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Implementation of an LDA/DME Approach to Runway 16R in Lieu of a Third Runway at Sea-Tac

I. INTRODUCTION

The April 1995 Seattle-Tacoma International Airport Master Plan Update Draft Environmental Impact Statement, (DEIS, Chapter 11), identifies seven alternatives to "Improve the Poor Weather Airfield Capability In A Manner That Accommodates Aircraft Activity With An Acceptable Level of Aircraft Delay."

The alternatives are:

a. Use of other modes of Transportation
b. Use of other Airports or Construction of a New Airport
c. Activity Demand Management
d. Runway Development at Sea-Tac
e. Use of Technology
f. Blended Alternative (Combination of other modes, use of existing airports, and activity demand management).
g. Do-Nothing/No-Build

The DEIS concludes that the preferable alternative to improve "poor weather" airfield capability is to construct an 8500 foot runway 2500 feet West of Runway 16L/34R. The DEIS infers that an LDA Approach to Sea-Tac is not viable due to the frequency of "poor weather". The Port attributes this conclusion based on the poor weather conditions they claim exist 44% of the year.

LDA has and will be referred to many times in this report therefore; following is a definition of the term LDA. The Localizer Directional Aid (LDA) is an electronic beam used to guide aircraft to a specific point in space. It works similar to the localizer beam of an Instrument Landing System (ILS). Unlike an ILS the LDA is not aligned with a runway. The beam is used as guidance through the clouds. After descending clear of the clouds the pilot then abandons the course guidance and executes a sidestep type of maneuver to the runway of intended landing. In the case of Sea-Tac the landing runway would be 16R.

This report refutes the DEIS analysis of "poor weather" and its impact on the airports ability to accommodate the aircraft activity forecast in the year 2020.

This report supports the following conclusions:

Detailed analysis of SEA-TAC weather (years 1993 and 1994), refutes the Port's claim that 44% of the time, weather conditions limit the airport to single flow operations. Detailed analysis reduces that period of time to approximately 17% annually.

An LDA/DME approach procedure to runway 16R is feasible, and will reduce the capacity forecast delay for the year 2020 to an acceptable level.

With the installation of an LDA runway 16R the year 2020 annual forecast and dally hourly demand identified in the DEIS can be accommodated in an orderly fashion negating the need to construct a third runway.

II. DETAILED WEATHER ANALYSIS.

To understand the significance of such detailed weather, when it existed, and how airfield capacity demands can be influenced by bad weather etc., it is necessary to understand the definitions of the weather conditions at Sea-Tac:

Visual Flight Rule 1 (VFR-1). Ceiling (height of cloud base above the ground) is at least 5,000 feet and visibility at least 5 miles.

Visual Flight Rule 2 (VFR-2). Ceiling is between 2,500 feet and 4,999 feet and visibility is more than 3 miles.

Instrument Flight Rule 1 (IFR-1). Ceiling is above 800 feet and less than 2,499 feet and or the visibility is less than 3 miles.

Instrument Flight Rule 2 (IFR-2), and (IFR-3), and (IFR-4). Ceilings from zero to less than 800 feet and Visibility zero to 2 miles. IFR-4 is the worst ceiling and visibility weather condition.

The DEIS states that 10 years of weather was reviewed 1 and concludes a third runway is required at Sea-Tac. That review of the weather data resulted in a determination that 44% of the year weather conditions exist that prevent air traffic control from utilizing dual arrival flows. Delays occur when hourly traffic demands exceed single arrival flow capacity. The DEIS contends that the excess operations are delayed beyond a reasonable time and that the costs to the airlines and the traveling public are not acceptable. The conclusion is that a third runway constructed at Sea-Tac will allow dual arrival streams during inclement weather conditions and that the increase in hourly airport capacity will reduce the remaining delays to an acceptable level.

To determine if the DEIS weather analysis was correct, two years of hourly airport weather observations were obtained from the National Weather Service (I 993 and 1994). The data is the exact hourly weather reported 24 hours per day each day of each month for the two year period. This detailed weather was analyzed with the confidence that It depicted exactly what the weather conditions were any given hour of any day or month during the two year period.

The analysis concluded that weather conditions requiring single stream flow at SeaTac is not 44% as claimed in the DEIS. Instead the 1993 and 1994 "Poor weather' that requires single stream arrivals after implementing an LDA procedure is approximately 17%. That is a significant difference from the DEIS conclusions, especially when airport efficiency is at Issue.

At Sea-Tac during VFR-2 and all IFR weather conditions, the DEIS claims arriving aircraft are limited to a single stream. This is the result of only one runway being equipped with an ILS and the capacity constraints that result from such an arrival configuration. The DEIS states that during VFR-1 conditions the maximum hourly arrival acceptance rate is 60. VFR-2 is 48, IFR-1 36, and IFR-2, 3, and 4 Is 24. In the DEIS weather analysis, no consideration is given to what time of day poor weather conditions exist. The DEIS 44% VFR-2 and IFR-1, 2, 3. 4 weather is spread evenly throughout the day which supports the claims of excessive delay and subsequent cost to the airlines and flying public. Logic would say that some of that poor weather had to occur during off-peak hours and therefore, did not cause delays due to a single flow arrival stream. If the proportion of the 'poor weather' is higher during off peak hours, the delays due to a single flow arrival stream are less.

To properly analyze the actual weather conditions rather than assuming overages during critical delay calculations, hourly observations had to be examined. Only then could a proper weather impact on delay be developed.

The first analysis was of VFR-1 and VFR-2 weather conditions validating the actual hours these conditions existed. The same analysis was conducted for the hourly IFR1. 2, 3, 4 weather reports. After determining the actual weather conditions that existed, an analysis was performed to determine It any VFR-2 or IFR-1 weather conditions met or exceeded the criteria established by the Federal Aviation Administration (FAA) when they approved LDA approach procedures at other air carrier airports. Spread sheets were developed to depict hourly weather conditions for VFR-1, IFR-l and VFR-2 that meet and do not moot FAA LDA weather criteria for the years of 1993 and 1994. 2

After analyzing the hourly VFR-2 and IFR-1 weather, It became obvious there was a significant number of hours that met or exceeded the FAA's weather criteria that has been used in establishing LDA approaches. The In depth hourly analysis confirmed the percent of weather conditions that currently restrict dual flow operations at SeaTac is over-stated in the DEIS. To present a true picture of Sea-Tac weather, and demonstrate how dual flow hours within the existing 2 runway configuration can be increased, the VFR-2 and IFR-1 weather reports for each hour were sorted and identified into two new categories, IFR-1 good (IFR-1 G) and IFR-1 bad (IFR-1B).

They are defined as:

> IFR-1G. VFR-2 and IFR-1 weather where the ceiling is between 2,200 feet and 4,999 feet and visibility 6 miles or more. This weather exceeds FAA LDA weather criteria approved for SFO and STL airports.
>
> IFR-1B. The remaining VFR-2 and IFR-1 weather where ceilings are less than 2,199 feet and or visibility less than 6 miles down to and including IFR-2, 3, and 4 weather conditions. These weather conditions were determined not suitable for LDA approaches at Sea-Tac even though FAA has approved lower ceiling and visibility requirements at STL than has been

defined for IFR-1 G in this study. An interesting side note, due to the apparent acceptance of LDA approaches, FAA is considering reducing ceiling and visibility criteria for LDA approaches. The new weather criteria, if approved, would increase the number of hours that dual stream arrival flows could be conducted at Sea-Tac beyond what is identified in this report, resulting in even less delay.

IFR-1 G weather (IFR-1 and VFR-2 that meets FAA LDA weather criteria) was combined with the VFR-L weather conditions when analyzing dual stream potential. Our hourly analysis confirmed that VFR-1 weather conditions exist approximately 66% of the year. VFR-2, and IFR-1, 2, 3, and 4 account for the remaining 34 % of the annual weather at Sea-Tac. IFR-1G accounts for approximately 17 % of the 'poor weather" conditions, with IFR-1B, (which does not meet the FAA LDA weather criteria) the remaining 17%.

III. FEASIBILITY OF AN LDA APPROACH PROCEDURE AT SEA-TAC.

The main thrust of this study is to determine if an LDA approach to runway 16R will allow dual stream arrivals during some of the 44% of poor weather conditions claimed by the DEIS. If LDA approaches can be conducted a sufficient number of hours per day, and reduce delays to an acceptable level, construction of a third runway is not necessary. To determine the actual number of hours that LDA approaches could be conducted, this study compared IFR-1 G and IFR-1 B weather criteria to the hourly forecast demand identified in the DEIS. 3

VFR-1 weather exceeds FAA weather requirements for establishing an LDA approach procedure. Hourly VFR-2 and IFR-1 conditions of the 1993 and 1994 weather data was analyzed and separated into IFR-1G and IFR-1B, as defined earlier in this report. IFR-1G criteria was developed by equaling or exceeding the weather criteria required by the FAA when procedures were approved at San Francisco International (SFO) and Lambert Field St. Louis International (STL) airports. Minimum weather requirements for SFO are 2,100 foot ceiling and 6 miles visibility. STL weather requirements are 1,200 foot ceiling and 5 miles Visibility. Instead of utilizing the weather criteria approved for STL, the IFR-1G weather criteria was designed to exceed the SFO criteria. Therefore the IFR-1G weather criteria of a ceiling minimum of 2,200 feet and 6 miles visibility is more conservative than what has been approved by the FAA for either SFO or STL.

IFR-1G weather (by definition meets LDA weather criteria),added to VFR-1 meets or exceeds LDA weather criteria and accounts for approximately 83% of the year. The remaining 17% of the year only a single arrival stream can be used in the LDA 16R and ILS 16L scenario. Later in this study the resulting impact on airport capacity of the remaining 17% is discussed in detail. Clearly an LDA approach to 16R plus the planned ILS approach to 16L is a viable alternative to constructing a third runway at Sea-Tac. It reduces the 44% of single arrival stream time claimed by the DEIS to 17%.

The unanswered question is, without a third runway, can Sea-Tac accommodate the year 2020 forecast utilizing a dual stream LDA approach 83% of the year.

IV. YEAR 2020 ANNUAL FORECAST AND HOURLY DEMAND.

An hourly analysis of the DEIS 2020 arrival and departure forecast was conducted. The arrival and departure peaks do not occur in the same hours. The arrival peak hours significantly exceed the number of departure peak hours, therefore; arrivals were selected for detailed analysis. 4 The 2020 arrival forecast concludes that 38% of the time, the arrival demand is less than 24 operations per hour. The DEIS has identified 1 0 minutes as the 'maximum tolerable level of total all-weather delay per operation." It concludes this maximum delay will allow Sea-Tac to maintain an efficient and profitable air service. The stated goal is to operate the airport in such a fashion that average delays do not exceed 6 to 7 minutes per operation. The DEIS claims this reduced delay goal is desirable and will minimize airline operating costs and passenger inconvenience.

Using the DEIS acceptable delay factor as a guide the 2020 fleet mix and forecast volume was exposed to an airport operational scenario consisting of the two existing runways and dual arrival streams using ILS 16L and LDA 16R procedures. The airport arrival operating capacity data identified in the Draft EIS is: VFR-1 with an hourly arrival maximum of 60, VFR-2 with a 48 per hour arrival maximum, IFR-1 with a 36 per hour arrival maximum, and IFR-2, 3, and 4 with a maximum hourly arrival rate of 24.

The 2020 arrival forecast does not exceed the VFR-1 maximum hourly acceptance capacity of 60 arrivals during any hour of the forecast period. Therefore, it is assumed that during VFR-1 conditions (66% of the year), additional arrival delays due to weather constraints will not occur. Analysis of other weather conditions such as IFR-1G (weather conditions that meet LDA requirements) was conducted with the same results as that of VFR-1. That is, during IFR-1 G dual arrival streams, no additional delays due to airport arrival rates should be encountered. Further analysis was conducted to determine the ability of the airfield to accommodate future arrival demand during those periods of weather (IFR-1 B, IFR-2, 3, and 4), when only single stream arrivals can be conducted.

The DEIS indicates that from 1988 to 1993 delays at Sea-Tac have been reduced from 48,000 hours to 26,000 hours, a delay reduction of approximately 46%. The DEIS credits the reduction in delays to several airport improvements and improved air traffic control efficiency. This reduction in hours of delay was accomplished even with an increase in annual operations. The annual operations increased from 316,260 in 1988 to 353,052 in 1994. Examples of airport improvements cited in the DEIS include: relocation of ILS runway 16R aircraft hold lines, installation of runway centerline lights on runway 16L, improved air traffic control monitoring of traffic flows, improved lighting and signage, and a more homogeneous fleet mix.

Upon analyzing weather conditions that have been the cause of airport delays, namely reduced arrival capacity during single stream arrival periods, it is obvious airport delays are attributed to reduced capacity associated with poor weather. Therefore the 46% reduction in delays should be in direct proportion to improved airport acceptance rates during those single stream arrival flows. The DEIS states that all the improvements were directly related to enhancing airport efficiency and mitigating the reduced arrival capacity associated with single stream operations. Yet even with the improvements that reduced the delays, the DEIS does not adjust the hourly arrival acceptance rates in its current analysis from the arrival rates in 1988 prior to the identified delay reduction of 46%.

When the DEIS uses the 1988 arrival rate for IFR-2+ in the 1996-2020 analysis it ignores all of the improvements already made plus any future improvements that may be implemented during the next 25 years.

The Sea-Tac single stream acceptance rate in 1988 was 24 arrivals per hour. As previously stated since the airport improvements, the reduction in delays equal 46%. Therefore; it is reasonable to assume the single stream arrival rate increased proportionately. 24 operations increased by 46% (24 ops. X 46% = 35 ops.) which is a substantial increase in hourly acceptance rates. One can reasonably assume that the airfield will continue to operate in an ever increasing efficient manner. Accordingly, runway acceptance rates should increase. FAA Advisory Circular 150/5060, Airport Capacity and Delay, identifies what hourly operations should be expected for different runway configurations. The numbers below, identified as runway capacity arrival expectations, parallel the hourly runway arrival figures found in the FAA Advisory Circular. The figures on the right (DEIS Runway Capacity: Arrival Expectations) represent hourly arrival rates used in the DEIS study encountered prior to all the airport operational improvements cited since 1988. Those improvements are the basis for the 46% reduction in delays. Obviously, the improvements fostered increased hourly acceptance rates during bad weather. Without increased acceptance rates, delay reductions of 46% could not have been attained.

Conditions:	Runway Capacity: Arrival Expectations	DEIS Runway Capacity: Arrival Expectations
Good Weather		
VFR-1	65 +	60
Poor Weather		
VFR-2	52-55	48
IFR-1	48-50	36
IFR-2, 3, and 4	36-38	24

Analysis of dual stream capacity (LDA 16R and ILS 16L) concludes delays can be kept to an acceptable level. Although 46% equals an arrival rate of 35 per hour, this analysis is based on a single stream capacity of 36 arrivals per hour which is within the calculations of runway acceptance rates cited in the FAA Advisory Circular. In keeping with the improving airport operating efficiency described in the DEIS, a conservative 36 arrival rate should easily be attained by the year 2020. When comparing the airport arrival rate of 36 to the DEIS 2020 Hourly Arrival Distribution data, those hours that did not exceed the arrival capacity of 36 (per the DEIS) were considered to not cause additional delays and dropped from further review.

The DEIS 2020 Hourly Arrival Distribution chart identifies 8 hours per day that forecast demand exceeds an arrival capacity of 36 per hour. Those 8 hours were analyzed using the detailed 24 hour weather data for December 1993 and February 1994. 5 The purpose of this study is to prove that with proper instrumentation (LDA 16R and ILS 16L), Sea-Tac can operate in an efficient manner without having to construct a third runway. To assure credibility of conclusions formed as a result of this study, December 1993 and February 1994, were selected for weather computations. December and February recorded the lowest percentage dual stream weather condition during the two years of detailed weather analyzed. Following is a description of the analysis process used in the forecast demand and detailed weather breakdown that was analyzed.

Detailed weather, December 1993:

9:00 AM Arrival demand is forecast to be 38 operations for the 9:00 AM hour. For seven days th3 9:00 AM hourly arrival rate is 36 per hour during the weather conditions that require a single stream scenario. 2 operations exceed the arrival capacity for those 7 days; or 14 operations (7 x 2), have experienced additional delays at that hour during the month of December, 1993. Using this calculation method the excess hours of demand in December 1993, are listed below.

9:00 AM 14 operations exceed the monthly arrival rate for that hour.

10:00 AM 104 operations exceed the monthly arrival rate for that hour.

11:00 AM 42 operations exceed the monthly arrival rate for that hour.

1:00 PM 6 operations exceed the monthly arrival rate for that hour.

3:00 PM 6 operations exceed the monthly arrival rate for that hour.

6:00 PM 50 operations exceed the monthly arrival rate for that hour.

7:00 PM 36 operations exceed the monthly arrival rate for that hour.

8:00 PM 18 operations exceed the monthly arrival rate for•

that hour.

A total of 276 operations during that month exceed the 36 hourly runway operation single flow capability.

Detailed weather, February 1994:

Using the same methodology as described for the December analysis, the hours of excess demand for February 1994, are listed below.

9:00 AM 26 operations exceed the monthly arrival rate for that hour.

10:00 AM 88 operations exceed the monthly arrival rate for that hour. 9

11:00 AM 90 operations exceed the monthly arrival rate for that hour.

1:00 PM 5 operations exceed the monthly arrival rate for that hour.

3:00 PM 10 operations exceed the monthly arrival rate for that hour.

6:00 PM 60 operations exceed the monthly arrival rate for that hour.

7:00 PM 32 operations exceed the monthly arrival rate for that hour.

8:00 PM 12 operations exceed the monthly arrival rate for that hour.

A total of 323 operations during that month exceed the 36 hourly runway operation
single flow capability.

In the year 2020 the DEIS forecasts annual operations to be 441,600, an average of 36,800 operations per month, or an average of 18,400 arrivals. Of the 18,400 arrival operations forecast per month, 276 operations or approximately 1.5% of the total December arrival demand could encounter some additional delay due to a single stream arrival flow. For the February arrival demand, the percent of delay due to a single stream arrival flow is approximately 1.80/o. When considering the possible inaccuracies acceptable in long range forecasting, this delay of less than 2%, is negligible. This low estimate of delay is because the DEIS claims 44% weather where single stream is required, versus the 17% identified in the detailed analysis conducted in this study.

Additionally, the DEIS underestimates the success of the past airport and airspace improvements it identifies as the cause of the 46% reduction in delays since 1988. Because the DEIS does not properly credit their contribution to delay reduction the DEIS underestimates the true hourly acceptance rates at Sea-Tac. When the cited improvements are properly considered and single stream arrival rates adjusted accordingly unwanted delays rapidly decline- Unlike the DEIS conclusion this can be accomplished without the addition of another runway. Finally, the 2020 arrival peak hours have a smaller proportion of the 17% single flow arrival stream weather than the off peak hours.

An annual average analysis was made for 1993 using acceptance rates of 36 operations per hour for the expected case, and 24 operations per hour for the worst case during non LDA weather. The annual results also indicate that the acceptance rate is exceeded less than 1% of the year for the "expected case" and less than 2% for the "worst case'. The analysis of 1994 weather should produce similar results. 6

The purpose of this study was to evaluate methods of satisfying forecast demand versus the airport acceptance capability. During the preliminary analysis it became obvious that three key issues drove the focus of this study. The need to analyze the weather in greater detail to determine specific weather conditions i.e., VFR, IFR, etc., and when that occurs by hour. Predicated on the outcome of the detailed weather analysis, could dual stream arrivals using LDA 16R and ILS 16L with the existing two runway configuration be a viable solution to demand forecasts. Lastly, the third and probably most crucial issue was, is the above mentioned airport configuration compatible with the forecast demands and possible delays. As in the DEIS an important goal of this study was to limit delays to an acceptable level.

Without doubt the extensive analysis of the three key issues and secondary concerns that surfaced all validated the following conclusions and recommendations.

The DEIS claims to have analyzed ten years of Sea-Tac hourly weather observations. Upon a review of the conclusions and assumptions it is obvious that the analysis was not in sufficient detail to identify when and how often weather conditions really limit the arrival flow to single stream. A detailed analysis identifies what hours of the day or night that certain weather conditions exist. This is especially important when the purpose of the DEIS is to determine if the airport can accommodate the year 2020 forecasts with or without the need for a third runway.

The DEIS weather analysis was not detailed enough to give credit for off peak hours when weather is poor. 7 That oversight erroneously leads one to believe demand will suffer due to "poor weather" even though a large portion of inclement weather occurs during low or non demand periods. This study refutes the DEIS conclusion regarding the percentage of 'poor weather' and the ability to conduct dual stream approaches to accommodate forecast operations.

Those peak hours when arrivals exceed 36 per hour significantly exceed the number of hours when departures would not be accommodated without unacceptable delays. Arrivals are exposed the most delay and are the main thrust of this study.

The detailed analysis of the 1993 and 1994 Sea-Tac annual weather concludes that the ceiling and visibility impact on single stream arrivals is only approximately 17% of the year. Annual weather in the Seattle area is such that ceiling and visibility conditions that will support LDA criteria equals or exceeds FAA requirements approximately 83% of the year. This means that dual stream arrival flows can be utilized to satisfy nearly all the airports forecast hourly demand. This includes the long range forecast period of 2020 and the 441,600 annual operations and approximately 38.2 million passengers.

The DEIS annual hourly demand forecast was analyzed with special emphasis on the following issues.

a. Actual detailed hourly weather observations
b. The Port's runway use plan, and fleet mix, cited in the DEIS
c. Dual flow capabilities of an LDA 16R and an ILS 16L arrival plan
d. The impact of single flow when dual streams can not be used
e. Keeping the airport runway layout at two runways only

The sum of the analysis of these issues concludes, constructing a new third runway is unnecessary to reasonably accommodate current and future (year 2020) operations. The recent airport and air traffic control improvements have resulted in an significant reduction in delays and subsequent costs to the airlines and flying public. There is no reason to think that this efficiency will not continue and even increase over the years. If all these gains have been accomplished with the current airport configuration, then increasing dual flow operational periods by use of an LDA approach should accommodate the DEIS forecast for the year 2020.

With weather conditions that equal or exceed LDA criteria (83% of the year) all that is required is to get the aircraft below the clouds in an efficient and orderly manner. This can be done. When aircraft are below the clouds the airport can reasonably accommodate the volume, including the long range forecasts, with the current two runway configuration.

V. CONCLUSION

Detailed analysis indicates that a third runway is unnecessary, and that the DEIS conclusions are based on faulty assumptions. The Port has not exhausted all alternatives including LDA approach procedures in an effort to resolve future capacity problems without constructing a third runway. Equipping the airport in its present configuration with LDA capability to an existing runway can reasonably accommodate the activity forecast for the year 2020. LDA approach procedures have implemented at San Francisco and St. Louis and soon will be at Charlottesville. It proves that implementing LDA procedures can be accomplished quicker and cheaper than building an additional runway.

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GLOSSARY

Sea-Tac Seattle Tacoma International Airport.
SFO San Francisco International Airport.
STL Lambert Field St. Louis International Airport.
16L The easterly of the 2 parallel runways, south flow.
16R The westerly of the 2 parallel runways, south flow.
DME Distance Measuring Equipment.
EIS Environmental Impact Statement.
DEIS Draft EIS.
ILS Instrument Landing System.
LDA Localizer Directional Aid.
Ops Operations.
Wx Weather Report.
TERPS FAA Handbook, Terminal Instrument Procedures. Visual Flight Rule Conditions.
IFR Instrument Flight Rule conditions.
VFR-1 Local definition of VFR (ceiling at least 5,000 feet and visibility 5 miles or more).
VFR-2 Local definition of VFR (ceiling between 2,500 feet and 4,999 feet and visibility 3 miles or more).
IFR-1 Local definition of IFR (ceiling above 800 feet and less than 2,499 feet and or visibility is less than 3 miles).
IFR-2 All three of these categories. Ceilings from less than 800 feet down to zero and IFR-3 visibility 2 miles down to zero. IFR-4 is the worst weather condition.
IFR-4

IFR-1G Weather defined for this study. A combination Of VFR-2 and IFR-1 where the ceiling is 2,200 feet to 4,999 feet and the visibility is 6 miles or more.

IFR-1B Weather defined for this study. A combination Of VFR-2 and IFR-1, or worse, with a ceiling of 2,199 feet or less and the visibility is less than 6 miles.

EXHIBITS

2 Sea-Tac Airport LDA Weather Conditions 1993 - (pg 3).

3 a- Sea-Tac Airport Weather Conditions 1993 - (pg 3).

SOURCE DOCUMENTS

Sea-Tac Airport Master Plan Update Draft EIS Apr.1995 (select sections).

U.S. Weather Bureau Service Hourly Surface Weather Observations Sea-Tac Airport 1993 and 1994.

FAA Technical Center - Sea-Tac Capacity Enhancement Plan Update Data Package # 1 1 -

FAA approved LDA Procedures - SFO and STL International Airports.

FAA Advisory Circular - Airport Design.•

FAA Advisory Circular - Airport Capacity and Delay.

FAA Handbook - Airspace Procedures.

FAA Handbook - National Airspace System Plan.

FAA Handbook - Aviation Capacity Enhancement Plan.

FAA APO 80 - Terminal Area Forecasts.

United States Standards for Terminal Procedures (TERPS).

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1 pg. 54-58 Expert Arbitration Panel Transcript dated 5/4/95.
2 Exhibit - a,b,c,d, weather conditions 1993 and 1994.
3 Exhibit - hourly arrival distribution average day year 2020.
4 Exhibit - hourly arrival and departure distribution average day, year 2020.
5 Exhibit - a,b. non- LDA weather conditions by hour of day Dec. 1993, Feb. 1994.
6 Exhibit - expected case, worst case, annual ops analysis 1993.
7 Exhibit - non-LDA weather conditions by hour of day Jan. to Dec. 1993