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AEDT

JASA STUDY TOO NARROW TO DRAW BROAD CONCLUSIONS ON AEDT ACCURACY, FAA SAYS

ANR asked the FAA for comment on the findings of a major study reported March 11 in the *Journal of the Acoustical Society of America* (JASA) which concluded that FAA's Aviation Environmental Design Tool used in regulatory mode (AEDT-R) "is overly simplistic and gives far from accurate comparison with ground sound level monitor [SLM] measurements" (36 ANR 26).

Following are FAA's comments on the study, which was conducted by four researchers in Stanford University's Department of Aeronautics and Astronautics and one researcher at NASA's Jet Propulsion Laboratory in Pasadena, CA:

"The FAA sponsored this research under ASCENT Project 53, *Validation of Low-Exposure Noise Modeling by Open-Source Data Management and Visualization Systems Integrated with AEDT* (ASCENT - The Aviation Sustainability Center – https://ascent.aero/.

"We sponsor research such as this to help the global community further improve the noise modeling accuracy of our environmental modeling tools beyond what is the current recognized standard (ICAO Doc 9911). The results of this research will be studied further to evaluate current noise modeling capabilities.

"However, as the authors note, this study is a comparison of modeling and measurements "...focused on SFO arrivals..." only. The FAA is further funding Project 53 to examine noise from departure operations as well. In addition, we are funding other ASCENT analyses of operational noise at different airports to expand national coverage.

"While we view Project 53's initial results as useful, they are too narrowly focused to draw broad conclusions regarding the overall accuracy of AEDT's noise modeling capability and its ability to meet the requirements for which it was developed."

Better Thrust Data Needed

ANR asked Vince Mestre, who has over 50 years of experience in airport noise control and acoustical engineering nationally and internationally, to weigh in on the AEDT study reported in JASA.

Mr. Mestre is the former Chairman of the Society of Automotive Engineers A-21 Subcommittee that develops best practice guidance documents for the measurement and modeling of noise and aviation emissions modeling. He also is a member of the Institute of Noise Control Engineers, the Society of Automotive Engineers, and the Acoustical Society of America. He is a licensed Mechanical Engineer and has published peer reviewed journal articles, including 13 JASA articles.

He provided the following "Additional Thoughts On the Discrepancies Between Measured and Modeled Noise Levels":

The recently published JASA paper "A large-scale validation study of aircraft noise modeling for airport arrivals," by Thomas C. Rindfleisch, et al. draws some specific conclusions on how well the FAA's AEDT noise model predicts measured arrival noise levels in the vicinity of San Francisco International Airport. Specifically, the authors conclude that "on average, AEDT underestimated LAmax by 3.09 dB and SEL by 2.04 dB." The authors provide a list of potential reasons for these underestimates but miss at least one additional major modeling shortcoming and two measurement shortcomings.

In order to compare noise modeling results to noise measurement results, it is critical to recognize that there are two uncertainties that need to be understood: modeling uncertainty and measurement uncertainty. The authors treat the measurement results as a gold standard for describing the true noise level. While that is a common assumption, it neglects to recognize that the measurement uncertainty is real and has been defined and needs to be considered as an important part of comparing measurement results to modeling results. There are two types of measurement uncertainty that are important: the uncertainty of the instrument itself (including microphone) and the uncertainty due to contaminating non-aircraft noise sources. In terms of the former the International Standards Organization has published Document 20906 that includes Annex B. Here the uncertainty of measurement of SEL is stated as plus + 0.8 dB. The focus here will be on SEL as it is building block of Day-Night Average Noise Level, DNL.[1] Considering that the authors concluded that the AEDT underestimated SEL by an average of 2.0 dB, accounting for the 0.8 dB uncertainty of measurement provides a more precise conclusion, i.e., the AEDT underestimated the SEL by as much as 1.2 dB (note that I have rounded to a single decimal place as 2 decimal place precision is unwarranted). In the world of modeling aircraft noise getting the answer right to within nearly 1 dB is quite good, but it is worth examining why the data in the report show a consistent underestimation of arrival noise.

There is a second type of measurement uncertainty caused by contamination of the measurement data by background ambient noise such as cars, trucks, buses, motorcycles, wind noise, etc. If the aircraft noise is loud enough, the background noise sources have a much smaller, even potentially negligent effect, on the measured SEL. The JASA paper provides a good indication that aircraft noise event data were

[1] LAmax is a component of SEL and the two are related by the duration of the noise event. Because LA is accumulated over the duration of the event, its uncertainty will always be larger than the resulting SEL.

potentially contaminated for some of the noise events. For example, Figure 7 plots the modeled SEL value for the 747-400 between 87 and 88 dB SEL and the CL600 (a business jet and the quietest aircraft listed) between 68 and 70 SEL. Table II shows for the 747-400 the difference between measured and modeled was 0.2 dB (statistically insignificant) and for the CL600 a difference of -6.89 dB. Figure 6 generally seems to show the difference between measured and modeled noise level decreases for louder aircraft. This is not a definitive proof of contamination but gives reason to look more closely at background noise data for both measurement sites. Note that Society of Automotive Engineers Committee A-21 has published guidelines on aircraft noise measurement techniques and is currently revising that document (ARP 4721) to provide more robust guidance on recognizing and minimizing the effect of background noise on measured noise levels.

The authors went to significant effort to analyze the effect of using measured altitude and speed in the modeling effort versus the standard profiles that are in AEDT. This is an important adjustment because AEDT (and its predecessor INM) assume a continuous 3 degree descent profile (CDA). While that is a Nextgen goal, it is not what is happening with real world approaches today. There are some CDA approaches but most approaches include long level segments. It takes a lot more thrust to fly a level segment compared to flight idle thrust used to fly a CDA. The authors correctly say that thrust data is hard to get. True. What is needed is to calculate thrust from the trajectory data and use that thrust in the modeling. This would have greatly enhanced this report. Thrust assumptions included in the standard AEDT profiles have never been validated as representative of what the airlines actually use.

The authors are correct that AEDT would be improved with better airframe noise modeling. Better thrust data is more important.

Communities Respond to Study Findings

Following are comments on the AEDT study from community group leaders and members.

Darlene Yaplee, President and Co-founder Aviation-Impacted Communities Alliance

Both the FAA's AEDT software and Noise Policy fail to accurately reflect the lived experience of impacted communities in the 21st century. It is concerning that AEDT underestimated LAmax by -3.09 dB and SEL by -2.04 dB on average using two AEDT modeling approaches.

This latest study substantiates our position that AEDT does not accurately reflect the impacts experienced by communities, especially for NextGen arrivals: standard profiles are overly simplified, airframe noise at different flight stages is not captured, and noise is significantly underpredicted.

In the FAA's presentation "Updates on FAA and the Neighborhood Noise Survey" hosted by International Institute of Noise Control Engineering and the National Academy of Engineering, November 2022, the FAA's Figure 7.5- 3 is labeled "Which

additional factors could explain airport-to-airport DNL differences?" related to the dose-response curves from the Neighborhood Environmental Survey.

Factors the FAA is not considering are the accuracy of AEDT noise predictions and the sole reliance on AEDT predictions instead of actual noise measurements when determining community impacts even when measurements are readily available.

Cindy L. Christiansen, PhD, Co-founder Aviation-Impacted Communities Alliance

The research by Rindfleish, et.al., demonstrates how the FAA's current methods of assessing aviation noise is seriously flawed. Prior to this publication, a large gap in knowledge about modeled aviation noise caused by arrivals and approaches existed in the peer-reviewed scientific literature.

This current research helps to show how little of the true noise burden is captured by the FAA's current methods. The knowledge gap only widens for modeled noise burden from rotocraft, advanced air mobility, and other aircraft noise events.

What goes wrong with the FAA's noise modeling? It lacks common sense. Repetitive aviation noise events above ambient noise levels, especially for hours and days on end, burdens those on the ground – we don't need rocket science to know this. Counting noise events above LMax minus one or 2 standard deviations, as reported in this work, would go a long way to incorporate common sense into the FAA's noise modeling method.

Jennifer Landesmann, a member of the grass-roots community group
Sky Posse Palo Alto, CA

I see the MONA study as a big data story. The FAA's flight path data without ground noise validation and airport ground noise monitors narrowly focused on the vicinity of airports will never add up to produce reliable information for airspace design or environmental stewardship.

If the FAA Reauthorization is to focus on Improving Safety and Advancing Technology, it needs a big data initiative to repair AEDT; ensure that the public's regulatory tools are working and also used for the public good. I applaud the scientific work that took a hard look at AEDT.

David Goebel, President, Vashon Island Fair Skies, WA

Dr. Alonso and his colleagues in the MONA project have again provided an extremely valuable service to the many communities across the country suffering under newly concentrated NextGen arrival procedures. This meticulous research proves that noise modeling for such changes, assuming any was even done before implementation, is deeply flawed.

The bottom line, fundamental to the very concept of the scientific method, is that theories and models are subordinate to actual experiments and measurements. The current FAA regulatory structure which inverts this relationship is absurd.

Marie-Jo Fremont, Co-founder Concerned Residents of Palo Alto, CA

This large-scale study confirmed that AEDT underestimates the noise impacts of arrivals: on average, peak noise level Lmax was underestimated by 3 dB and sound exposure level SEL by 2 dB. The study also describes some serious AEDT shortcomings such as the use of NPD curves used for engine certification and inadequate accounting of airframe noise even though airframe noise, not engine noise, is the major source of noise on arrival.

Despite having been aware of these AEDT shortcomings for years, the FAA has used and continues to use AEDT flawed estimates to make decisions on arrival noise impacts. Communities have repeatedly asked the FAA to validate AEDT estimates against actual noise measurements, including after implementing a major change such as replacing a conventional procedure with an RNAV procedure.

As shown by this study, validating AEDT estimates against actual noise levels is feasible given that airports collect actual noise data through their permanent or portable noise monitors. Until it can demonstrate that AEDT is a reliable predictor of arrivals noise, the FAA should stop making decisions that are solely relying on AEDT numbers.