingency fuel for known delays or holding;

e) Section 121.193(c) or the ETOPS critical fuel requirements of § 121.646;

f) PBCF;

g) Minimum landing fuel or other additional fuel (e.g., captain- and dispatcher-added fuel);

h) Alternate fuel if required; and

i) Thirty-minute final reserve fuel (refer to § 121.645).

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

F. Reports Required by this OpSpec (cont.)

2) The following information will be provided in a quarterly report to the CHDO:

a) Summary of the air carrier's performance measures related to this process, including measures of complete PBCF burns, both expected and actual, for each airplane make and model/city pair/arrival time window and in aggregate;

b) A table summarizing the PBCF values on the last day of the quarter for each airplane make and model/city pair/arrival time window combination in effect on that day; and

c) The quarterly report shall list all flights excluded from PBCF calculations during the quarter, including the reasons for exclusion.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

F. Reports Required by this OpSpec (cont.)

3) All data necessary to generate/duplicate the PBCF values will be made available to the Administrator for the purpose of an audit of a sampling of airplane make and model/city pair/arrival time window combinations. This audit shall be conducted no less than annually and shall cover no less than five unique airplane make and model/city pair/arrival time window combinations.

- CMO is required to see that audit is completed, may request AFS-200 assistance

4) The air carrier must report to the POI within 24 hours, whenever any flight makes a declaration of minimum or emergency fuel to the air navigation service provider.

5) Additionally, the certificate holder will report any occurrence of a low (minimum fuel) fuel state, which results in actions being taken by air traffic control and/or dispatch in order to provide priority handling, even if no emergency or minimum fuel state is declared. This will be included as a part of the quarterly reporting.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

G. Calculating PBCF Values

- FAA has established performance thresholds
  - Approved air carriers will set their level of unplanned contingency fuel to meet the performance threshold for each specific combination (MM/City Pair/Arrival Window) based upon their historical fuel-planning accuracy for that combination
  - You will be setting the PBCF fuel values for the probability of burning all PBCF fuel at the targets of
    - With minimum fuel program
      - 1 in 10 in non-convective conditions at destination,
      - 1 in 100 for expected convective conditions at destination
    - Without minimum fuel program
      - 1 in 70 in non-convective conditions at destination,
      - defaulting to 10% for expected convective conditions at destination

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

G. Calculating PBCF Values (continued)

2) A method for calculating the necessary PBCF is provided in the Guidance

- *FAA adopted the rank order percentile method*
- The air carrier is not limited to this method but must obtain CHDO and HQ approval for any deviation
  - *the onus will be on the applicant to show proposed alternate method provides sufficient accuracy and end results*
  - *FAA has limited resources to review alternate proposals*
- Air carriers may apply seasonal weighting factors to their PBCF data to better match the seasonal operating environment.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

H. Additional Requirements

- The certificate holder must retain
  - the PBCF values used *for a minimum of 1 year*
  - and the data used to generate those PBCF values
    - *For example, if you use 2 years of historical data to generate PBCF values, you would be required to retain 3 years of flight data*
- Any change in airframe or engine condition, or configuration that may affect the performance of the airplane make and model (e.g. winglet modification, re-engine mod, etc.)
  - requires a reassessment of the fuel consumption biases used in the calculations of PBCF.

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

I. Oversight Monitoring Program

- The certificate holder must establish an internal oversight program to monitor this deviation acceptable to the Administrator.
- This oversight program must at a minimum evaluate the number of complete PBCF burns quarterly, both expected (based upon performance threshold applicable to each flight) and actual.
- These measures must be generated for each airplane make model/city pair/arrival time window *[where PBCF was used during the quarter]* and in aggregate

Guidance (N8900.1 Vol. 3, Ch 18, Section 4)

I. Oversight Monitoring Program (continued)

– For those airplane make and model/city pair/arrival time window combinations where actual complete PBCF burns exceed the expected value by a significant amount, the operator must consider mitigating action, which may include one or more of the following:

1) Adding additional unplanned contingency fuel to each flight;

2) Reassessing whether the model used to calculate PBCF is appropriate;

3) Excluding route(s) from B343;

4) Reevaluation of B343's performance thresholds; and/or

5) Closer monitoring of specific route(s).

Performance Measures

- **Proof of Concept for B343 Update**
  - Demonstration Flights began March 2015
  - Continue to-date
    - As of early Feb 2017, United had performed more than 160,000 flights

Year	Intl Flights	Min Fuel Events	Events Per 10000/flts
2013	163,500	5	0.3058
2014	166,572	5	0.3002
2015 Before ARF	24,855	1	0.4023
2015 After ARF*	58,490	5	0.8548
2016*	92,386	5	0.5412
2017*	11,197	0	0.0000
Totals	**517,000**	**21**	**0.4062**

*International Flights after "2015 after ARF" only include ARF flight counts and fuel events

Performance Measures

- **Proof of Concept Summary Data**

(none of calculations below include minimum fuel contribution)

Summary Values		% of Total	
Total Flights	160647		
ARF_90 Flts	155677	96.9%	
ARF_99 Flts	4970	3.1%	
Burn ins (partial)	48839	30.4%	
Complete ARF Burn	11608	7.2%	
ARF90 Burn Ins	47142	30.3%	
ARF90 Complete Burns	11442	7.3%	
ARF99 Complete Burns	166	3.3%	
Flights dispatched w/5 mins	48674	30%	
ARF90 Flts dispatched w/5 mins	47645	31%	
ARF99 Flts dispatched w/5 mins	1029	21%	
Flights dispatched w/> 10%	2461	1.5%	
ARF90 Flts dispatched w/> 10%	1058	0.7%	
ARF99 Flts dispatched w/> 10%	1403	28.2%	

Conclusions

- **The Operator has several avenues to reduce the amount of unplanned contingency fuel**
  - If they cannot meet the requirements of B043, B044, or the updated B343, the prescriptive requirements of 121.645 are still available to them
- **The B343 process requires a disciplined approach to procedural compliance, data gathering and data analysis**
  - failure by the operator, CMT, or headquarters to carry out their responsibilities could lead to a reduction in safety
- **The premise of B343/PBCF is that it is the correct amount of unplanned contingency fuel**
  - Hence, B043 and B044 should not be necessary

Inflight Fuel Monitoring

- An operator shall establish policies and procedures, approved by the State of the Operator, to ensure that in-flight fuel checks and fuel management are performed.
- The pilot-in-command shall continually ensure that the amount of usable fuel remaining on board is not less than the fuel required to proceed to an aerodrome where a safe landing can be made with the planned final reserve fuel remaining upon landing.

Company Policies for inflight fuel monitoring should include:

- a) the variables used in the calculation of the usable fuel required to take off or to continue beyond the point of in-flight re-planning; (min fuel)
- b) the alternate aerodrome selection and fuel planning methods used in flight planning; (Alternate fuel how that relates to expect further clearance times)
- c) flight crew responsibilities and actions related to pre-flight fuel planning and fuel load determination; (discretionary fuel or shared preflight responsibility)
- d) flight crew responsibilities and actions related to flight planning methods that require specific in-flight re-analysis, re-planning or re-dispatch procedures (e.g. RCF, PNR. DP, PDP); (point of no return or redispatch)
- e) the OFP and instructions for its use; (waypoint fuel cross checks, position reports)(Reference B343 monitoring and reporting requirements by the flight crew slide 56)
- f) deviations from the OFP or other actions that could invalidate flight planning assumptions (e.g. acceptance of direct routings, altitude changes, speed changes);

Company Policies for inflight fuel monitoring should include:

- g) actions related to the acquisition of timely and accurate information that may affect in-flight fuel management (e.g. meteorology, NOTAM, aerodrome condition);
- h) the practical means for the in-flight validation (or invalidation) of assumptions made during alternate aerodrome selection or fuel planning including instructions for recording and evaluating remaining usable fuel at regular intervals; (Fuel score, record management and analysis)
- i) the factors to be considered and actions to be taken by the PIC if flight planning assumptions are invalidated (re-analysis and adjustment) including guidance on the addition of discretionary fuel at the flight planning stage if necessary to ensure adequate safety margins are maintained throughout the flight;(Pilot in Command Authority and exercise of same)
- j) actions to be taken by the PIC to protect final reserve fuel including instructions for requesting delay information from ATC; (PIC Authority)

Company Policies for inflight fuel monitoring should include:

- k) instructions for the declaration of *MINIMUM FUEL*; (Company Guidance, when to declare, application of alternate fuel e.g. calculated from the destination not from the holding point, protection of final reserve at destination alternate, contingency if necessary for that airport)
- l) instructions for the declaration of a fuel emergency (*MAYDAY MAYDAY MAYDAY FUEL)*. (Many countries do not understand Minimum fuel, this is WHY the term MAYDAY, spoken three times followed by the word FUEL is so important,)

Questions?

Thank you for your attention