Order 1050.1E 3,000 ft. AGL Categorical Exclusion Validation Study

1. Introduction

In 1984, among other things, the FAA added provisions to the appendices for Air Traffic and Flight Standards in an update to FAA Order 1050.1C identified as 1050.1D. FAA added to the list of actions in the Air Traffic appendix (Appendix 3) normally requiring preparation of an environmental assessment proposed air traffic changes over noise sensitive areas below 3,000 feet above ground level (AGL). Similarly, FAA added to the list of actions in the Flight Standards appendix (Appendix 4) proposed changes in instrument approach and departure procedures below 3,000 feet above noise sensitive areas. FAA also added to the Flight Standards appendix list of actions normally categorically excluded "Instrument Approach Procedures, Departure Procedures and En Route Procedures conducted at 3,000 feet or more above ground level which do not cause traffic to be routinely routed over noise sensitive areas; modifications to currently approved instrument procedures conducted below 3,000 feet AGL that do not significantly increase noise over noise sensitive areas, and increases minimum altitudes and landing minima…." The Council on Environmental Quality (CEQ) reviewed and commented on Order 1050.1D. FAA addressed CEQ comments, none of which related to this categorical exclusion (CATEX). The FAA published a Notice of Action for FAA Order 1050.1D in the Federal Register on July 12, 1984. FAA interpreted 1050.1D to include a categorical exclusion for Air Traffic actions comparable to the Flight Standards categorical exclusion. But see, Seattle Community Council v. FAA, 961 F.2d 829, (9th Cir. 1992) (FAA indicates "[c]hanges in flight patterns above 3,000 feet…are categorically excluded from environmental review, absent extraordinary circumstances." The court noted that "FAA Order 1050.1D requires that an EA and either a FONSI or an EIS be prepared for 'New or revised air traffic control procedures which routinely route air traffic over noise sensitive areas at less than 3000 feet above ground level.' FAA Order 1050.1D, App. 3 at 3(a).")

In 1999, the FAA proposed changes to Order 1050.1D, identified as draft Order 1050.1E. In its Federal Register Notice, the FAA solicited public review and comment concerning the proposal to codify its policy and practice of using the air traffic screening procedure to identify extraordinary circumstances warranting preparation of an environmental assessment for air traffic procedures above 3,000 feet AGL. However, FAA did not solicit comments concerning the addition of an explicit categorical exclusion for air traffic changes above 3,000 feet. FAA received 60 comments concerning this categorical exclusion, more on this categorical exclusion than on any other. While FAA does not consider 1050.1E as proposing a substantive change in FAA policy in this area, in view of the level of public concern and the lack of an opportunity for public review and comment concerning the categorical exclusion when first added in 1984, FAA decided to reevaluate the scientific basis for the categorical exclusion and its relationship to FAA's standard of significance for increases in aircraft noise in the vicinity of airports.

In general, commenters on the 3,000 ft. AGL CATEX stated that there is nothing in the common knowledge that would clearly explain the significance of the 3000 ft. AGL threshold invoked under this categorical exclusion. (proposed as FAA Order 1050.1E, Procedural Actions, No. 11, p. 55546 [note: adopted as paragraph 311i in the final Order 1050.1E])

A technical study was conducted based on the Integrated Noise Model (INM) Version 6.0a, to demonstrate the noise exposure effects of aircraft flights at or above 3,000 ft AGL, and specifically to demonstrate the degree to which these actions could *contribute to significant impact of DNL 65 dBA*.

The technical study focused on the same types of parameters that can be inputted into the Air Traffic Noise Screening Model (ATNS) Version 2.0 including 1) the number of annual operations, 2) the type of operations (arrival/departure), and 3) the percent daytime/nighttime operations.

2. 3,000 Foot AGL CATEX Evaluation Methodology

The technical study utilized INM 6.0a (the most current technology in noise modeling) to identify the number of aircraft operations required to produce DNL 65 dBA under various noise exposure conditions. To conduct the study the following steps were followed:

- Selection of four aircraft to represent different categories of commercial aircraft (i.e. composite fleet). The following aircraft were selected to provide conservative estimates (estimates that would tend to over-protect, rather than under-protect people from noise impacts):
  - Boeing B747-400 (747400) for wide-body aircraft,
  - Boeing B757-200 (757RR) for large aircraft,
  - Fokker F100 (F10065) for medium size jets, and
  - Embraer 145 (EMB145) for small jets, regional jets, and props.
- Selection of aircraft climb/power settings and speeds to reflect full power conditions (worst case); which is the same assumption used to build the tables of the ATNS.
- Conduct INM 6.0a runs for level fly-over, using the selected climb/power settings and speeds for each aircraft at the corresponding altitudes of 3,000, 3,500, 4,000, 4,500, and 5,000 feet.
- Development of an Excel spreadsheet (CATEX Tool) that predicts the number of flight operations necessary to increase to DNL 65 dBA (See Appendix 2 - Equations that Relate Sound Exposure Level (SEL) to the Day Night Average Sound Level (DNL)).
- Analysis of the year 2000 Official Airline Guide (OAG) data for twelve U.S. airports (representative of large, medium and small operational capacities) and develop representative aircraft fleet mix and percent nighttime operations.

3. Results

The study addressed the number of operations required to create a significant impact (i.e. creation or enlargement of a DNL 65 dBA noise contour or for areas already within the DNL 65 dBA noise contour, a 1.5 dBA increase in noise). Two worst case scenarios were analyzed for (1) areas currently exposed to aviation noise (Existing Noise) and (2) areas not currently exposed to aviation noise (No Preexisting Noise). The results are shown in Table 1 for the *composite fleet*.

Table 1. "*No Preexisting Noise*" versus "*Existing Noise*" for the Composite Fleet. *(The composite fleet is the average of twelve airport fleets and night/day operations. See Appendix 1.)*

Airport Noise Exposure Environment	% Night Operations	% Day Operations	Operations @ 3000 ft. *CATEX Tool*
No Preexisting Noise to DNL 65 dBA	16%	84%	*900*
Existing Noise (DNL 63.5) to DNL 65 dBA	16%	84%	*263*

The final column, "Operations @ 3,000 ft.CATEX Tool", represents the number of new operations, flying over the same point at 3,000 feet AGL during a single day which would produce a significant impact by either creating a DNL 65 dBA noise contour or, for areas already within the DNL 65 dBA noise contour, a 1.5 dBA increase in noise. In other words, modifications to air traffic procedures at or above 3,000 feet AGL would have to route 900 new operations over noise sensitive areas not currently exposed to aviation noise or 263 new operations over noise sensitive areas currently exposed to aviation noise in a single day.

In the FAA's experience, the likelihood that changes to air traffic procedure would direct numbers of operations exceeding this level over a single noise sensitive area around any airport is remote. Therefore, changes to air traffic procedures at or above 3,000 feet AGL in normal circumstances (i.e. absent extraordinary circumstances) qualifies for categorical exclusion in normal circumstances.

The Air Traffic Noise Screening Model (ATNS), a computerized version of the former FAA Notice 7210.360, *Noise Screening Procedure for Certain Air traffic Actions Above 3,000 Feet AGL*, should assist in addressing public concerns about potential misuse of the categorical exclusion. ATNS assists the FAA in making informed judgements about whether to apply the 3,000 foot categorical exclusion in modifying air traffic procedures. The ATNS is intended to assist decision-makers in judging the appropriateness of categorical exclusions, and in determining whether extraordinary circumstances exist for proposed actions normally excluded from an EA.

ATNS provides criteria and procedures to identify extraordinary circumstances that may warrant preparation of an environmental assessment considering potential noise increases over noise sensitive areas located outside the DNL 65 dBA contour. ATNS allows the user to evaluate potential noise impacts resulting from changes in airport arrivals and departures and determine whether a proposed air traffic action will result in a 5 dBA increase in the overall community noise exposure level in communities beneath the proposed aircraft route. The ATNS determines if the proposed air traffic change would result in a 5 dBA or more increase in overall Day Night Average Sound Level (DNL) over any residential or noise sensitive area. For the purposes of ATNS, the 5 dBA increase in the overall noise exposure serves as one indicator on whether a proposed action is likely to trigger an extraordinary circumstances analysis. The ATNS does not displace the use of a 1.5 dBA increase within the DNL 65 dBA noise contour as FAA's definition of threshold of significance for noise sensitive areas. These impacts are not considered significant and therefore do not automatically require an Environmental Assessment

(EA). But 5 dBA changes in areas of cumulative noise exposure between 60 DNL dBA and 45 DNL dBA are noticeable and are indicators of potential controversy on environmental grounds, which may warrant preparation of an EA.

The ATNS logic is derived from the same sources of scientific knowledge and information that comprise the algorithms and data in the FAA's Integrated Noise Model (INM). The INM is the well-established, standard computer tool for generating airport noise exposure maps and predicting noise impacts, as designated in FAA Order 1050.1 and FAR Part 150.

Appendix 1 provides a detailed summary of the intermediate results, both for this study and for the ATNS comparison. ATNS is described and its function discussed in the following supplement.

4. Supplement - ATNS Screening Procedure

The ATNS is a computerized version of the former FAA Notice 7210.360, *Noise Screening Procedure for Certain Air traffic Actions Above 3,000 Feet AGL*. The ATNS is intended to assist decision-makers in judging the appropriateness of categorical exclusions, and in determining whether extraordinary circumstances exist for proposed actions normally excluded from an EA. The ATNS logic is derived from the same sources of scientific knowledge and information that comprise the algorithms and data in the FAA's Integrated Noise Model (INM). The INM is the well-established, standard computer tool for generating airport noise exposure maps and predicting noise impacts, as designated in FAA Order 1050.1 and FAR Part 150.

ATNS allows the user to evaluate potential noise impacts resulting from changes in airport arrivals and departures and determine whether a proposed air traffic action will result in a 5 dBA increase in the overall community noise exposure level in communities beneath the proposed aircraft route.

The current language of proposed Order 1050.1E, Chapter 3, Figure 3.2 - Categorical Exclusion List, Procedural Actions No. 11, p. 55546 [note: adopted as paragraph 311i in final Order 1050.1E], calls for a noise screening analysis prior to establishing that an air traffic procedure modification be categorically excluded. This screening analysis would be based on the ATNS model. Both the ATNS and the CATEX Tool used in this study are based on the INM. The ATNS was last updated in January 1999, Version 2.0, and is based on INM 5.2.

In updating the categorical exclusion language, it is important to verify that the assumptions contained in the ATNS are applicable to current concept of categorical exclusions and screening analysis. It is also important that the current model continues to correlate with the INM and to ensure that the results of ATNS screening are consistent with independent use of the INM by another party. This will be achieved through the updates of the ATNS and clear understanding of the modeling assumptions. The model assumptions, although simplified compared to the INM, should continue to provide an indication of whether the proposed action should be categorically excluded or if further analysis is required.

At present, the ATNS is designed to screen for 5 dBA increases in overall DNL of a residential community, taking into account the variety of other noise sources present in the community. Typically, the existing noise levels are well below DNL 65 dBA. The 5 dBA increase in overall community noise exposure in a noise sensitive area serves as an indicator of whether a proposed action is likely to be considered highly controversial. Proposed actions are considered highly controversial when they are opposed on environmental grounds by a federal, state or local government agency, or by a substantial number of persons affected by such an action. A highly controversial action is one example of an extraordinary circumstance that precludes the use of categorical exclusions. An EA is required under these conditions, and ATNS can be used to characterize aircraft noise intrusion and evaluate possible opportunities of mitigation. The presence of a 5 dBA increase alone does not require that an EA be conducted under FAA Order 1050.1, but if such an increase is foreseen, consultation with the Regional Air Traffic Division Environmental Specialist (ATD ES) is essential to determine further action.

Appendix 1: Comprehensive Summary of Results

The table below shows the inputs used in this study, including representative fleets and their percent nighttime operations for several airports. The source of the data is year 2000 Official Airline Guide (OAG).

The table also shows the number of operations required at 3000 feet to trigger a DNL 1.5 dBA increase [see final Order 1050.1E, Appendix A, Section 14.3 "Significant Impact Thresholds"] from DNL 63.5 to 65.0 dBA, over a 24 hour period on the ground, for the (12) twelve representative airports and *composite* case. This represents the most sensitive case for a significant impact. *(The number of operations for the composite case is obtained by averaging the fleets and night/day operations for the twelve airports.)*

Airport	% Heavy (747400)	% Large (757RR)	% Medium (F10065)	% Small (EMB145)	% Nighttime Operations	Operations @ 3000 ft. ***CATEX Tool***	Operations @ 3000 ft. *ATNS*
ORD	9	61	9	22	14	313	262
PHX	9	75	0	16	14	306	262
BOS	15	41	2	42	15	303	252
CVG	10	28	2	60	17	379	234
EWR	20	55	1	23	18	217	226
IAD	10	31	0	59	11	478	297
MIA	30	48	0	21	16	192	242
LAS	22	74	0	4	27	143	172
DCA	5	60	4	31	12	415	284
PDX	10	44	7	39	20	283	211
HNL	25	59	0	16	23	161	193
TPA	23	45	1	31	17	220	234
Composite	**16**	**52**	**2**	**30**	**16**	263	242

The ATNS is a much simpler model, which screens for potential controversy at lower levels of noise by searching for 5 dBA increases under different situations. Simplifying assumptions in ATNS include modeling all stage 3 aircraft (including hushkits) with a Boeing B737-300 (737300) and a 10% day/night split in the absence of better data.

The last column demonstrates how results of INM (i.e. CATEX Tool) would compare with the ATNS assumptions. Given the dynamic nature of the aviation industry, models will need to be routinely updated and annual or biannual calibrations should be made using OAG or AirCraft Analytical System (ACAS) to determine which aircraft or simplified set of aircraft best correlate with the noise impact of the national fleet.

Appendix 2: Equations that Relate Sound Exposure Level (SEL) to the Day Night Average Sound Level (DNL)

Background on Single Event Metrics

The SEL is a single event metric that may be thought of as the accumulation of the sound energy over the duration of the aircraft event. All event durations are normalized to a one-second duration, which allows for comparisons among events that have different exposures. As the duration of the noise event increases, SEL increases. Also, the louder the aircraft, the higher the SEL. Because SEL is normalized to one-second, it will almost always be larger in magnitude than the maximum A-weighted level (L_{max}) for the event. In fact, for most aircraft overflights, the SEL is on the order of 7 dBA to 12 dBA higher than the L_{max}.

Noise Calculation Equations

The following equation may be used to obtain DNL from a single source:

(1) $DNL = SEL + 10*\log (D + 10*N) - 49.365$

Where,
SEL = SEL for a single event.
D = Number of daytime events.
N = Number of nighttime events.
49.365 = 10*log (# of seconds in a day) and is subtracted to compute a daily average.

If you are considering a single daytime event, this equation reduces to:

(2) $DNL = SEL - 49.365$

This means that if a location experienced a single event with an SEL of 114.4 dBA, that location would be in the 65 dBA contour. Single events of 114.4 dBA are very loud and typically are found only near the airport environment.

Another question asked is the effect of a single event on the DNL metric. To answer that question the following equation is used. It is constructed using Equation (1) for DNL of a single event.

(3) $DNL = 10*\log (10^{DNL1/10} + 10^{DNL2/10})$

Where,
DNL = New DNL after the addition of the single event.
DNL1 = Current DNL before the single event occurred.
DNL2 = DNL of the single event.

To relate this to an SEL we substitute Equation (2) into Equation (3) to obtain:

$$(4) \qquad DNL = 10*\log (10^{DNL1/10} + 10^{(SEL-49.365)/10})$$

The equation may then be solved for SEL. This provides an ability to investigate the sensitivity of DNL to single noise events.

$$DNL/10 = \log (10^{DNL1/10} + 10^{(SEL-49.365)/10})$$
$$10^{DNL1/10} = 10^{DNL1/10} + 10^{(SEL-49.365)/10}$$
$$10^{(SEL-49.365)/10} = 10^{DNL/10} - 10^{DNL1/10}$$
$$(SEL - 49.365)/10 = \log (10^{DNL/10} - 10^{DNL1/10})$$
$$SEL - 49.365 = 10* \log (10^{DNL/10} - 10^{DNL1/10})$$

$$(5) \qquad SEL = 10* \log (10^{DNL/10} - 10^{DNL1/10}) + 49.365$$

Equation (5) can then be used to answer the question, what sound level would be required by a single event to raise a location from DNL 60 dBA to DNL 63 dBA? A 3 dBA increase in DNL is used as an indicator of perceptible noise exposure in the Noise Impact Routing System. Using Equation (5) we obtain:

$$SEL = 10* \log (10^{6.3} - 10^{6.0}) + 49.365$$

Or

$$SEL = 109.34$$

Which is a relatively loud SEL that is usually experienced in only very close proximity to an airport.

The next question asked is how many single events does it take to raise a baseline DNL to a new DNL level. Begin with Equation (3):

$$DNL = 10*\log (10^{DNL1/10} + 10^{DNL2/10})$$

Where,
DNL = New DNL after the addition of the single event.
DNL1 = Current DNL before the single event occurred.
DNL2 = DNL of the single event.

$$DNL/10 = \log (10^{DNL1/10} + 10^{DNL2/10})$$
$$10^{DNL/10} = 10^{DNL1/10} + 10^{DNL2/10}$$
$$10^{DNL2/10} = 10^{DNL/10} - 10^{DNL1/10}$$
$$DNL2/10 = \log (10^{DNL/10} - 10^{DNL1/10})$$

Therefore to go from DNL 63.5 dBA to DNL 65.0 dBA requires

$$10* \log (10^{6.5} - 10^{6.35}) = 59.365463$$

We now need to know how many single events with a given SEL will make a DNL of 59.65463 dBA. For this we rearrange Equation (1):

$$DNL = SEL + 10*\log(D + 10*N) - 49.365$$

Where,
SEL = SEL for a single event.
D = Number of daytime events.
N = Number of nighttime events.
49.365 = 10*log (# of seconds in a day) and is subtracted to compute a daily average.

$$DNL + 49.365 - SEL = 10*\log(D + 10*N)$$
$$(DNL + 49.365 - SEL)/10 = \log(D + 10*N)$$
$$10^{(DNL + 49.365 - SEL)/10} = (D + 10*N)$$

Assuming all operations are daytime events:

$$D = 10^{(DNL + 49.365 - SEL)/10}$$

Assuming different daytime/nighttime splits use the relation:

$$(1-p)*X + 10*p*X = \text{Total Noise Events Weighted (TNEW) [weighted for nighttime penalty]}$$
$$(10p - p + 1)*X = TNEW$$
$$(9p + 1)*X = TNEW$$
$$X = TNEW / (9p + 1)$$
$$X*(9p + 1) = TNEW$$

Where,
X = # of events in a full day (24 hours)
p = % of nighttime events
TNEW = # of events plugged into the DNL equation (accounting for nighttime penalty)

How many TNEW's are equivalent to X events where a percentage p are nighttime events?

Need to convert nighttime events to daytime events:

$$N = 10*D$$

Where,
N = # of nighttime events.
D = # of daytime events.

Then,

$X = D + N$ $\qquad\qquad$ $TNEW = D + 10*N$

$X = (1 - p)*X + p*X$ $TNEW = (1 - p)*X + 10*p*X$

Where p = percentage of nighttime events.

For TNEW=100, If p = 1.0, X = 10
If p = 0.0, X = 100
If p = 0.5, X = 18.1818

Because noise uses a base 10 logarithmic scale, the user can freely interchange a 10 dBA penalty with a 10-times multiplier on the number of nighttime events. This in general is not the case with other weightings and the user needs to be more precise in ascertaining if weighting constitutes a multiplier on the number of events or dBA penalty to be applied to a non-weighted noise value.