NASA Conference Publication 2241

Airport/Community Noise

Proceedings of a workshop held at
NASA Langley Research Center
Hampton, Virginia
February 25-26, 1982

NASA

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PREFACE

A workshop on airport/community noise was sponsored by the National Aeronautics and Space Administration and held at NASA Langley Research Center, Hampton, Virginia, February 25-26, 1982. The purpose of the workshop was to exchange information and ideas about airport noise and community planning for noise compatibility. The information and results of the workshop will be used by NASA to guide future planning and policy in the area of noise effects research, which includes the quantification and modeling of community noise impact for use in noise reduction programs.

The workshop consisted of roundtable discussions to define the magnitude and impact of current and projected noise problems, and work sessions to identify technology needed to improve airport/community noise compatibility.

The efforts of Linda Sutherland and Barbara Fryer in making arrangements for the workshop are gratefully acknowledged. Particular appreciation is extended to Barbara Fryer for her efforts in transcribing the tapes and preparing this document. The efforts of the participants in preparing position statements, editing transcripts, and particularly in sharing their ideas on noise compatibility were very helpful and are greatly appreciated.

David G. Stephens
Langley Research Center

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INTRODUCTION

Langley Research Center has been involved in aircraft noise reduction research since the early 1940's. Our research considers the total noise problem, starting with the source of the noise, includes the propagation of noise from source to receiver, and ends with the effects of noise on the receiver. Three of Langley's four noise research groups are engaged in reducing noise at its source, i.e., from jet exhausts, turbomachinery, rotors, or propellers. The jet and duct acoustics research for controlling turbomachinery noise is conducted in anechoic laboratory facilities. We use a quiet anechoic flow facility and wind tunnels for projects to quiet rotors and propellers. We also do analytical modeling and numerical analysis on computers, as well as some flight tests to augment laboratory research.

The remaining noise research group is concerned with understanding and controlling the effects of noise on people. This noise effects research is aimed at reducing the noise inside general aviation and rotor aircraft by developing structures that protect the passengers and developing criteria to characterize people's response to noise. This latter research is conducted both in laboratories and in homes, and is the focus of this workshop.

NASA is an aerospace agency that has traditionally worked with manufacturers and operators of aircraft. In our noise research we have established relationships with aircraft manufacturers and operators as well as with interested government agencies, such as the FAA and EPA. However, the noise problem really comes into focus in the airport community. We have communicated very little with representatives of noise-impacted airport communities, even though they are the ultimate users, or beneficiaries, of the technology we develop. Improved communications with airport operators, community organizations, local governments, city planners, and consultants is an informal objective of this workshop. However, the specific goals of the workshop are (1) to assess noise problems, current and future, in the airport community, and (2) to identify technology needs to resolve these problems. We must consider the total air transportation system, including general aviation aircraft, helicopters, and even military aircraft, and determine how the system is impacted by the airport/community noise problem. The identification of technology needs as perceived by the users will act as a guide for our research.

ROUNDTABLE I - AIRPORT NOISE

Chairman: Robert E. Pendley
Douglas Aircraft Company

David Heal, Airport Manager, Westchester County Airport: Westchester County Airport is primarily a general aviation, small-air-carrier facility located 40 miles north of New York City. We have three Air Florida 737 departures a day, as well as 25 departures per day by commuter-type aircraft. There are more than 400 aircraft based at Westchester, and over 100 of these are corporate jets. We have the largest concentration of corporate jets of any airport in the world. The area surrounding the airport is primarily a very high class, expensive residential area, and this is the area that our aircraft overfly.

We live, breathe, and may be destroyed by the issue of noise. Everything we do at the airport is controlled by noise. If we fill a pothole on an access road, someone in the neighborhood will complain that we're improving the character of the airport, making it more attractive to users. The problem at Westchester is not one of money; last year we generated $1 million in profit which was returned to the county. The problem is not one of technology; we believe that the technology is out in the field and is available. Our problem is the public's perception of the role of the airport and what might be considered to be reasonable noise exposure limits within the community. The problem is also an apparent lack of assistance, until recently, from the Federal government in terms of doing anything that is constructive or really helpful in assisting us.

The corporate jet users at our airports are gradually changing to the new generation of quieter aircraft engines. However, there are still a great many of the first-generation turbojet-type aircraft here (i.e., the early Lear jets, Jetstar 1, etc.). One of our biggest problems is with Grumman's and Gulfstream American's latest generation of aircraft, which is the G2 and G3 series. Powered by the Spey jet engine, these aircraft generate the largest percentage of our noise. We have 28 G2's and G3's based at our airport, and their comings and goings are creating a tremendous problem for us. We are fortunate to have had the assistance of the FAA, AOPA, NBAA, and other user groups to work with us in the community to try to develop a noise abatement program and alternative flight tracks. They have been very constructive and have done about as much as they can.

This is where we move into the question of public perceptions. We are optimistic that further steps can be taken. In dealing with local groups, we have found that because of the resultant political and community exposure, the individual corporations will not stand up alone and say "we support the airport." Instead they have gathered together in the form of a local airport support group, or have joined a national organization such as the AOPA or NBAA. These groups are the only effective means we have of dealing with the various users. Such groups, however, are usually divided by the business, airline, and private interests of the various members. As a result they are easily fractured and

defeated. If the aviation community is to move progressively into the future, the various aviation specialty groups must come together and resolve their basic differences.

E. H. Haupt, National Business Aircraft Association: The NBAA represents over 2600 corporate members of the general aviation community. In corporate aviation, we see more "noise restricted" airports emerging because nearby communities have become sensitive to aircraft sounds. It is a problem evident today at all classes of airports. At the large hub airports, the air carrier aircraft usually produce the greatest volume of sound. At general aviation fields, the business aircraft can be the noise maker, and if the surrounding community is noise sensitive around a small non-hub field, the Cessna 172 may be the problem. Some elements of the aviation industry do not consider noise to be a problem, and therefore aviation as an industry does not always approach aircraft sound levels as a problem.

NBAA looks at the airport as the proverbial three-legged stool. The airport sits on top of three legs: the users-pilots are one leg, airport management is another leg, and the surrounding community is the third leg. If any of these elements (legs) do not function or do not understand the nature of the noise problem, then the airport does not operate at maximum efficiency. The airport users need to understand the effect aircraft noise has on people in the community and to use noise abatement techniques at all times. Communities need to understand the value of the aircraft and the airport. This educational process does not produce immediate results but must be continued to insure airport survival.

We found that aircraft noise problems at airports follow a pattern. The scenario usually begins with a community group formed as an anti-airport noise force. Next the pro-airport group (friends of the airport, pilots, etc.) is either newly formed or an existing group activated for the noise issue. If both sides can sit and talk with each other in a rational manner, then solutions do occur. If both sides have become so polarized that negotiations are not possible, the issue then goes to court. When this happens, we in aviation have lost. The users, communities, and airport managers need to work together for a better understanding of the noise problem.

James E. Densmore, Federal Aviation Administration: A speech was made by the Administrator of the FAA (Helms) at the Universsity Air Law Symposium that contained significant policy related to the subject of this workshop. Mr. Helms spoke on the constraints that aircraft noise is imposing on our aircraft transportation system. If allowed to continue, the trend in airport use restrictions such as curfews could cripple our air transportation system and stifle this nation's continued economic development. Despite considerable technological progress in aircraft source noise reduction, the political ramifications of the noise problem have become more intense. Local airport authorities are under increasing pressure and the most expedient measures that keep surfacing are curfews and operational restrictions. It is a matter of considerable concern, because airports are a near-finite resource and it is

essential that we squeeze all the capacity out of the airport system that we can. The needed future capacity cannot be provided if we permit noise use restrictions to go unchallenged. Because of the ripple effect, use restrictions such as curfews are not a matter of purely local concern. They not only harm the local economy, but also have an adverse impact at the national level. This administration recognizes that airports are vital national assets and intends to protect them from unreasonable assault. Our first perimeter of protection will involve an attempt to intervene positively when such restrictions appear. This is exactly what we are doing at Westchester County Airport. The second mechanism is litigation; in the past, the United States Government usually waited until a private party initiated an action before even considering involvement. That will no longer be our posture. Our legal considerations include no undue burden on commerce, safe and efficient use of airports, no unreasonable discrimination, and recognition of the terms of federal airport grants. Third, the FAA is drafting legislation that would continue to allow local authorities to propose terms they deem acceptable for the operation of an airport. However, the legislation would require FAA review and approval prior to implementation. Under the bill being drafted, the FAA would consider national consequences and determine if the benefits to the national users would be greater than the costs to local residents. If so, a proposed restriction would not be approved. The FAA would propose the acceptance of the economic consequences of such a judgment, that is, become liable for the incremental difference between a reasonable local viewpoint and a truly national perspective. Thus, we regard airports to be a vital national asset, and we will take whatever steps are necessary to protect them, hopefully with positive interaction with local authorities. If necessary, we will use available legal mechanisms to protect these national assets and in the long term we intend to implement a system which places the initiative with the localities but which provides the FAA with the means to reflect national needs.

Considering these important policy statements and their implementation, we would put particular emphasis on research on time-of-day noise events and also on the effects of ambient noise level on the response to aircraft noise. We are working with the NASA Langley staff to further evolve such research.

Major Richard Woodworth, United States Air Force, Pentagon: I am from the Environmental Division in the Pentagon. Among other things, this Division is responsible for developing policy and guidelines for quantifying and analyzing the noise environment around our air bases and for establishing requirements for considering the noise environment in air base development planning.

To address the first question presented in the invitation to this workshop: Yes, there is an airport/community noise problem. From the Air Force perspective there is less of a problem now than there was 10 years ago. This is primarily because of extensive efforts to identify and mitigate noise impacts. Ten years ago we were very concerned with encroachment of private development on our airfields. We developed the Air Installation Compatible Use Zone (AICUZ) Program, which combined safety considerations and a quantification of noise

levels associated with our flying activities. The noise level values were produced using the NOISEMAP computer program, which considers aircraft operations (aircraft type, flight profile, power settings, time of day of the flight, etc.) and aircraft engine run-ups. These noise level values are used to help both Air Force and local community planners determine land uses that are compatible with the Air Force mission. Implementation of the AICUZ Program recommendations by local governments during the past 10 years has helped control air base encroachment by incompatible land uses.

However, in order to maintain the credibility of our AICUZ Program, it must be continually refined as the state of the art of noise analysis changes. Also, we have determined a need for continued research on the impact of noise on humans and on wild and domestic animals. A general consensus on the impact of noise and resulting land use guidelines were published in June 1980 as a result of a Federal Interagency Committee action. The document, entitled "Guidelines for Considering Noise in Land Use Planning and Control," summarizes various Federal agencies' policies and guidance on considering noise impact in land use planning. This is a good start, but much work remains. For example, whenever the Air Force proposes a change to its flying activities, an analysis of the noise impact associated with the change is made. Part of this analysis includes a determination of the impact of the noise generated by the proposed action on the affected area. We must be sure we consistently interpret the impact of the noise levels and that our analysis is supported by current research and development work.

In addition to the detailed analysis of noise impact resulting from activities at our air bases, we must also analyze the impact of aircraft noise in our military operating areas and along military training routes. At times supersonic speeds are reached in these activities, so we see a need for additional research into the effects of sonic booms.

In response to three other questions presented:

1. The aircraft noise problem does have community-wide impact. The impact could be in the form of land use limitations if zoning restrictions are in effect or if there are complaints and controversies over continued use of an airfield.

2. The noise problem does impede the air transportation system through limited routes, limits on flying hours, and limits on operational changes that could make the overall system more effective.

3. The information needed for better decision making is a better understanding of the impact, both psychological and medical, of noise.

The Air Force has identified several areas related to the aircraft noise problem that need detailed analysis. Some are:

1. Continue to update the acoustic data file of the NOISEMAP Program;

2. Update the NOISEMAP computer program which predicts noise levels of air operations;

3. Establish procedures to do a more effective job of dealing with noise compliance (i.e. recording, analyzing, responding);

4. Identify and accurately assess the impact of noise on humans and animals;

5. Determine the effectiveness of noise suppressors, hush houses, and barriers in limiting noise levels;

6. Develop a better definition of activities that are compatible with various noise levels.

I appreciate the opportunity to observe and discuss the activities of NASA Langley and look forward to the dialogue with the other workshop participants.

Captain James L. McLaughlin, Airline Pilots Association: ALPA represents pilots of most of the major airlines in the United States and is therefore pleased to be invited to this workshop by NASA. We are well aware of aircraft noise and its effects, not only on the communities around our nation's airports, but on the air carriers as well. We believe every airport has a noise problem; some just haven't been publicized as much as others. But what we are most concerned about is the tendency to try to reduce noise by operational methods that are questionable in their effects and potentially unsafe in their usage. We feel operational ways of reducing noise are essentially fully developed in today's fleet, with only "fine tuning" left as small noise adjustments are still available. We feel certain safety criteria should be applied and enforced nationally, both on runway usage for noise abatement and on noise abatement take-off procedures. Without these criteria, potentially unsafe operating procedures will be designed by local authorities unfamiliar with aircraft operations. Their only concern is noise. We are concerned about noise and also about safety. We are ultimately responsible for the safety not only of flight, but of all those involved with this noise issue, and we are generally the only ones who fly in the aircraft performing these noise abatement maneuvers. If we're expected to continually "do something" to abate noise, we will try. But let's flip the coin and see if the communities on the ground can't do something also, something like responsible land use planning, zoning, and buyer awareness programs for those areas impacted by noise. Thank you for inviting us to attend this forum and be heard.

J. Donald Collier, Director, Environmental Affairs, Air Transportation Association: I am the Director of Environmental Affairs of the Air Transport Association of America, which represents virtually all of the nation's scheduled airlines. My comments today will be brief, and I will attempt to respond directly to the queries posed in Mr. Morgan's letter of invitation.

First, is there a noise problem at airports? This may seem to be a trivial question, because if the answer is "No," my comments would be brief indeed! But the answer is obviously "Yes" if the quantity of ink and paper devoted to aviation noise over two decades is any indication. The more penetrating question might be "Is the noise problem of the 1980's (a) a public relations problem, (b) an economic

problem, (c) an aircraft problem, (d) an engine problem, (e) an airline problem, (f) an airport problem, (g) a federal transportation system problem, (h) a land use problem, or (i) none of the above?"

Second, how does noise affect the airport and the community? Well, the airport is, for one thing, a place of employment subject to workplace noise standards. Any noise "problems" are solved by proper use of ear plugs or muffs. The airport is also a transportation depot where passengers encounter brief exposures to aircraft noise that usually is well muffled by the terminal structure. There is no evidence of any significant problems in this respect. As to the community, airport noise is best characterized as an irritant. Researchers have repeatedly attempted to correlate airport noise with various medical or social maladies. They principally found that airport noise is not a primary causal factor. At worst, noise is an aggravation to causal factors over which nobody has effective control other than the exposed individuals. We sometimes feel that aviation is being made the scapegoat for the other causal factors.

Next item: "Does noise impede the air transportation system?" We think so. Since the enactment in 1970 of the Environmental Protection Act, the growth in airport capacity has been brought to a virtual standstill. Many airports are even reducing capacity today through curfews, runway use restrictions, aircraft type restrictions, and other locally imposed initiatives. The proper development of reliever airports is about the only hope we have today for capacity gains under current circumstances. If we are to have a national air transportation system, environmental planning must be developed by the national agency responsible for that system, and the erosive local initiatives must submit.

What abatement alternatives are available to us? The airlines have already accomplished or set in motion those alternatives available to them, principally the adoption of noise abatement operating procedure and the acquisition of new-technology engines and aircraft. Many people are of the opinion that there are gains yet to be made in locally tailored flight procedures, but this position fails to appreciate the commanding need for pilots to use standardized procedures for all airports. On the new-technology front, airlines are hungrily awaiting quiet new jets that also offer efficiency gains. We think these new aircraft, once their numbers dominate the fleet, will relieve noise such that other local use restrictions can be removed. Of course, the speed of fleet replacement is impacted by the economic climate in the industry.

A third alternative - not a noise reduction alternative, but a reduction of the nuisance effect of noise - lies in the public relations field. Psychologists remind us that "noise is in the ear of the beholder;" thus, people who like aviation for its aesthetic qualities or for the economic benefits it brings will be less irritated by aviation noise than those who do not appreciate those benefits. Airlines, therefore, are persevering in their efforts to turn back the hostile attitude fostered by overzealous environmentalists and keep community leaders and the public well informed of the benefits of aviation.

Next item: What information is needed for better decision making? Who would use it and how? For starters, airport planners need to know when aviation

noise is and is not a local issue. We have seen the ANCLUC process, for example, create noise problems where none existed. In such cases, the overzealous and sometimes incompetent investigator twists the public's psychological perception of the costs and benefits of aviation, a needless interference that benefits nobody, least of all the airport neighbor.

Another information need, one which NASA might assist in filling, is a method for measuring noise irritation to individuals. Current methods appear to be adequate to guide long-range airport planning efforts. Methods also exist for describing thresholds of physiological damage, but nothing satisfactorily guides the courts, the regulators, the planners, the airport managers, the airport users, the insurers, and the public on the matter of when and by how much an aviation party incurs a noise liability vis-a-vis the airport neighbor.

As I've said, these comments are brief. We look forward to expanding them as appropriate in the work sessions.

Richard J. Linn, American Airlines: I fully agree with what FAA is trying to do according to Mr. Helms' address at the University Air Law Symposium.

I don't think there is anyone in the airline business who would not agree that there is and has been a serious noise problem; however, the seeds for the majority of the cure for that problem have already been planted. In my travels and discussions with some of the community groups, there is no doubt that Stage III airplanes, such as the DC-10, DC-9-80 and A-300B, are coming on line and are bringing a noticeable, measurable improvement in the noise environment at the airports. Our problem is that we can't get these airplanes on line fast enough. We think that the retirement of airplanes such as the 707 (58 being grounded in the last year) represents actions that are bringing a noticeable reduction to the noise impact in the community. The technology is available to bring a solution satisfactory to most of the community. When we get to the point where there is a 100-percent Stage III operation, undoubtedly small portions of the community will still experience a small impact. I feel that somewhere along the line, someone is going to have to say, "Folks, this is it; this is the best we can do; there is no more; and you either live with it, or move."

The reaction of people who have been exposed to Stage III aircraft has been fantastic. I think the public's reaction in California to the DC-9-80 is well documented as being very favorable. The technology is there to bring about a tremendous reduction in the noise problem. I wish there were more money to increase the fleet of these airplanes. There is no doubt that part of the noise problem is in the reaction of the community leaders and their lack of effective land planning. We still see in parts of the country, in footprint areas that are deemed to be noisy, new private home construction; therefore, part of the problem lies with the city fathers. They are not doing their jobs. The only solution to the problem is that everyone has to do a fair share.

From an American Airlines point of view, and certainly from an A-21 Committee point of view, we would continue to support the efforts of NASA Langley to try and understand the dose/response relationships. Also, let's see if we can determine a better way of doing some of this footprinting so we can stop some of the arguments over the technical aspects of methodology and the research that should be done to perfect time-of-day weighting.

James P. Muldoon, The Port Authority of New York and New Jersey: One of my principal responsibilities is the management of the aircraft noise abatement programs conducted by the Port Authority. In its 1976 noise policy statement, the FAA estimated there were over 2 million people around our airports who were impacted by aircraft noise, that is, residing within the NEF contour equivalent to L_{dn} 65. Our current studies indicate that by the year 1990 the number will, perhaps, be reduced by one-half. These studies are based on a fleet forecast that calls for 100 percent FAR-36 aircraft, in accordance with the federal timetable. Our forecasts also assume a reasonable percentage of Stage III aircraft; however, certainly not the total Stage III environment that Dick Linn just mentioned. On that score, I do not believe that too many of us here will live to see 100 percent Stage III fleet at any major airport.

Large numbers of people are still going to be impacted by noise, and our point of view is that the only way to deliver any additional relief is through flight procedural means. The Port Authority is proposing a new noise monitoring system at the three metropolitan airports which will analyze flight tracks with the concomitant noise levels under and adjacent to the flight tracks. The system will permit analyses and value judgments to be made on the degree of conformance of abatement procedures. The system will permit existing procedures to be improved and new procedures to be evaluated. We do not see much more that can be done at major noise-impacted airports without adversely affecting the air transportation system, and to that extent we continue to support the research of NASA and others engaged in the field.

Thomas N. Duffy, Executive Director, National Organization to Insure a Sound-Controlled Environment (NOISE): The membership of the NOISE organization is composed of representatives from the local governments of smaller cities and counties whose residents are involuntary noise consumers. These localities include, for instance, Inglewood near Los Angeles International Airport, College Park and Forest Park in Atlanta, Schiller Park near O'Hare, and Nassau County near JFK International. NOISE and its members are bothered by aviation noise. We do not condemn aviation; we are only trying to soften the impact of aviation noise on people.

Most definitions of the noise problem can be characterized as secondary definitions. Noise is not an operator problem, either for the aircraft pilot or for the airport operator. It is not a legal or regulatory problem, nor is it a manufacturer problem. Noise is a people problem. If noise did not impact on people's ears and nervous systems, none of the other groups mentioned here would have to worry about it. As a mayor or city councilman in one of these affected localities, you're going to be upset when those people come to you and ask, "Why are they doing that to us, and what are you doing to stop it?" You're going to have to do something (1) to make sure that this problem is recognized, and (2) to reduce the problem.

As it turns out, the noise problem is being reduced, at least in part, by other considerations. Fuel-efficient engines also happen to be very quiet engines;

thus OPEC has become the biggest ally that noise organizations have. NOISE and the noise consumer are taking more and more steps to solve the aviation noise problem. The organization will approve of and support almost any effort toward this end. We would like to see operational and technology changes that cut down on noise, and in some cases our members have resorted to legal solutions to noise problems. Many localities are planning solutions that are effective and that can work. It is interesting to note, however, that the public relations aspect of the noise problem has been largely ignored. Simply going out into a community and saying, "We care, we're trying to do something about it, and we'll be talking to you about it," can have a significant impact on people. If you show people that you care, they don't feel as badly or as aggrieved about what is being done to them.

Leo F. Duggan, Airport Operators Council International: The membership of the Airport Operators Council International (AOCI) is made up of representatives from 190 public-owned airports. These airports are owned by a municipality, county, state, or port authority. Public-owned airports are not profit-oriented; rather, they have a mission to provide a service to the community. Recently the Administrator to the FAA, Mr. Helms, has given presentations that touch upon two of the most serious problems facing airport operations - capacity and delay, and environmental issues.

On January 22, 1982, Mr. Helms introduced to the aviation community the FAA's new National Airspace System Plan. In brief, he said that there is adequate airspace to accommodate forecasted traffic if this system plan is funded and implemented. He noted that the weak link in the air transportation system is the airport; more runways are needed to accommodate projected growth. Airport operators concur in this observation and regret that the system plan does not suggest evaluation or research and development steps, nor does it supply funding to correct the deficiencies.

Mr. Helms addressed the second critical problem facing airport authorities in a presentation given before the Aviation Attorneys Conference at Southern Methodist University. The subject of his presentation was aircraft noise and curfews because of their constraints on international commerce, and expressed his view that noise abatement procedures such as reducing power on take off are a trade-off between noise and safety. He called California's noise standards unrealistic, and stated that the FAA will take whatever steps are necessary to prevent such interference with the national transportation system.

AOCI, as an association of airports, strongly supports the position that the airport operator has the proprietary right to run his airport as he sees fit, but at the same time the organization recognizes that safety cannot be compromised. This makes our position somewhat ambiguous; on one hand, we are saying that the airport has the right to establish noise abatement procedures, including curfews, but on the other hand we do not favor curfews because of their effect on national and international commerce. The present situation at Westchester Airport illustrates this point.

Great strides have been made in the last decade in reducing noise at the source, but we in the industry realize that there is a limit to noise reduction in the aircraft. Some arrangement will have to be made to inform the community that a limit has been reached. Public relations can play a major role in this task.

In the late 1940's, Midway Airport was the busiest airport in the country. When the immediate community complained about the noise, it was decided to shift operations to O'Hare International Airport. O'Hare then became the busy airport that Midway had been, and the business community at Midway evaporated. It was an economic disaster for the area, and the communities then concluded that noise had not been as big a problem as they had thought.

O'Hare is a major employer in Cook County, Miami International is a major employer in Dade County, and Kennedy International is the largest employer on Long Island. These and most other airports which are responsible for noise problems pour millions of dollars into local economies. Airports are a source of noise, but they also lend tremendously to the vitality of the economy of the community. We must communicate that to the people who need to know.

Robert E. Pendley, Douglas Aircraft Company: I am with the Douglas Aircraft Company, where I direct the Acoustics Engineering Group. This group is responsible for developing the design of the noise control features in our airplanes. The group also provides data for operators of our equipment to assist them in determining how best to operate their airplanes at airports with noise exposure problems. We are concerned with several aspects of the airport noise problem. First, we would like to be confident that the design measures we apply in our airplanes and the airport noise data we furnish operators can lead to the least practicable disturbance of communities near airports. We are not confident that present aircraft noise and airport noise metrics guide us as well as they should toward that objective.

Second, we encounter several problems in our efforts to design efficient airplanes that can comply with growing airport noise restrictions. At some airports, existing and proposed noise limitations are expressed in terms of single-event noise level limits and/or cumulative noise exposure limitations. These limits are so stringent in some cases that we are unable, through the limitations of present and foreseen aircraft and acoustics technologies, to provide airplanes capable of complying with the noise limits while simultaneously satisfying economically the full spectrum of capacity, range, and flight frequencies needed to properly service the airports. That part of the passenger and freight traffic turned away from an otherwise satisfactory airport must be transported on the ground to more distant airports. This reduces the accessibility and overall economy of air transportation.

Third, curfews are applied at some airports irrespective of airplane noise level. Needed air transportation services are completely curtailed through the independent effects of curfews at specific airports and through mutually exclusive effects of curfews at city pairs in different time zones.

Finally, we are concerned with the severe resistance airport authorities experience in seeking approvals for the siting of new airports or for runway improvements needed to accommodate traffic demand. We suspect that much of the resistance is unreasonable, attributable perhaps to a lack of public confidence in the noise metrics being used in the definition of noise impact area.

ROUNDTABLE II - COMMUNITY NOISE

Chairman: Professor Clifford R. Bragdon, AICP
Georgia Institute of Technology

Charles C. Snyder, Jr., Assistant Manager of the Noise Abatement Office, Massachusetts Port Authority (Massport), Boston: Before I discuss briefly the nature of the noise problem in Boston and what Massport, as the airport proprietor, has done about it, I'd like to touch briefly on a point made earlier this morning by Lee Weinstein and Don Collier. The point deals with the definition of "public relations" as a tool to be used in dealing with an airport noise controversy. I would note, based on a few years of experience in the public relations field, that those two words take on a different connotation depending upon which side of an issue one is on. It is fair to say, based on my 2-year involvement with communities around Logan Airport, that residents have a negative view of the term "public relations," especially when it is used by airline officials. Justified or not, residents perceive anything short of face-to-face, give-and-take discussions across a table with airline representatives as a public relations approach to a noise problem. The same community perception, by the way, applies equally to the airport proprietor.

With this in mind, let me say a couple of things about Logan's noise problem and what Massport has done and is doing about it. As a major part of our overall effort (and this relates to my preceding remarks) we consider an effective community relations program to be nothing less than listening to what residents have to say. At Boston these residents live as close as 2,000 feet from a heavily used turbojet runway; they're the experts on the level of annoyance from noise. When requested, we'll provide technical assistance to communities in order that they may develop a proposal to minimize noise - a proposal, by the way, that if implemented might cause a negative noise impact on some other neighboring community. Conflicts between the interests of one community versus another are discussed before a Citizens Advisory Committee to Massport, which tries to hammer out a compromise. Sometimes this process works, sometimes it doesn't, but concerns are voiced and people listen to each other.

Unlike other U.S. airports, people living around Logan are in many cases second- and third-generation families who grew up in their homes and who aren't about to move. Massport simply doesn't have the luxury of planning any major land acquisition or relocation program; we must deal within certain constraints familiar to all airport proprietors, while at the same time operating a facility serving the commercial needs of New England.

Third, it's important for carriers to make their case directly to community people concerned about noise. Air carriers and other operators at Logan have been very cooperative in our noise abatement efforts. They have jumped into the fray, as Dick Linn and Frank Leyden can attest to from their participation in our Preferential Runway Study, one of those face-to-face forums I mentioned earlier.

I think it goes without saying that a noise problem exists at Logan. People's perceptions differ as to the level of annoyance, as to the time of year they get annoyed, and as to the time of the day. I think the noise metrics currently used at most airports - L_{eq} and L_{dn} - are satisfactory and we shouldn't spend

a lot of time arguing about a better mousetrap. At Logan, we've got better things to do.

James Miller, Office of Environment and Energy, HUD: As part of the responsibilities of our office we administer the HUD noise regulation, which has been in effect for over 10 years. By way of background, we in HUD have been concerned with noise around airports since 1952, when the Federal Housing Administration issued its first report on the effect of aircraft noise on housing located in the vicinity of airports. This early concern was primarily focused on the marketability of the housing, so that the resale value of the housing would be maintained; that is, if a house were to be resold, it would be marketable and there would be buyers for it. This approach continued through the 1960's concurrent with the development of the first joint military/civil airport noise descriptor, the CNR. In the late 1960's we were starting to assist people through subsidized housing programs concerned with the quality of the interior noise environment. Thus, we received some pressure in certain localities to provide noise attenuation in projects which we financially supported earlier. At that time, the Secretary of HUD decided that a better approach would be to keep these projects out of high noise areas. This led to issuance of the HUD noise policy which indicated where we would and would not provide assistance and under what conditions.

Along with the new policy, we also emphasized compatible land use planning by developing and providing guidance and financial assistance through the 701 planning assistance program to planning agencies. The 701 program is no longer being funded, but over a period of time a considerable amount of money has been spent for planning around airports. More recently, we entered into a project with four other Federal agencies to provide guidelines for planning around airports and other noise sources. A report was prepared, "Guidelines for Considering Noise in Land Use Planning and Control," which was signed by the heads of the Department of Transportation, the Environmental Protection Agency, the Veterans Administration, and the Department of Housing and Urban Development as well as by the Assistant Secretary of Defense. This guidance document has been distributed widely to planning agencies and officials. So you can see that we have taken steps to encourage compatible development around airports. In this process, we have had to deal with several noise descriptors - CNR, NEF, ASDS, and L_{dn} - as well as several versions of noise models. Each time we are faced with these changes in descriptors, while there may be some minor technical variations that are useful, we have a problem of explaining what we are trying to do. Explaining our actions to developers and local officials who question the areas designated as unsuitable for residential development is pretty difficult when it appears that we cannot agree among ourselves. Our major concern is that we have to use the best supported descriptor to support our determination on the suitability of sites for housing, and the numerous modifications are of little help.

The question was raised this morning about the new generation of aircraft; for planning purposes, we have to look to the near and long term and see what is in store for us. We know that technology has improved considerably and that we are going to have quieter aircraft. We would like to see these improvements included in all projected noise contours. We need to assure residents in the vicinity of airports that everything possible is being done to reduce noise at its source.

We need a body of knowledge which deals better with the effect of noise on people, something that we can articulate to the people we have to deal with, people who want to support us in implementing our policy. I think that this is an area in which NASA could provide more assistance by filling in the gaps, cataloging the state of the art, and evaluating past research. This would help us to support and refine our policy in areas where we know refinements are warranted. For example, lifestyles are different in different parts of the country, but our policy does not and cannot account for these variances. We would like to be able to reflect living patterns which are considerably different, for example, in the sun belt as opposed to northern climates. We need an improved body of knowledge on the effects of noise so that we are able to articulate and defend our decisions.

I think that the efforts we are making to reduce airport-community conflicts can be aided considerably by a consistent methodology for describing noise. Constant changes in the methodology, many of which are minor, keep us and the general public confused; thus, our policy is challenged and becomes less effective. I believe, therefore, that NASA research should provide the basis for a consistent Federal approach for describing noise and human response to noise.

Jesse O. Borthwick, Executive Director, National Association of Noise Control Officials: The National Association Noise Control Officials (NANCO) is a nonprofit environmental organization representing over 400 state and local noise control officials who are responsible for implementing and administering environmental noise laws. We have representatives throughout most of the United States, and we also have international members in Mexico, Canada, New Zealand, Australia, Egypt, France, and Israel. We're a fairly new organization, having been formed (incorporated) in 1978. We have been working very closely with the Environmental Protection Agency in developing national, technical, and financial assistance programs for state and local noise control programs.

With regard to the problem that we are discussing today, we appear to be entering a new era in the field of aircraft/airport noise control. During the 1970's, as was mentioned earlier, much was done to control aircraft noise at the source in terms of developing quieter aircraft. New technologies were developed, demonstrated, and utilized. Last October, John Wesler from the Federal Aviation Administration told NANCO members at our annual meeting that we have just about bottomed out in terms of quiet technology and that in the years ahead we must look elsewhere for relief. His statement was echoed last week by Administrator Helms in his speech to the Southern Methodist Symposium.

The question that now arises is, with all that has been accomplished in the area of source control, is airport noise still a problem? Will it be a problem in the future? I think that answer is undeniably yes. According to the EPA, close to 5 million Americans are currently exposed to noise levels in excess of L_{dn} 75. While these noise-impacted individuals can expect some relief in the future (as the fleet compliance with FAR 36 regulations increases), the problem is still going to be there. For any of us to think that it will go away is just wishful thinking. In the past the people around the airports have

been promised relief in the form of the new quieter aircraft. Now they must be told, "That is as quiet as you are going to get; that's just as quiet as we are going to be able to make them." What do you think their reaction is going to be? Some might say that the reaction is going to be "That's great, we're happy with it." I, for one, don't think they will be satisfied. I think they will demand that action be taken by the local authorities in terms of noise abatement procedures, curfews, and use restrictions at these airports.

We can also look forward to a phenomenal increase in general aviation operations in this country. The FAA forecast is just unbelievable in terms of the number of operations we are going to be experiencing in the next decade. Many aviation officials are concerned about this increase in general aviation operations in terms of the impact of the air traffic control system. What about the noise problems? I think that general aviation noise is something we really need to spend some time looking at, more so than we have done in the past. The citizens who live around today's general aviation airports are going to start complaining as operations increase, and they are going to demand that action be taken to control noise.

Another important issue I think we should consider is the phase-out of the Environmental Protection Agency noise control program. What impact is this going to have? For those of you who don't know, the Office of Noise Abatement and Control at EPA is scheduled to be phased out by this October. Will the states and cities move to fill the void? If so, will this lead to more state and local airport noise regulations? It's a question that remains to be answered.

State and local noise control officials are concerned about a number of airport noise issues, such as whether noise abatement procedures are safe. Mr. Helms has stated that noise abatement procedures are unsafe and fuel inefficient. We need to resolve this issue once and for all. How can we optimize flight operational procedures? We tend to go into the airports and say this can be done and that can be done without looking at the total system in terms of coming up with the most efficient means of controlling the noise. Why isn't more being done about preventing encroachment? We mentioned Dallas/Fort Worth this morning. That's a good example of a case where they thought they had the problem licked and all of a sudden houses are popping up. Dulles is a similar case.

In terms of what NASA can do, we feel that the metrics aren't totally adequate. More research is needed on the intrusiveness of the problem. We need to get away from using L_{dn} as the universal indicator of airport noise impact. We need to know at what levels you can expect the citizens to react to specific noise events.

One final comment is in order. It goes along with what's going to happen when the Federal EPA is phased out. State and local government officials are becoming more organized. Through the NOISE organization, elected officials are getting together and discussing what they can do to alleviate airport noise problems. We at NANCO have established a forum where noise control officials

can all get together and talk about each others' problems and what works and what doesn't work. The National League of Cities has become involved. Through its Airport ECHO Project, noise control professionals serve as volunteer advisors to communities interested in reducing airport noise. So it's not like you have a bunch of people out there working in isolation as they were perhaps 10 years ago. An awareness is also growing in communities around airports. Citizens are hearing about what is being done at other airports and they want to know "Why can't it be done at our airport?" So I think that the problem is going to get worse before it gets better, and one of the reasons is that people are becoming familiar with noise and learning that they don't have to accept it, that other communities are doing something about it. The problem is not going to go away.

Mayor Lee Weinstein, President, NOISE (Mayor of Inglewood, CA): I agree with Tom Duffy - ours is quite a mouthful as an organizational name. It is a contrived acronym, but it does get the message across.

I am also the Mayor of Inglewood, which lies near the approach pattern of all the runways of Los Angeles International. For that reason, we've been pioneers in trying to cope with this problem. To tell you a little more about NOISE, it is a national organization and is not, as some people believe, anti-aviation. All of our members recognize the importance of the aviation industry to the economy and the public convenience. NOISE was established 12 years ago, I believe. It was jointly sponsored by the City of Inglewood on the West Coast and the City of Hempstead on the East Coast. Its objective is simple - to bring people relief from aircraft noise, and as Tom (who is our Executive Director in Washington, D. C.) indicated, NOISE seeks reduction of aircraft noise through legislation, through regulation of operations, and through fostering replacement and retrofit of equipment for quieter efficiency. Our officers have testified before Congress on behalf of noise objectives and we help shape national policy on aircraft noise through the U.S. Conference of Mayors and the National League of Cities. The Board of Directors meets in conjunction with conferences of the National League of Cities. The NLC is holding its mid-winter session in Washington this week, and I will be going there and, incidentally, meeting with Mr. Helms.

The annual conference of NOISE brings together legislators, aircraft manufacturers, airport operators, and the FAA. Some of you have participated in that annual conference. Because this particular panel, as I understand it, is concerned with airport/community planning, I will tell you a little about what we are doing in Inglewood.

Reference has been made to Mr. Helms' speech. To a certain degree I give thanks to Mr. Helms, because I think his speech is going to increase our membership - I'm willing to bank on that.

I would like to respond to the gentleman from American Airlines on the subject of economics making it possible to solve some of the noise problems. That's true. However, I have to point out an error made by Mr. Helms in his speech, in which he states that noise abatement operations and technology are more costly and less efficient. Not true! The high-bypass engine does quite the contrary. It is more fuel efficient and therefore we are finally seeing airlines moving into the new technology because it is more economical. We are going to continue to try through various means to make the present manner of operation less economical. We introduced the Fly Quiet program. I think we will probably reactivate

that. If we can get people not to fly on the airlines that will not cooperate with the new technology, then I think these airlines will soon find out that it is more economical to bring in the new technology. There are ways of getting at this and we're not going to lie down and go away simply because some officials in Washington say it's not a probelm in Washington, therefore they shouldn't be involved in this.

You don't eliminate the problem by eliminating the program. The problem is still there and it's going to grow. Let me tell you a little bit about Inglewood's approach to some of the problems. The City of Inglewood, through the Inglewood Urban Noise and Community Revitalization Project, is the recipient of a $50,000 demonstration grant from the Noise Abatement Office of the EPA. That is in addition to some contributions from other agencies, including the operators of LAX. This project will develop a comprehensive program to recycle a major residential neighborhood which is heavily affected by jet noise into a noise-compatible sports, convention, and industrial park type complex. Because of the magnitude of the project, the cooperation of the Federal government, the State of California, Los Angeles City and County, Los Angeles International Airport, and the City of Inglewood will be required. We hope the completed project will demonstrate that the Federal Government in conjunction with state and local agencies can effectively eliminate critical urban airport noise problems and produce a more livable environment - but not by having the Federal government withdraw, or take over control and remove control from state and local government. The latter is contrary to the expressed philosophy of the President of the United States.

The Vice-President of American Airlines said he has been given numbers by Los Angeles Airport which indicate that its operational footprint is shrinking. Not true! My numbers are in the telephone book, and I know from the calls I get that the footprint is getting bigger, not smaller!

We're doing things in relation to LAX about the size of the airport's operational footprints. The City of Inglewood is engaged actively in the ANCLUC process around LAX. Just last Tuesday we approved a contract with a computer firm in Oakland (which is doing some work for the Air Force) to analyze various airport operational changes and the resultant impact on surrounding land uses. This work will be accomplished by using the FAA's integrated noise model, a computer model which calculates noise levels around an airport after analyzing various airports' specific variables, such as footprints and runway usage. Updated land use and population density for Inglewood will be compiled and put in the computer model, and the result will be a tabulation of the total population impacted by each of the operational strategies investigated. I have learned today from Mr. DeLoach that studies of this type are available to us from NASA as well.

This contract also envisions looking into the noise insulation problem. I am skeptical about the insulation approach to the problem. I'll be arguing this in City Council when I get back, because we have an item on our agenda regarding a study by Wyle Laboratories. They have done studies for cities

around the country and for the Air Force on insulation. One of these studies was done about 10 years ago, and Wyle is considering updating it with new technology. Regardless of the new technology, when a residence is closed off for sound insulation purposes, someone is going to pay for the resultant air conditioning that is necessary for our part of the country, an ongoing energy cost. That's a problem - you may shut out the sound, but you are creating economic problems for the people who are living in those homes. And it certainly doesn't take care of the use of their backyards, their streets, or their school yards.

This gives you an idea of what we are doing in the city of Inglewood. We are gathering our own statistics. We are engaged in our own programs, and I'll tell you, there is no satisfactory answer to the question. Why do people live there? We are doing a great deal in the city of Inglewood in the area of land use compatibility. We are obliged to move in this direction because we don't have room to build many more homes. The city of Inglewood was there when LAX was a bean field. We didn't have too much problem with it then or when it was a military field or before the jets came.

The advent of jet airlines created a problem. At that time we had the two south runways, and jets using these runways heavily impacted the southern part of our city, which used to be a very fine residential area. The area was so severely impacted that the people who could afford to have moved out of the area. Those who cannot afford to move are stuck, trapped in there especially under today's financial constraints. As a result, the southern part of our city has been taken over largely by criminal elements, and that area has now become the major problem in the city of Inglewood in terms of criminal activity, drug use, maintenance of buildings, and fires. About 25 percent of the service calls for our police department, our fire department, and our building maintenance enforcement come from a few blocks of that area. All this puts a drain on the services to the rest of our city. It used to be that when you had a call from that area, you sent out a police car. Well, we can't do that anymore. We send out a police car, and when the police are inside taking care of the problem somebody steals the police car! Now we send two police cars to assist the original one and another to protect the equipment. It's that serious a problem.

These are human problems, and I'm speaking of human problems because you have termed this workshop "human response." I'm pleased to see NASA doing this. (I did not know that NASA was interested in other than technical aspects.) I think it is time that all of you present become interested in the human aspects of noise. The problem is not going to go away through public relations. It is going to be cured by some trade-offs but only if we get together and recognize each other's problems and try to do something about them.

John Tyler, Environmental Protection Agency: Up to the first of this month, I was an employee of EPA and am now a consultant to EPA; I'm not speaking as an EPA employee. I would like to make a recommendation to NASA in connection with the human factors problem, a problem which has been perceived by EPA for the past few years and which has to do with the long-term effects of noise on people.

Several years ago, a study made of individuals living near the Los Angeles Airport indicated that these people had all kinds of critical problems, including miscarriages and birth defects, which were out of proportion to these effects in the general population. The general reaction to this study was to forget it because the researcher didn't provide the proper control group for his study. I think that NASA should consider doing a proper job now that this kind of information has surfaced. EPA attempted to do research in this area with a project in Florida in which a rhesus monkey was used. The rhesus monkey is physically similar to the human. The project indicated very severe heart problems as a result of noise equivalent to what an individual would experience in a work place and living conditions for up to a 24-hour period day after day. This project was for a single individual, and was to be followed by another project which involved a number of individuals. This project got started and then the administration decided to terminate the noise office of EPA because noise was not considered a health problem. I would like to strongly recommend that NASA look into this problem to see whether it could pick up where these other studies left off and determine in a professional manner what the long-term effects are.

I would also like to relate some personal experience along this line. During the 1960's, each of the aircraft manufacturing firms conducted studies to determine the relative annoyance of various aircraft noise spectra. This study was in connection with the development of the EPNdB scale in which tones were identified as a factor in the annoyance of a noise. Pratt and Whitney, General Electric, Boeing, Lockheed, and Douglas all conducted programs in which individuals were scheduled for tests in a laboratory anechoic chamber. At P&W a schedule was developed to use P&W employees for these tests. The tests involved exposing people to spectra at various levels and asking them to determine which of two noises was more annoying. After we had run this program for a few days and had scheduled the chamber for employees to participate on certain days in the future, we discovered that quite a few of these employees took sick leave on the days that they were scheduled to participate in tests in the chamber. This was particularly true of pregnant women and secretaries. Some pregnant women became ill or fainted in the chamber. The effects on pregnant women were well beyond the kinds of effects we could identify as being strictly annoyance or loudness.

Dr. Chung Tsiu, Co-Director, Noise Technology Assistance Center: In my contacts with government officials through our work at the Noise Technology Assistance Center, I find that there are increasing concerns on the encroachment of noise on the communities from smaller airports. The concerns invariably are put aside, since little action is ever generated to address them. Apparently, there are difficulties (technical incapability and/or unwillingness) which require in-depth study and assessment.

Another issue involves the development of machinery which uses less fuel while emitting less noise. In buildings, noise reduction benefits through energy conservation measures should be quantified and made available to builders, architects, and planners. Along these lines, work in the aircraft source reduction area should be continued.

Finally, optimization of aircraft operations on a national level should be pursued. Up to the present, limited success has been achieved by noise abatement measures for reducing the populace affected by airport/aircraft noise through administrative procedures such as runway switching and time restriction on takeoff and landing at individual airports. The success of the administrative maneuver can be quantitatively demonstrated by calculated results from established noise prediction models with known inputs such as number and time of operations and type of aircraft. Also, the number of passengers served by the airport is known to the airport administrator and the carriers. It would be interesting to use the same prediction model to perform calculations covering major airports in the nation with deliberately altered input while keeping constant the number of passengers served by them. The results of this exercise may reveal that certain combinations of flight operations would give a more superior overall reduction of noise impact on the populace of the nation and could serve as a basis for carriers to determine if such a change of their services is financially viable to them. The model can be expanded in the future, adding tangible and intangible parameters and weightings, such as availability of quieter and more fuel-efficient aircraft, change of operations to maximize earnings of individual carriers, community and passenger reactions and benefits to operational changes and fuel cost escalations. I visualize that the model could eventually serve as a guide not only to government officials in decisions (awarding of new routes, expansion of airport/aircraft noise reduction) for the well-being of the population and passengers of the nation as a whole, but to individual carriers in their continuous assessment of costs and future planning of new aircraft acquisition and operations.

Kenneth M. Eldred, President, Ken Eldred Engineering: I've been involved in airport noise since about 1954 when I put on my blue suit and went to the U.S. Aero Medical Laboratory at Wright Field. There, I became involved in the entire gamut of airport noise issues ranging from how jets make noise and how to quiet them to how people feel about noise and how to describe it. Some of this effort culminated in the first Air Force Planning Guide for Air Base Noise, TR 57-10.

Today, I think that we are at a very important cross-roads in the civil aviation airport-community noise situation. We now have a major opportunity to make real progress towards solutions of long-standing problems, because we are making, for the first time, really significant reductions in noise. We are retiring or reengining the early four-engine narrow-body jet aircraft, and we are bringing in and demonstrating Stage III airplanes. We therefore have a real opportunity to gain credibility with the public with respect to industry sincerity in solving existing noise problems.

For these efforts, I think we need to sharpen up our forecasts of airport noise impact potential for the years 1990 to 2000. We need to include airport-specific noise control actions in these forecasts to estimate their total potential effects on a national basis. We need to consider the economic consequences of reducing some existing airport use restrictions in trade for quieter future airplanes. We need to look at what the population growth realistically is going to be in neighborhoods affected by aircraft-airport noise. From those improved forecasts, we need to generate national noise goals for a possible Stage IV.

Then we need to see what the technology requirements are to meet the possible Stage IV goals. These goals may require aircraft to be quieter than Stage III by as much as 10 dB.

These goals need to be developed even if they are totally impracticable with current technology. Only then will we have the basis to formulate the research program required to eventually meet the goals. Or, if the assessment of potential future technology indicates the goals to be too ambitious, we will have the basis to develop alternative long-term plans. We have considerable lead time. We probably won't get a Stage IV fleet until at least 2010 or 2020. But research and planning must begin now if we are to accommodate growth of the fleet in the future.

With respect to the health aspects of airport noise which have been claimed by some researchers, I agree with John Tyler that data is sometimes needed to refute claims which are obviously wrong. I have no opinion on how much NASA should become involved. But I would caution against over-emphasizing the health aspects of noise with respect to annoyance. EPA tried to focus on health because the soft connotations of subjective annoyance had difficulty competing for resources with those who were attempting to solve problems involving carcinogens which could possibly kill someone, even if with infinitesimal probability. Although some research on health effects is clearly warranted, physiological health effects are not what led Congress to pass the Noise Control Act of 1972. The pressure on Congress came from the people who were disturbed by environmental noise and who complained about it to their representatives. It was not health concerns that led to these complaints - it was simply anger, engendered by the disturbance of the noise. As to other topics related to airport noise control that need research consideration, let me summarize a few very quickly.

As to noise descriptors we do need to improve our ability to measure intrusiveness. We do have to better understand what background noise means - why it is that people complain more in quiet communities than they do in noisy communities. We should certainly continue to examine time-of-day weighting. Nobody likes the 10 dB penalty which occurs when the time changes from 9:59 to 10:01 p.m., but there are no solid data on the subject from which a better rule could be formed and agreed to.

For obtaining airport noise control through the use of preferential runway systems there are several new issues. Two of these issues have to do with how long a given group of people is exposed to noise. "Dwell" is the duration of continuous exposure either within a day or over a period of several days because of higher than normal utilization of a specific runway combination. In both cases there are few, if any, data to determine the importance of these two factors and to develop strategies to give effective noise relief from them.

The third issue is that of seasonality. It only becomes a factor in assessing the annual average noise exposure when the seasonability of the winds causes different use of the airport by season. Because noise in the summer usually has more potential impact than does the same noise in the winter (open windows and

outdoor people activities) those subjected to increased differential usage in the summer might be anticipated to have more potential impact than would be expected based on their annual average noise exposure. Similarly, those who experience the noise from more differential usage in the winter might be anticipated to have less potential impact than otherwise expected. There are some suggested methods which could lead to developing a seasonally weighted annual average day-night sound level. However, the research data base is almost nonexistent.

Finally, we need improvement in our methods for arraying for decision makers the potential noise impacts of alternative actions. One current methodology was developed by the CHABA Working Group 69. It weights the population impacted by noise in proportion to the number of people expected to be "highly annoyed," based on a synthesis of several social surveys. There are almost no data that compare real decisions made among alternatives to the ranking of the alternatives by the CHABA method. However, at least some data indicate that for airports the CHABA method gives less weight to people with the highest noise exposures and more weight to people with the lower noise exposures than do lay decision makers. Effective research and improved methods in this area would help to facilitate minimizing potential noise impact at specific airports.

Jack Reynolds, Federal Aviation Administration: I would like to define a few points of interest as well as our concerns in the noise area. The Office of Airports not only prepares guidelines but must review and accomplish noise planning based on those guidelines. Our primary problem is that we are required to use imprecise and often inaccurate tools for purposes that require greater degrees of precision. I hope today we can identify some of these areas to study.

As an illustration, I would tell you that there is good news and bad news in the area of quantifying noise impact. The good news is that in the near future, noise contours for a given location will shrink as a result of your new computer analysis. The bad news is that the shrinkage will be due primarily to the change in computer calculation of noise.

In the past and I hope in the future, a primary purpose of our organization was and will be to develop airports to meet capacity demand. We normally do this based on planning and construction of the appropriate geometric airport layout for runway capacity. We have done a good job over the past 10 years of funding development but we find that capacity is still a problem - not a physical one based on runway pavement available, but a political one based on subjective decisions to limit operations in order to reduce noise. Hence, we have capacity reduction due to noise, or more simply put "noise capacity."

I think we would all agree this morning that noise reduction is a bona fide cost of doing business or getting the business, depending on your point of view. What we may not agree on is who should pay the cost.

As many of you know, our office issued a report to Congress giving program evaluation findings on the airport noise control and land use compatibility planning efforts of the FAA. A primary finding which I hope will be discussed here

today was the increasing incompatibility between an airport and its community because of a multijursidictional split of authority for land use control. Another interesting finding was that the success of the noise abatement planning efforts at specific locations was in proportion to the public involvement; that is, the more involvement, communication, and coordination, the more likely the report findings were to be accepted. As obvious as this relationship appears, it was one which was missed by many location sponsors.

I know many of you are interested in the status of FAR Part 150, Airport Noise Compatibility Planning. This regulation is being rewritten with substantial changes incorporated in the area of program administration and development. We hope to have a notice of proposed rulemaking out by late summer 1982.

Roy F. Madgwick, Howard, Needles, Tammen & Bergendoff: I am with the consulting firm of Howard, Needles, Tammen & Bergendoff and am today representing the American Planning Association. I have spent most of my last 4 or 5 years working on noise abatement programs at a series of large and small airports around the country and abroad.

I would like to think of the role of the consultant as not representing solely either the airport operators or the community groups. Developing a successful noise abatement program involves walking a very delicate tightrope - balancing consideration of the complaints and concerns of the residents of the neighborhood groups around the aiport and the very important interests of the operators and users of the airport. It has become almost a truism in our business that a measure of one's success in these studies is when neither side is satisfied with the recommended program; then you know you have come close to a program that has some chance of being negotiated successfully, politically and in terms of the agreements that have to come from the aviation community.

I would like to refer to the original brief that we were given in the materials that were passed out, and then look at the problem. One of the things that we have learned from some of the more controversial situations - Dallas' Love Field, Westchester County Airport, Minneapolis/St. Paul Noise Abatement Programs - is that when someone tells you they have a problem, do not tell them they do not have one merely because they do not lie within noise contours that we use to define noise problems today. A noise problem is a subjective thing; you only have to look at the difference between the way that the resident of Westchester County, New York, defines it vis-a-vis the way in which a retired Navy Captain in the approach path to the Naval Air Station, Norfolk, Virginia, would define it. It is a very personal and subjective thing and depends on the individual's background, perspective, and value system. Continuing with this thought, it may be that over the next 1 or 2 decades we are going to be achieving considerable reductions in noise but that the problem will not decline. Just looking at the kinds of improvements in noise that are going to happen as a result of industry commitments to introduce new quiet aircraft, you can show, using today's methods of noise analysis, that average and maximum noise is going to decline. That doesn't necessarily mean that the problem is going to decline. What is happening, and we see it around the country today, is that the community groups are getting better organized, better informed, more active, and more politically powerful. Westchester County is an example of an airport where the neighborhood is mobilized

and a number of incorporated opposition groups have their own legal arm. As around other East Coast airports, these activist groups are fully familiar with the California legislation that is of concern to Administrator Helms. The political pressures increase even while there is no increase in the problem as defined by the L_{dn} contours.

This increasing problem is transferable by law and through the political process to the airport operators; even though the noise levels may be declining, the legal/political effects on airport operators are not going away. I have discussed the idea of subjectivity in definition of noise problems, but ultimately the practitioner, the operators, and the analyses have to have some documentable, scientific definition that they can fall back on. Some of our discussion will hopefully be in this area of improved problem definition.

In our work for the Metropolitan Airports Commission on the development of a noise abatement operation plan for Minneapolis/St. Paul International Airport, one of the really important things that we learned is that composite annual average noise indices such as L_{dn} do not tell the whole story. Many incidences of moderate noise events can produce the same daily average as a lesser number of noise events, and the level of disturbance associated with the two may not be the same. For some types of activity the number of intensity of noise events will be the best index of change in the degree of disturbance that they create. It may be extremely difficult to accomplish, but development of a system that incorporates these other aspects of noise into a total description of noise would be a giant step forward.

Whether NASA is the correct agency to do it, I am not sure, but there is a clear need for development of an improved system of defining noise, a system that will probably be multidimensional in form. Continued refinement of the L_{dn}-type composite seems unlikely to provide a significantly improved tool for practitioners. What is needed is not only a multidimensional index that includes single-event and maximum noise levels as well as average noise levels, but one that can be used to address the special concerns and sensitivities of those living around different airports. No two airports in this country, or the people who live around them, are the same. If you, the research community, can put into our hands a composite index that is sensitive to those different kinds of local situations, we are off and running, with a much better chance of being able to pull people into the process and resolve the problems.

Robert J. Koenig, Environmental Protection Agency: I have been involved with aviation noise for over 30 years, first in the aerospace industry with Convair, Douglas Aircraft, North American Aviation, and Boeing, and then with the FAA for 7 years before moving to EPA about 3 years ago.

At EPA we have been doing some airport noise-exposure studies looking to the year 2000. Our main effort has been with air-carrier airports, but we have also looked at general aviation and joint-use civil/military airports. These studies have involved the FAA integrated noise model (INM) and a NASA Langley airport community noise impact assessment model. Now that the EPA Noise Office

is closing, I hope to see NASA continue working in this area. With the 1980 census information now available and the upgraded INM to be ready soon, we will have some powerful airport noise planning tools.

The work we have done gives us a good indication of where we are going over the next 20 years with air carrier airport noise. Our studies show 5 to 6 million people currently exposed to noise levels above L_{dn} 65 dB, depending on operational and flight procedures, on a national basis. By 1990, with FAR 36 Stage II compliance completed, these numbers will drop down very significantly to 3 or 4 million people. With continued introduction of FAR 36 Stage III aircraft in the years 1990 to 2000, we will see a further decline, but at a slower rate than that brought about by Stage II, and a leveling off by the year 2000 at about half the current exposure. We believe that some further population exposure reduction can be obtained from operational procedures based upon how and where the airplanes are flown. However, after all of these steps have been taken, there will remain a residual residential exposure problem. This is a land use compatibility problem. For L_{dn} levels of 65 to 75 dB, and perhaps as high as 80 dB for cases where people do not spend much time outside the house, soundproofing would provide a practical solution. At higher noise levels, there is no practical solution short of relocation. Steps need to be taken at the local level to stop residential encroachment on land expected to remain exposed to L_{dn} levels about 65 dB.

We see airport land use compatibility planning as essential for all airports, especially where there is undeveloped land nearby. If we define a current noise contour, this contour could shrink in future years because of changes in the aircraft fleet toward an all FAR 36 Stage III fleet, but there will always be some minimum L_{dn} 65 dB contour inside which is not considered suitable for residential development. This land must be controlled to prevent residential use in order to avoid future noise exposure problems.

With regard to general aviation (G/A) airport noise and land use planning, the FAA and EPA jointly sponsored a national conference in New Orleans recently. A national conference was also sponsored by EPA about 2 years ago in Atlanta. I was pleasantly surprised to see the difference between the two meetings. At the first meeting people were just getting acquainted with each other. At the second meeting we found people were rather well acquainted. We did not have representation from communities at the second conference, but the industry was well represented and was very vocal. These were people who recognized the problems and were working on them. We talked about the problems of education and communication which are certainly very important. Attendees generally agreed that the community should be included as part of the planning process. They should be involved early and continue to be involved, and they should be told the truth, not what they want to hear. The airport operator should learn from experience, be flexible, and expect to compromise. I think that both the FAA and the EPA considered the meeting to be very successful. The people in general aviation have recognized noise problems. We see only a few G/A airports where the noise problem is getting

fairly severe, such as the one at Westchester, New York, where some of the jet operations at night aggravate the situation considerably. At the present time, where we are concerned with noise levels above L_{dn} 65 dB, the general aviation problem is quite small. We did learn at the New Orleans conference of some G/A airports that are having noise problems where the exposure level is as low as L_{dn} 55 dB. These are suburban communities with relatively low background noise levels. The general aviation noise problem has to be worked out or it will only get worse, as we have seen at the air carrier airports.

We have also considered noise exposure at joint-use civil/military airports. When civil aircraft become quieter, meeting Stage II and Stage III requirements, the military aircraft can pose a problem if nothing is done to quiet them.

Tim Anderson, Manager, Noise Abatement, Metropolitan Airports Commission: I am Manager of Noise Abatement and Environmental Affairs for the Metropolitan Airports Commission (MAC), Minneapolis/St. Paul International Airport. I am also Technical Advisor to the Metropolitan Aircraft Sound Abatement Council, which is our MASAC joint user-citizen group.

With regard to the noise problem, my position is very simple: If there is one complaint, there is a noise problem, and we have and always will have at least one complaint in Minneapolis, no matter what we do.

There are, however, several pockets of chronic problems where I concentrate my noise-limiting efforts with MAC. We operate seven airports, but my main concern is the hub air-carrier airport. That is where my problems arise. Our procedures do place some restrictions and some requirements on air carriers: a curfew (nighttime agreement), maintenance run-up procedures, and a preferential runway system. There is ill will in the communities, but not as much as there used to be. There probably always will be some ill will, especially in the aforementioned chronic noise problem areas, and most especially with those who are uninformed.

That is where my noise complaint process comes into being. I do not accept noise complaints to solve the problems. I have two reasons for accepting noise complaints. First, it keeps me abreast of any changes in our current procedures; because when I receive complaints from areas which do not ordinarily complain, I know that something is postively wrong - perhaps a breakdown in communications. Second, noise complaints allow me to inform people. Ignorance is not bliss in the noise business. If one does not understand why noise exists where it does, the noise can be more aggravating.

It is my responsibility to continuously monitor the procedures, some of which I have already mentioned. I have to be able to relate to a great many people - the FAA, communities, our MASAC group, the staff I am a part of, and the Commission itself - to keep everybody informed and involved in the process.

Our noise program, I believe, does not impede the air transportation system. Restrictions placed on the air carriers are not inhibitive and none of them are dangerous. This is true for a couple of reasons. We have a good realationship

with the FAA; the FAA knows our system, they accept the extra responsibility of keeping the preferential runway system in operation, and they do it well. The other reason is that our preferential runway system, which is our main method for avoiding noise problems (although it presents some other problems), is not in effect during peak times of the day and during certain weather situations; so if safety is a consideration, the preferential runway system is not being used.

At Minneapolis/St. Paul, most of the efforts that we can make to reduce noise have been accomplished at the airport. Now we are fine-tuning what has already been done and hope that generation III airplanes will come into use. In the meantime we are staring insulation, acquisition, and litigation in the face - not necessarily in that order. With that in mind, I have to emphasize what Roy Madgwick said, "It is important that we correctly identify the extent of the problem by using the proper metric and including the consideration of human response to noise." When that is done, and only when that is done, will we be able to effectively attack the noise problems - at least those problems that we can attack.

Clifford R. Bragdon, Professor, Georgia Institute of Technology: I think the issue of noise as a problem has been identified. The question is, "To what extent does the issue exist?" "What will the future of the problem be?" "How will it exist in the future?"

I think there are some things that we need to address in terms of potential solutions. One is multiple effects in terms of human response. We have talked about noise as if it were an isolated factor in terms of human perception around an airport. Many of you have done major studies that suggested noise is integrated with other factors, including the issue of safety. I think the issues of safety and noise will have to be linked more closely together in the future, more strongly than they have been in the past. However, other factors will also have to be introduced, including the issue of territorial invasion, which is an issue communities are concerned about. Another issue to touch upon is the area of organizational behavior. All of us really are behaviorists, whether we like it or not. We interact with other institutional groups and other parties, and we are parts of organizations. The dynamics of that are not well understood. In terms of what I call applied or soft technology, we need to look at organizational behavior from the standpoint of role playing, group dynamics, and decision making. This is critical to us in terms of resolving conflicts. The theory here deals with consistency and abatement; we're moving away from federalism to some extent. That doesn't mean the problem is going to go away, it means that there are still three levels of government to interact in terms of decision making. If they are counterproductive to one another, that's not solving the problem. For example, in Virginia, the Governor is reconsidering some implementation plans, in terms of enabling legislation, which would allow local communities to have much greater control over such things as airports. That is an issue of policy, but it affects three levels of government, and therefore it affects people around airports. A fourth area of long-term evaluation is accountability. How can we be accountable for what

we are doing in terms of implementation? Politicians are known for being in office and then out of office. People living around airports find it's a long-term commitment, whether it is because of financing a home, or some institutional commitment.

The next area deals with the future dynamics of the population. I think we are underestimating what the future holds in terms of where we are going. These are some very subtle things - land conversion around airports, and land conversion in the cities. In talking with the fellow from Westchester, for example, I found that when those large mansions with three or four acres and 28 rooms get converted to townhouses with 15 to 20 units and densities of 5 to 8 families per acre, the potential problem of airport impact is going to be increased. The issue of land conversion is a critical factor and it is not factored into most of the estimates in terms of population impact of the future.

In the future, we are not going to be talking about a journey to work which is going to be done necessarily by transportation. The journey to work is going to become electronic to a greater and greater extent. Business machine people have introduced a new system whereby, using their word processors, you can hire people in their homes to do work. This means a very significant change of descriptor perceptions. Last is the issue of cohort survival. Where are we going in the year 2000? Forty percent of the population will be above 60 years of age by the year 2000. This means the dynamics around an airport may significantly shift because of what we call permanent necessitarians - people living in the city by virtue of services that are only available in the central city point. This also means the potential disturbance of this population may increase by virtue of their health characteristics and their inability to be mobile. This changes the whole impact procedure. Land planning and future perception (which I call soft technology) could be focus areas for NASA, in terms of some of their interests, and for everybody at the workshop today.

WORKSHOP I

SUMMARY OF AIRPORT TECHNOLOGY NEEDS

Homer G. Morgan, Chief, ANRD, Langley Research Center: The Airport Noise Group was made up of people who tended to have a long association with airport noise problems; thus the group had an extensive corporate memory. These people pointed out that politics and economics tend to outweigh psychoacoustics in the real world of airports and community noise. However, they supported a continuing need for improving our understanding of human response to noise, even though decisions are ultimately based on the realities of life in the community.

The group consensus was that noise assessment methodology is unreliable, primarily because of the inability to account for all of the variabilities of individuals and communities. Noise impact is not consistently quantified, even though the best information available is used. The unreliability in methodology leads to lack of confidence on the part of the public in decisions that must be made. Thus, both the public and the technical people are dissatisfied with the results. The impact quantification problem is very complex, but the public demands simple measures. Even though the tools for quantifying psychoacoustic impact are getting better and better, prediction of political consequences is still out of reach. Progress has been made and more is needed, but we must recognize that completely satisfactory answers are unlikely to be achievable.

Research by NASA to develop a better relationship between noise dose and individual and community response should be pursued with the assurance that a better understanding of this relationship would be applied by people working on real airport noise problems. Both laboratory research and field testing appear to be required for continued progress in understanding airport/community noise impact, and these should be used, as appropriate, to answer specific questions. Whenever community surveys are conducted, they should be accompanied by physical noise measurements in order to improve their accuracy and utility. It was also pointed out that health effects (if any) attributable to aircraft need to be quantified. It was also generally agreed that communication between community groups and active researchers as represented by this workshop was valuable, and that this effort should be continued.

Two general approaches to further research in the area were discussed. They may be roughly described as (1) a multidimensional, organization dynamics approach to studying community characteristics, and (2) the traditional psychoacoustics approach of laboratory and field testing. The majority of the participants believed that the latter approach had a better chance of contributing to the research effort. Within the traditional psychoacoustics approach, the group selected five factors as topics for further study. In descending order of importance, they are:

(1) Time-of-day effects

(2) Noise level versus number of operations

(3) Complaint insight

(4) Dwell

(5) Ambient noise level effects

WORKSHOP II

SUMMARY OF COMMUNITY TECHNOLOGY NEEDS

Clifford R. Bragdon, Professor, Georgia Institute of Technology: The Community Planning Roundtable, which had 22 participants, came up with an overall statement of the problem and then defined critical technology needs for identifying and implementing solutions. Although noise is a recognized problem in terms of airport planning, the magnitude and extent of this problem are somewhat unclear. Noise impacts the quality of life around the airport and the economic welfare of the community as a totality. The noise problem has had an adverse effect on the development and expansion of existing airports, and has frequently resulted in operational restrictions. There were some fairly strong opinions in the group that noise may be the single most significant factor in airport planning.

The noise problem is not unique to the large hub airports; even general aviation airports are feeling the effects of an increasing public awareness of noise. Land use conversion around airports may actually heighten this problem in the future, even though technology may be reducing the actual noise level. The recognition of noise as an environmental problem, along with the conversion of land around airports, which may increase the residential settings and certainly the potential population densities, may at least keep the problem constant and may even elevate it in terms of increased awareness.

Some important information and technology needs were identified which could contribute to the solution of the overall problem. Technology was defined here to include the application of the social sciences as well as engineering to the task of problem solving. These needs are discussed here in the order in which the group felt they should be addressed.

(1) There is a great concern that the impact model be a method of working and assisting with problem solving. The criteria for this impact model are essential in developing an accurate and effective tool.

(2) Determine the most optimized way of using a ground track relative to aircraft operations and land use management.

(3) Approach the parts of profile optimization (takeoff and landing) again in terms of optimizing land density operations or ground conditions relative to approaching the problem of increasing our traffic loads.

(4) Source noise reduction should be viewed in an aggregate sense. From a noise standpoint, the data should be integrated into an overall assessment of the aircraft as a source.

(5) Real-time simulation of noise impact is needed. In other words, the information that is aggregated from various techniques must actually be used in making decisions. We may have solutions or at least alternatives, but this information must be delivered to the decision makers in a community setting and they must be responsive to it.

(6) Economic incentives must be defined to enhance the adoption of noise abatement as a method of improving conditions in the airport situation.

(7) Future technology needs must be defined relative to the targets and goals of a plan of attack.

(8) Optimization studies are needed on a national level in the areas of airspace management and energy.

(9) Projections of community characteristics are needed to insure that factors that may be unknown now will be incorporated in future planning efforts. At present a lot of our projections are based on existing census information, but dynamic changes in our communities may change the impacts around airports.

Other technology needs were grouped into several broad areas:

(1) Group dynamics is an important tool and must be used effectively.

(2) An information clearinghouse could be developed for solution development and transfer of information.

(3) A cumulative noise descriptor is needed to supply a more accurate determination of the existing problem.

(4) The various airport communities and noise abatement commissions should be looked at with a view toward improving their effectiveness.

(5) Impact metrics deals with a variety of factors that we need to identify, including the extent to which we can measure the impact of a variety of inputs.

(6) Aircraft activity monitoring should be carried out so that the data that are essential can be developed further if necessary.

(7) Non-noise factors such as safety must be incorporated into any model of the program.

(8) Expansion of the operating envelope must consider both noise and safety to insure that noise abatement is not maximized at the expense of safety.

(9) Energy is a major issue in soundproofing, particularly since soundproofing of external surfaces is now becoming technologically feasible.

(10) Energy and acoustical trade-offs must be identified to determine where they can work to improve conditions in an airport setting.

(11) Microwave Landing System (MLS) deployment should be considered in terms of its potential contributions to noise abatement.

All of these technology needs and issues are critical, but if we can't transfer this information to user groups, then we haven't succeeded in using the information to solve the problem.

The group also expressed the concern that NASA and other organizations have limited resources to be applied to a given solution. Careful consideration must be given to pursuing a program that will yield the maximum desired effect relative to the problem that has been identified. Jet aircraft, as a category, should be the focus of research to develop solutions to the noise problems around airports. In conclusion, the group emphasized the need to continue this type of communication and discussion of this problem.

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16. Abstract

A workshop on airport/community noise was sponsored by the National Aeronautics and Space Administration and held at NASA Langley Research Center, Hampton, Virginia, February 25-26, 1982. The purpose of the workshop was to exchange information and ideas about airport noise and community planning for noise compatibility. The information and results of the workshop will be used by NASA to guide future planning and policy in the area of noise effects research, which includes the quantification and modeling of community noise impact for use in noise reduction programs.

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