



AVIATION NOISE: THE NEXT TWENTY YEARS

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EXECUTIVE SUMMARY

A great deal of progress has been made since 1973 to deal with the aviation noise problem posed by commercial carrier operations. The Federal Aviation Administration (FAA) has promulgated a number of important regulations which, when fully effective, will provide dramatic relief for a large number of people around our nation's airports who are now exposed to high levels of noise from commercial aircraft operations.

Progress has also been made on the control of noise at the local level. Both the Courts and the Federal Government have articulated more clearly the rights and responsibilities of the airport proprietor to reduce the noise from his specific facility, and a small start has been made at the Federal level to finance the development of plans which lay the groundwork for such actions.

It would be a very serious mistake, however, to become too complacent about this progress and to lose sight of the substantial portion of the aviation noise problem which remains. Accomplishments, though considerable, fall far short of what those who live around our nation's airports had expected at the time Congress enacted the Noise Control Act of 1972, directing the Executive Branch to deal aggressively with this problem. There is still widespread dissatisfaction on the part of those who live in the vicinity of airports with the current level of aircraft noise abatement progress. Community objection to aircraft noise has in some cases already resulted in airport restrictions involving night curfews, aircraft type restrictions, and limitations on expansion of existing airports. Construction of new airports is also being blocked. Legal action involving noise damage claims is continuing.

Aviation Noise Exposure Goals

Stated in general terms, the national goals of

aviation noise abatement are to confine severe outdoor aircraft noise exposure levels greater than $L_{dn} 75$ dB,* around U.S. airports to the areas included within the airport boundary, or to areas which are otherwise being used in a manner compatible with this level of noise, and to reduce substantially the number and extent of areas receiving noise-exposure levels that interfere with human activity. The EPA, the FAA, and the Department of Housing and Urban Development (HUD) all have essentially the same noise exposure goals for aviation.

Based on actions taken to date, in the year 2000 there would still be approximately 2.5-million people living in areas exposed to outdoor noise levels, from aviation operations, of $L_{dn} 65$ dB or above. Approximately 100 thousand of these will live in areas with extremely high levels of noise ($L_{dn} 75$ dB or greater). Many more millions of people will still be exposed to levels greater than $L_{dn} 55$ dB.

EPA's Proposed National Strategy

In this Report Plan, EPA proposes a national strategy for dealing with these remaining cases of high noise exposure from aviation (greater than $L_{dn} 65$ dB). To be fully successful this proposed strategy must receive the support and active involvement of the FAA, the aircraft manufacturers, the airlines, the pilots, the airports, elected officials, and airport neighbors. The strategy is divided into two parts: The first is focused on providing relief to airport neighborhoods as soon as possible but no later than the year 2000. Since the nature of the aircraft fleet is to a large extent already determined by actions previously taken, the strategy for this period is targeted on operational changes and compatible land-use actions. Changes in the noise characteristics of the aircraft fleet are more possible in the

*The generally accepted measure of community noise exposure is the outdoor annual average day/night level in decibels, denoted L_{dn} .

years beyond 2000 if steps are taken now to begin the process of facilitating those changes. These necessary changes are spelled out in the second half of the proposed national strategy.

The Next 20 Years

Relief for the approximately 2.5 million people expected to be still exposed to noise levels of L_{dn} 65 dB or greater by the year 2000 is possible but, of course, difficult. EPA proposes that a goal be set of relocating those families living in neighborhoods expected to remain exposed to noise levels of L_{dn} 75 dB or higher, and providing relief to families living within the L_{dn} 65 dB areas *at least inside* their homes. Such a strategy identifies soundproofing as the ultimate solution for these families if relief is not obtainable in other ways at less cost. We believe that there are a number of steps which should be taken which will have the effect of reducing the number of people who will need to be protected through soundproofing. These include the following:

- Optimization of aircraft flight procedures, including throttle and flap management, flight tracks, and preferential runway utilization.
- Airport noise abatement planning.
- Off-airport land-use management which prevents future encroachment of neighborhoods on airports.

Optimization of Aircraft Flight Procedures

The FAA has promulgated two regulations pertaining to noise-abatement flight procedures. One prohibits sonic booms from SSTs over land; the other requires pilots of subsonic aircraft to use less-than-maximum flap settings when *approaching* an airport. Lower flap settings require lower thrust thereby leading to less noise exposure.

The FAA has issued an advisory circular which recommends noise abatement *takeoff* procedures which can reduce noise exposure considerably. In addition, it is possible to optimize the selection of runways (use of "preferential runways") and the flight tracks to be followed for approach and departure so as to minimize population exposure to noise.

Pilots and airlines should be encouraged to adopt these noise abatement flight procedures. The FAA should take the initiative by convening one or more

conferences and a series of training seminars for affected individuals. The FAA should also explore the need for further regulation in this area. For its part, EPA proposes to initiate a program with several airport operators to monitor approach and departure flight procedures routinely employed by commercial air carriers to determine whether procedures recommended by the FAA are being employed and to determine the benefits resulting from them. Reports will be published quarterly to determine seasonal weather effects as well as effects of schedule and traffic pattern changes. These data will be provided to the FAA, air carriers, airport proprietors and pilots in support of FAA-sponsored conferences and seminars and will be available to support the development and promulgation of regulations, if they are found to be necessary.

Airport Noise Abatement Planning

As recognized by the Aviation Safety and Noise Abatement Act of 1979, airport noise-abatement planning must play a key role in future abatement efforts. Site-specific changes at individual airports can have a major influence on the impact of aircraft operations on surrounding neighborhoods. EPA promoted this idea in its 1973 Report to the Congress on Aviation Noise and its 1976 regulatory proposal to the FAA calling for mandatory planning at all commercial air carrier airports. This feature was also emphasized in the Department of Transportation's Aviation Noise Abatement Policy issued in 1976.

All airport proprietors should be encouraged to map noise-exposure areas around their airports and to work with representatives of surrounding communities to develop noise-abatement plans. This information will aid the proprietors in recommending site-specific flight procedures of the sort mentioned above. The proprietors may also use noise-exposure mapping as a basis for restricting numbers of aircraft operations or types of aircraft operating at their airports based on their noise levels and for taking other site-specific actions. There is still some confusion about the authorities and responsibilities of airport proprietors, particularly in light of airline deregulation. EPA will work with the FAA and the Civil Aeronautics Board (CAB) to develop a unified Federal policy regarding appropriate noise-abatement actions by airport proprietors. The Department of Housing and Urban Development and the

Council on Environmental Quality should participate in this policy as well.

The Quiet Communities Act of 1978 directs EPA to assist in the development of noise abatement plans in areas around major transportation facilities including airports. This authority builds on EPA's experience in working with airports in the development of airport noise abatement plans in the past. While the Quiet Communities Act of 1978 is very recent, EPA has received many requests for assistance from public officials and city governments which do not qualify for FAA planning grant funds, i.e., the FAA can make grants for planning only to airport proprietors. In many cases, the communities surrounding those airports do not feel that their concerns, particularly with regard to compatible land use can or will be adequately studied under an airport proprietor's planning process focused on abatement at the airport itself. In addition, land-use compatibility planning around airports can be very helpful even in the absence of on-site planning by the airport proprietor.

Airport plans developed without the active involvement of local officials and citizens in the surrounding communities affected by the airport cannot assure that all the resources of the larger community will be brought to bear on the task of making the airport compatible with the community and the community compatible with the airport. During the next several years EPA will work with local officials in communities surrounding the nation's largest airports to seek the active involvement of these officials in the airport planning process and the issue of compatible land-use development around the airport. In this task EPA will use the mechanisms and institutions developed in conjunction with other portions of EPA's noise control program — namely, Regional Technical Assistance Centers, the national Each Community Helps Others (ECHO) program, and State noise control programs.

Off-Airport Land-Use Management

New encroachment by neighborhoods on noisy airports must be restricted. Although all parties to the aviation noise problem, aircraft manufacturers and airline operators, airport proprietors and neighbors agree that future encroachment should be discouraged, they have not spoken with one voice on this subject. EPA will take the initial steps to form a "Compact" of these parties to work in a united

fashion along with the National League of Cities and the National Association of Counties to help persuade local officials and developers to find compatible uses for land near noisy airports.

The Airport Development Aid Program (ADAP) requires airport proprietors who receive funds for expansion of facilities to assure compatible land use. The mechanism of assurance is based upon Letters of Cooperation between the airport proprietor and the impacted communities. Letters of Cooperation cannot assure anything unless all parties agree on a compatible land-use plan. Thus, in those situations where no such plan exists or where disagreement develops, the Letters of Cooperation are totally ineffective. EPA will ask FAA to join in a thorough review of its policies regarding compatible land use with the expectation that these policies can be strengthened.

Soundproofing and Relocation

For those people who will continue living in areas where the outdoor noise exposure is between L_{dn} 65 and 75 dB after all the above actions are taken, EPA believes that a program of soundproofing of homes could provide adequate relief by the year 2000. While such a program might not be wholly satisfactory to these people because their enjoyment of the outdoors would still be limited, they could at least escape to the privacy of their homes and enjoy a good night's sleep, family conversation, and relaxation around the television or stereo without the nerve-racking disruption of over-flying aircraft. Where the outdoor exposure exceeds L_{dn} 75 dB, residents should be relocated to quieter neighborhoods.

There are a number of ways in which funds for soundproofing or relocation might be found. In fact, a variety of sources should probably be tapped. For instance, landing fees at airports and the targeting of existing grant programs should be examined. The application of such grants to the soundproofing needs of communities should be an interagency effort which is consistent with the President's August 1979 Environmental Message to Congress.

EPA will propose to the FAA to undertake the joint implementation of a soundproofing and relocation program. The program would investigate possible funding mechanisms and would also conduct an in-depth soundproofing study to establish as precisely as possible the number of residences affected,

together with cost and time estimates, and to resolve questions pertaining to the stewardship, use, and disposition of those properties which would be candidates for purchase. While we believe that the FAA's leadership, with full EPA participation, is desirable in developing this program, EPA is prepared to undertake the development of the program alone, if necessary.

Beyond the Year 2000

Looking beyond the year 2000, we realize that if we want quieter neighborhoods in the 21st century, or if we just want to maintain the gains we are making in this century, further actions must be taken now. Future expansion of the national air transportation system is likely and desirable, but not at the expense of airport neighborhoods. It is therefore essential that the following elements be added to the aviation noise-abatement program:

- Accelerate research and development to ensure the design and manufacture of quieter engines and airframes.
- Establish more forward-looking regulations for certification of new types of aircraft, derivative aircraft, and new-production aircraft. To achieve L_{dn} 65 dB for outdoor environments on a national basis would require that noise levels of future air carrier aircraft be reduced below present certification levels (Stage 3) by approximately 10 to 15 dB.

Accelerated Research and Development

Industry believes that up to a 10-dB reduction may be possible by the year 2000 with an aggressive Federal R & D Program. Continued expenditures in noise-abatement research will provide benefits in the post-2000 time period and may be necessary to maintain the level of environmental compatibility that will result from the national noise-control strategy proposed for relief in the next 20 years. Unfortunately, there has been a dramatic reduction in Federally sponsored programs in aviation noise research. From a high of \$47 million in FY 1973, Federal expenditures were down 60% to \$18 million by 1978 and this downward trend is continuing.

The Congressional Office of Technology Assessment (OTA) has a study underway on advanced air transport technology. EPA recommends that OTA

supplement that study with an evaluation of the existing NASA noise research program to identify the additional program effort required to develop and demonstrate the necessary technology to realize the long-range noise goals. Active participation of FAA and EPA would probably be necessary. In addition, EPA plans to undertake several joint projects with NASA to demonstrate the effectiveness of available emerging technology and to publish reports on results.

More Forward-Looking Regulations

The Federal Government needs to establish aircraft noise limits based upon future requirements to achieve realistic goals. It is not adequate in EPA's view to establish limits which are based on "common practice" technology as is now the case. The 10-15 dB goal should be incorporated in Federal noise regulations so that engine and airframe designers can identify and develop the technology necessary for its attainment and the necessary R & D programs can be undertaken and supported. The longer-range goal levels would apply to new aircraft designs which may become operational after the turn of the century, thereby providing adequate lead time to identify, develop, and demonstrate the requisite technology.

EPA will continue to press the FAA to act favorably upon its proposed "Stage 4" regulations, which would essentially meet an interim goal level of 3-5 dB noise reduction below current certification levels and would be effective in 1980. EPA may consider holding a series of formal hearings with the aircraft manufacturers to determine why some aircraft designs are now producing noise levels within EPA's proposed Stage 4 limits although some manufacturers claim that these limits are neither technologically feasible nor economically reasonable.

Further noise reduction should be required in the Stage 2 aircraft now in the fleet and those being manufactured. These aircraft will dominate the noise situation for many years in communities adjacent to many of the nation's air carrier airports. One approach would be to prohibit, after some future date, any change in air carrier fleet makeup that would of itself result in an increase in fleet noise level, unless operations are reduced so that fleet noise level remains the same or decreases. The EPA is re-investigating the potential benefits of a Fleet

Noise Rule that would incorporate these considerations and will provide appropriate recommendations to the FAA.

Another approach that has merit, and is being investigated by the FAA, is to issue a rule that after some date certain, e.g., 1982 or 1983, newly produced State 2 aircraft would have to meet Stage 3 noise limits. This approach is called "State 2 Production Cut-Off". It could hasten the purchase of available quieter and more fuel-efficient engines for use in the newly produced aircraft of older design.

General Aviation and Military Aviation

While the primary emphasis of this report is on air carrier noise, EPA recognizes that both general aviation and military aviation may also become significant contributors to the national aviation noise

problem. Studies, now under way, to evaluate the noise implications of these activities, will form the basis for additional national strategy recommendations.

Summary

Since the success of our proposed national strategy for actions during the next twenty years depends heavily on its acceptance by the FAA and other parties to the aviation noise problem, EPA will devote its resources during the next few months to discussing this strategy with these parties and taking the initial steps to clarify the strategy in such areas as soundproofing and relocation as mentioned above. EPA's plans for the next five years depend to a large extent on the degree of acceptance which this proposed strategy receives.

INTRODUCTION

This Report has been prepared by the EPA in accordance with its broad mandate to implement and coordinate the Federal Government's overall efforts to control noise. Many significant actions have been taken to alleviate the aircraft/airport noise problem since the 1973 Report to Congress on Aircraft-Airport Noise.¹ This Report assesses the adequacy of these actions and proposes a strategy for further reduction in aviation-related noise during the next 20 years and beyond.

DEVELOPMENT OF THIS REPORT

This Report was prepared after consultation with several groups outside of EPA. Results of a recent EPA forecast and assessment of the national noise exposure due to air carrier aircraft through the year 2000, together with related questions, were sent in a letter to the industry and the concerned public with requests for their views. Replies to the letter have offered a wide range of views² and have been very helpful in the preparation of this Report. In addition, meetings were conducted with representatives of aircraft and aircraft-engine manufacturers to give EPA the benefit of the industry's detailed views on the issues raised by the EPA forecast and assessment. The views of the industry representatives regarding aircraft noise and their outlook for the pace of future improvements in aviation noise were considered carefully in the development of the strategy for future aviation noise abatement proposed in this Report.

In the area of general aviation, the EPA sponsored a three-day conference in October 1979,

focusing on General Aviation Airport Noise and Land Use Planning. Participants represented the full spectrum of interests affected by the planning process.

The EPA also sponsored a Noise Technology Research Symposium in January 1979. The Symposium was motivated by the Congressional mandate expressed in the Quiet Communities Act of 1978 relating to aviation noise research.

CONTENT OF THIS REPORT

The adequacy of aviation noise abatement actions taken to date is measured in this Report against the common FAA and EPA goals for aviation noise exposure reduction. While considerable progress has been made, EPA studies show that the noise exposure goals will not be reached unless further action is taken. Therefore, a national strategy for reducing the number of people exposed to excessive aircraft noise in the vicinity of airports is proposed. The national strategy has two major parts: (a) actions to provide further relief to airport neighbors (within the next 20 years) and (b) actions to maintain this degree of relief and provide for further control of aviation noise beyond the year 2000. The need for support of all parties — aircraft and engine manufacturers, airlines, pilots, airport operators, Federal, State and local governments, and the public — is outlined in the Report, and EPA's plans to initiate its portion of this national strategy are detailed.

AVIATION NOISE EXPOSURE GOALS

Three Federal agencies have responsibilities for establishing Federal policy for civil aviation noise. The Federal Aviation Administration (FAA) has the primary responsibility through its authority to regulate aircraft noise emissions and flight procedures. The Environmental Protection Agency (EPA) and the Department of Housing and Urban Development (HUD) exercise mandates which cut across many sources of noise, specifically including aviation noise.

EPA has the responsibility to coordinate all Federal noise activities and policies. In addition, in the aviation noise area, EPA is required to make specific recommendations to the FAA regarding aviation noise regulations which are necessary to protect the public health and welfare.

HUD establishes guidelines for the use of Federal housing and redevelopment assistance in areas impacted by noise, including aviation noise. These HUD guidelines presently represent the Federal policy on identification of land uses that are compatible with high noise exposures.

In keeping with its mandate to coordinate Federal efforts to control noise, EPA in 1977 established some tentative goals for noise from all sources in its publication, "Toward a National Strategy for Noise Control"³. Three of these noise exposure goals for the nation are given in terms of annual average outdoor day-night levels of community exposure, L_{dn} , expressed in decibels, as follows:

- "Reduce environmental noise exposure of the population to an L_{dn} value of no more than

75 dB immediately, utilizing all available tools, except in those isolated cases where this would impose severe hardship."

- "Through vigorous regulatory and planning actions, reduce environmental noise exposure levels to L_{dn} 65 dB or lower, and concurrently reduce noise annoyance and related activity interference caused by intrusive noises."
- "In planning future programs concerned with or affecting environmental noise exposure, to the extent possible, aim for environmental noise levels that do not exceed an L_{dn} 55 dB. This will ensure protection of the public health and welfare from the adverse effects of noise based upon present knowledge." (emphasis added)

As applied to aviation noise the national goal is to confine noise exposure at and above L_{dn} 65 dB to the airport boundaries or to those land areas which are used for purposes that are compatible with their exposure to noise (generally not residential). Further degradation of the environment due to aviation noise should not be permitted.

The FAA has set aviation noise goals for L_{dn} 65 dB and greater essentially similar to those set by EPA⁴, and these goals are also compatible with the HUD land-use guidelines⁵ as well as State aviation noise regulations in California and Maryland. Consequently, these goals form the basis for evaluation of progress to date and for the formulation of future aviation noise strategies discussed in this Report.

ACTIONS TO DATE

Considerable progress has been made in the control of aviation noise since EPA last reported to the Congress on this subject in 1973. While more needs to be done to bring relief to airport neighbors, future actions need to be based on the progress made to date. Actions taken since 1973 are described in this chapter in three sections dealing with Federal, State, and local efforts. As will be seen, the roles of each of these levels of government have been significantly clarified during the last six years, although the boundaries between the authorities of the three levels are still not entirely clear.

The FAA regulates the manufacturers of aircraft and, to a lesser extent, the air carriers regarding the design, production, and use of quieter aircraft, in the U.S. fleet. NASA carries out research on the design of quieter aircraft and both the FAA and NASA study and demonstrate noise abatement flight procedures in order to promote the development and incorporation of new techniques by aircraft manufacturers and operators. The FAA also controls airspace use and management, air traffic control, and safety, all of which can affect noise around an airport.

State and local governments, acting as proprietors of air carrier airports, control the selection of airport sites, the acquisition of buffer zones around the airports, and also control airport design, scheduling, and operations — subject to the Constitutional prohibitions against creation of an undue burden on interstate and foreign commerce, unjust discrimination, and interference with exclusive Federal regulatory responsibilities over safety and airspace management.

All States and local communities, whether airport proprietors or not, may protect their citizens through land-use controls and other police powers, provided they do not transgress areas of Federal regulation or the airport proprietor's rights.

FEDERAL ACTIONS

The Federal Government has been very active during the past six years in controlling aviation noise. Activities fall into four basic categories which ensure:

- that through regulations and research, quieter aircraft are designed, produced, and operated in the U.S. fleet;
- that aircraft are flown in a quieter manner (flight procedures);
- that aircraft are flown into and out of airports along the most appropriate flight tracks (airport operations); and
- that airport proprietors and local officials are assisted in carrying out noise abatement actions.

1. Source Regulation and Research

The EPA 1973 Report to the Congress highlighted the essential need to control the amount of noise generated by aircraft if the overall noise from the U.S. fleet of commercial aircraft were to be significantly reduced. As a general rule, control of noise at the source (the aircraft) is more cost effective than trying to protect people from an excessively noisy source at each location where it operates.

In 1969 the FAA took one major step in this direction by issuing a new Federal Aviation Regulation Part 36 (FAR 36)⁶ requiring that new design aircraft be certificated to meet specified noise levels. These 1969 noise standards came to be known as Stage 2 levels. The unregulated aircraft in operation prior to 1969 were designated Stage 1.

Although FAR 36 was an excellent first step in aircraft noise regulation, it was understood by both the FAA and the industry that there remained many other problems to be resolved. The 1969 rule applied only to *new design* aircraft, that is, those whose application for initial certification was

submitted after the 1969 effective date of the rule. This left the *manufacture* of older design aircraft unregulated, as well as the *operation* of the older design aircraft. Thus, it was not surprising that, in 1973, the U.S. jet-powered carrier fleet of approximately 2000 aircraft consisted of more than 90% older design aircraft which did not meet, nor were they required to meet, the Stage 2 noise levels. Furthermore, due to the long structural and economic life of these aircraft, they would probably remain in the fleet for 10 to 20 years or more as a significant factor in the airport noise problem.

Since 1973 the FAA has taken steps to fill these gaps. The FAA has issued a rule which requires that new production of older design aircraft comply with the Stage 2 noise levels. In addition, in December 1976 the FAA set a phased compliance schedule by which all aircraft in the U.S. fleet, not engaged in foreign commerce are to be brought into compliance with Stage 2 noise levels no matter when they were designed or manufactured. Finally, because the Stage 2 noise levels were no longer sufficiently stringent for new-design aircraft, the FAA has further reduced the permissible noise levels for them (Stage 3).

The FAA rule for new production of older design aircraft⁷ was made effective on December 31, 1974. It brought under the Stage 2 limits the manufacturing of all turbojet subsonic aircraft which were of designs certificated before 1969. This represented the bulk of the aircraft being manufactured at that time, and therefore significantly increased the number of aircraft subject to the FAR 36 noise requirements.

Compliance with the December 1976 rule⁸ can be achieved by the acoustic modification (retrofit) of noncomplying airplanes or by their replacement with complying airplanes. This "retrofit/replace-ment" rule was intended to encourage the introduction of new-generation aircraft rather than retrofit of older aircraft. FAA plans call for expanding this regulatory requirement and effective date to include all international carriers operating in the United States.

Having established requirements for compliance of current civil subsonic airplanes with the noise levels established by FAR 36 in 1969 (Stage 2), attention was next focused on lowering noise levels for new-design aircraft. In March 1978, the FAA revised its noise standards⁹ to reflect the noise

reductions which are available in the more-fuel-efficient, advanced-technology engines. The new allowable maximum noise limits (defined as Stage 3 levels) provide approximately a 5-dB reduction from the earlier Stage 2 limits, when averaged across the fleet. This revision was made retroactive to November 5, 1975. It is in substantial conformity with modifications to the noise standards recommended by the International Civil Aviation Organization (ICAO) Committee on Aircraft Noise.

The FAA has also promulgated regulations covering small propeller-driven airplanes and supersonic transports. Propeller-driven airplanes with maximum certificated weights less than 12,500 pounds were made subject to FAR 36 noise certification requirements in late 1974¹⁰. Civil supersonic airplanes (SST), except the Concorde with flight time before January 1, 1980 (presently expected to include no more than 14 Concorde), are required to comply with the Stage 2 noise limits in order to operate in the United States, by amendment to FAR 36, effective July 31, 1978.¹¹

The above regulatory actions took advantage of the results of an aggressive, Federally sponsored R & D program. The predominant activity in aviation noise-abatement research, technology development, and demonstration programs during the late 60s and early 70s was directed at reducing noise levels of the large aircraft, which make up the bulk of the commercial air carrier fleet. The significant programs of that period, notably the Sound Absorbent Material (SAM) demonstration program and the refan program, are now finding their way into operational use. SAM treatment is being applied by some airlines as a retrofit to their fleets and is also incorporated in new-production aircraft as a noise reduction measure. The technologies demonstrated in the refan and SAM programs are both utilized in the new DC-9-80 series aircraft, which has been designed to meet the Stage 3 FAR 36 noise levels.

Although it is generally agreed that aircraft noise control at the source is the most cost-effective way to reduce noise exposure, particularly when technological improvements are applied early in the aircraft or engine design and development cycle, there tends to be a 7-10 year time lag between the demonstration of a new technology and its introduction into new designs for fleet use. Then an additional 10 or more years must go by before these quieter planes

make up a substantial portion of the fleet so that they make a noticeable impact on the noise exposure of the affected communities.

Air Carrier Technology For The Future. The introduction of the first generation of "quiet" aircraft (meeting Stage 2 noise limits) is only now beginning to make a significant change in neighborhoods impacted by airport noise. A second generation of quiet aircraft (e.g., B-757, B-767) utilizing the Stage 3 technology developed during the early 70s is now being produced for service in the 80s and will begin to be fully appreciated by airport neighbors in the 90s. It should be noted that some of these second-generation quiet transports are powered by derivative versions of existing engines and therefore may not incorporate all of the noise control technology that could be available in a newly designed advanced-technology engine. These second-generation aircraft will contribute to reduced noise-exposure levels at most commercial airports during the 1985-2000 time period. However, the projected reduction will still not result in achieving the previously stated L_{dn} 65 dB goal. Therefore, a third generation of quiet transports entering commercial operation in the late 80s or early 90s must have still lower noise levels if exposure levels are to be further reduced, especially in the face of the forecasted growth in fleet size and operations.

Noise-abatement technology continues to advance and newer developments, when applied to future aircraft designs, will permit a further lowering of the maximum allowable noise levels. However, the long-term success of the noise-abatement program is strongly dependent upon establishing challenging goals for the program.

A recent new engine-technology program, sponsored by NASA and conducted by both the Pratt & Whitney Aircraft Company and the General Electric Company has been stimulated by the energy shortage. This program will provide technology for use in new engines to be produced in the late 80s and early 90s. The primary design criterion is a 12-15% reduction in fuel consumption with a noise-level goal that will only meet the present Stage 3 requirements. EPA believes that the noise-reduction goal should be 5 dB below Stage 3 to assure incorporation of all available noise-abatement technology.

Previous studies indicated that reductions in aircraft approach noise were limited by the airframe

noise "floor," caused by air flowing across the aircraft. It was believed that significant reductions in engine-generated noise, in the approach mode, might not be perceived due to this airframe noise. More recent studies now indicate that this floor is somewhat lower than previously indicated and that further reductions in engine-generated noise can be realized.¹²

The NASA/industry acoustics program for advanced supersonic aircraft has included validation of the performance of advanced noise-abatement concepts uniquely applicable to supersonic aircraft. A recent Congressional Office of Technology Assessment (OTA) study¹³ states that present NASA work indicates the possibility of meeting the FAR Part 36 Stage 2 noise regulations. More research and development and technology validation will be needed to meet Stage 3 requirements. EPA believes that future supersonic transports should be required to meet the same noise regulatory requirements as are met by subsonic transports.

2. Flight Procedures

The FAA has promulgated two regulations pertaining to noise-abatement flight procedures; one addresses the sonic boom of supersonic transports¹⁴ and the other the landing flap settings of subsonic aircraft.¹⁵ The operator of an SST is prohibited, except over specified test routes, from conducting flight procedures over land which would cause the aircraft to exceed the speed of sound and thereby cause a sonic boom. Regarding landing flap settings, the operator is required to use a lower-than-maximum flap setting unless the pilot determines that weather, runway conditions, or other safety factors require the maximum. A lower flap setting requires lower thrust, which results in less noise exposure. Both of the FAA flight-procedure regulations are effective in controlling noise.

Noise-abatement takeoff procedures have been recommended by the FAA in an advisory circular.¹⁶ The recommended takeoff procedures are capable of effecting substantial noise reduction. However, because the recommendations are so broad and only advisory in nature, cooperating airlines are not necessarily going to achieve the maximum noise-reduction benefits due to the flexibility in the circular.

Nevertheless, the advisory circular on takeoff procedures is a step forward. It does recommend

narrowing the flight-departure options to achieve reduced noise, increased safety, and decreased fuel consumption. If all airlines choose to cooperate with the circular, there will be a reduction in the number of differing procedures that have existed since the jet age began roughly 20 years ago. The result will be more consistent operations and reduced overall noise exposure.

3. Airport Operations

Each airport has a unique distribution of population relative to its runways. At many airports, opportunities exist for reducing noise exposure by devising approach and departure ground tracks for each runway that take advantage of areas that have the least population, e.g., water, industrial land, agricultural land, etc. The development of minimum noise exposure ground tracks requires a coordinated effort shared by the airport proprietor, the public, the airlines and other aircraft operators, and the FAA to reduce noise impacts while maintaining high safety standards and airport capacity. This effort may involve adjustments to flight paths for both arrivals and departures to maintain adequate separation, locating new navigational aids, and training both air traffic controllers and flight personnel.

Recent experience at Los Angeles International Airport showed major noise impact reductions when departing aircraft changed ground tracks and climbed out over the ocean, recrossing the coast at altitudes exceeding 7500 feet. At Logan International Airport in Boston, the FAA is studying more-effective use of the harbor for climbout. By increased utilization of the Logan runway which has the greatest potential for community noise improvement, the number of people estimated to be exposed to L_{dn} greater than 65 dB can be reduced from 31,000 to 9,000 and the number exposed to L_{dn} greater than 75 dB can be reduced from 3,300 to nearly zero.

In addition to optimizing the ground tracks associated with each runway, there often is an opportunity to optimize the relative use of each runway to minimize noise exposure. In many parts of the United States, the winds vary significantly from day to day and season to season in both velocity and direction. It is often possible to design a *preferential runway system* which enables maximum use of runways which result in the least noise impact and minimum use of those runways which result in the

maximum noise impact. Preference rules for runway use can be defined as a function of both capacity and wind conditions so that a minimum total noise exposure results. Such a program requires the airport proprietor, the airlines and other aircraft operators, and the FAA to devise practicable systems that meet both capacity and safety requirements.

4. Airport Noise Control Planning Programs

From the Federal perspective, airport development and noise control planning are primarily local concerns with the Federal role limited to providing technical assistance and financial support. The funds are provided through the Airport Development Aid Program (ADAP), which was authorized by the Airport and Airway Development Act, Amendments of 1976¹⁷ to include, as allowable costs, “. . . the purchase of noise suppressing equipment, the construction of physical barriers, and landscaping for the purpose of diminishing the effect of aircraft noise on any area adjacent to a public airport, . . . (and) any acquisition of land or of any interest therein necessary to insure that such land is used only for purposes which are compatible with the noise levels characteristic of the operation of a public airport.”

From the date of enactment of the 1976 ADAP amendments (July 12, 1976) to June 30, 1979, 13 airports received \$22.1 million to acquire lands for noise control purposes. During the same period about \$0.5 million was granted for the construction of physical barriers. While \$22.6 million is a substantial amount, it is a very small fraction of the total ADAP program, and is nearly insignificant with respect to what some airports have spent on their own. For example, Los Angeles International Airport has spent \$144 million on land acquisition for noise control purposes between 1965 and 1978.

The FAA also conducts an Airport Noise Control and Land Use Compatibility (ANCLUC) Program. Some forty airports are participating in this grant program which will demonstrate noise control planning concepts on an airport-by-airport basis. Ultimately, a model planning process may evolve from these concepts and a base will be established for future planning programs.

STATE ACTIONS

Several States have taken the initiative in protecting the health and welfare of their citizens from the

adverse effects of aviation noise. Some examples follow.

California

The State of California has established 65 dB measured on the Community Noise Equivalent Level (CNEL) scale as the level to protect people residing in the vicinity of the airport. This level is very similar to EPA's L_{dn} 65 dB. The responsibility for adopting and enforcing the noise standards is assigned to the county in which the airport is located.

The community noise standards state that no airport shall operate so that adjacent areas are exposed to noise levels in excess of 65 CNEL unless the proprietor has obtained a variance. The variance process requires airport proprietors to do site-specific, time-phased planning which will contribute to the improvement of the noise environment around the airport.

Maryland

The Maryland airport noise control program addresses the problem of off-airport land-use compatibility by: (a) attempting to minimize noise levels at existing noise-sensitive developments; and (b) preventing the introduction of new noise-sensitive developments. Maryland's Environmental Noise Act of 1974 requires the following:

- Airport operators must assess the off-airport noise impact of current and projected aircraft operations.
- If the off-airport impact exceeds L_{dn} 65 dB, a *noise-abatement plan* must be developed to reduce the impact on noise-sensitive land uses to the extent practicable.
- In cases where the noise abatement plan does not reduce the off-airport noise exposure to L_{dn} 65 dB, a State-certified *airport noise zone* must be established. The zone must, at a minimum, encompass the area within the L_{dn} 65 dB contour. The State has control over land-use activities within the airport noise zone to prevent additional incompatible use.

Two other States, Florida and Minnesota, also have programs which encourage noise reduction in the airport vicinity, and at least two additional States (Illinois and Oregon) are considering the adoption of similar programs. These State programs can play an

important role in bringing the parties together to seek an agreed-upon solution and in controlling land use where the local jurisdictions are unable or unwilling to do so.

LOCAL ACTIONS

At the local level, the control of airport noise exposure involves use restrictions imposed by airport proprietors and compatible land-use planning.

Airport Use Restrictions

Beginning in 1962, the courts placed the financial liability for aircraft noise damages on the airport proprietor.¹⁸ Since the mid-70s, the courts have begun to recognize and define the authority of the proprietor to regulate aircraft activity so as to avoid or minimize this financial liability. The authority of the proprietor to establish noise limits applicable to all types of aircraft has been upheld,¹⁹ as has the setting of limits applicable only in stated time periods, such as nighttime,²⁰ and the control of training activities.²¹

Use restrictions at airports are important tools for near-term reduction of noise exposure around major airports because control of noise at the source (the aircraft) alone will not provide adequate relief. Ideally, such restrictions should be imposed on the basis of a thorough study of the noise levels in surrounding neighborhoods (calculated or measured) and a careful consideration of the most cost-effective and least-disruptive restrictions which will produce the desired reduction of noise levels. It was in recognition of the importance of airport-specific restrictions and the need for careful planning that Congress passed the Aviation Safety and Noise Abatement Act of 1979.²² Title I of this Act authorizes financial assistance to airports and communities in the development and implementation of noise-abatement plans and should make a significant contribution to the number and quality of individual airport noise abatement plans.

Local Land Use Planning for Airport Noise Control

Changing the use and operation of the airport is only part of the aviation noise-abatement effort at the local level. The use of the land around the airport is equally important. If this land is undeveloped, it is important that it be developed only for purposes which are compatible with the airport

noise. If the land is already developed, but has incompatible uses (such as residences), then there may be land-use changes such as rezoning which can slowly bring the land into a more compatible configuration.

Land use is clearly a local matter. In most circumstances, this means that local officials have the power to control local zoning, to acquire interests in land (such as "development rights"), to develop compatible land-use guidelines, to enact building codes, and to determine airport locations.

The establishment of compatible land-use plans for noise-exposure control can be a very useful step toward establishing satisfactory co-existence of airports and communities. Such plans are especially helpful if they are prepared in conjunction with an on-site airport noise-abatement plan which examines possible restrictions on the use and operation of the airport.

Environmental assessments or environmental impact statements must be prepared whenever changes or new developments requiring Federal support are proposed at an airport which might significantly affect the surrounding environment. The FAA has proposed new policies and procedures which will clarify and simplify earlier requirements for actions to be taken by airport proprietors in preparing these environmental assessments and environmental impact statements.²³ If done well, these assessments can foster compatible land-use planning by local officials in conjunction with the planning for the airport development.

Funding for Implementation of Local Land-Use Programs

Financing for off-airport land use management actions may be available to the airport proprietor through ADAP. However, in the past, ADAP funding for these purposes has been minimal. A more promising avenue, open to local political jurisdictions, is the Community Development Block Grant Program (CDBG) administered by the Department of Housing and Urban Development (HUD) under the Housing and Community Development Act of

1974 (P.L. 93-383). Specifically, the objectives of Section 101 of the Act include both the elimination of detrimental conditions and more rational land utilization. CDBG financing is now being used for noise related land use changes at Hartsfield Atlanta International Airport.

Another aid to financing land use changes for more noise impact reduction purposes is being considered by the Treasury Department in the form of revised project eligibility guidelines for tax-free Industrial Development Bonds. If programs related to noise reduction are made eligible for tax-free bonding, local financing of such programs will be easier to obtain.

Airport proprietors may find it necessary to fund noise-control programs without Federal subsidy. Locally funded programs could include the purchase of land, or an interest therein, the management of growth patterns through zoning and utility (sewer, water) extension policies, the preservation of important land resources by means of unique tax-assessment procedures, and the soundproofing of noise-sensitive structures.

A potential source of funding for airport noise-control programs, which has yet to be used in this country, is a noise charge, i.e., a charge to aircraft operators for the noise they make. Noise charges would be an incentive for aircraft operators to produce less noise and also be a source of funds for noise-abatement actions. This has the attractive feature that those who make the noise and benefit from the aviation service causing it would pay for the costs it imposes on the rest of society (the so-called "polluter pays" principle). The advantage of such a system is that it would force aircraft operators to take into account noise costs just as they now account for material and labor costs. Noise charges are now assessed in several foreign countries, including Japan, France, Netherlands, and Germany. Some part of the noise charges is used to support noise-control programs, such as soundproofing of buildings. Communities in the United States could also benefit substantially from the use of noise charges.

NOISE EXPOSURE STATUS AND PROJECTIONS

EPA's major effort in noise exposure analysis has been to study the impact of air carrier operations. Studies are just beginning on noise exposure due to general aviation (GA) and to military aircraft operating from joint-use civil/military airports. In this chapter we present some of our air carrier noise study results. We discuss the nature of the GA and military aviation noise problems in Appendix A.

AIR CARRIER NOISE EXPOSURE

Population Exposed to Air Carrier Operations

Of about 185,000 aircraft operating from about 14,000 airports in the United States only about 3,000 aircraft and some 600 airports are certificated for air carrier operations, the remainder are designated for general aviation. The noisiest aircraft are the air carrier jets weighing in excess of 75,000 pounds. They only operate to any significant extent at about 300 airports. Thus for the 600 or so air carrier airports, the noise at about half of those airports is due mainly to air carrier jet operations. The noise at the remaining 300 or so air carrier airports results principally from the operations of small jet aircraft, small and large propeller aircraft, and helicopters.

EPA has studied the noise exposure of large air carrier jets for the time period through the year 2000.^{24 25} It should be noted that the results obtained are dependent upon basic assumptions regarding types and numbers of aircraft, numbers of aircraft operations, fleet mixes at various airports, noise levels of the aircraft, and population distribution. Thus, they are based upon estimates for the next 20 years of a number of key factors, any one of which may change substantially as a result of economic, technological, or social changes in the United States. These difficulties have not deterred us from making projections based on best assumptions. It is very important to have a general concept of the size

of the problem in the year 2000 in order to design and implement abatement actions today which will have their real impact in the year 2000.

EPA predictions of noise exposure were made for the baseline year of 1975 and for every five years thereafter through the year 2000. The fundamental assumptions concerning types, numbers, and operations of aircraft, fleet mixes, etc., were based upon FAA data. The EPA baseline studies assumed that flight procedures were conducted essentially in accordance with FAA Advisory Circular 91-39 and that source regulations in effect at the time of the study would apply. The following table presents the mean values of the projected population exposures for a case of moderate aviation growth. It is apparent that without additional noise-abatement actions neither the L_{dn} 65 dB nor the L_{dn} 75 dB goal will be achieved by year 2000. A large reduction in exposure occurs over the 5 years between 1980 and 1985 due to the retrofit/replacement regulation. However, the decrease in the following 15-year period is comparatively modest.

Population Exposed To Noise From Air Carrier Aircraft.

Outdoor Exposure Level (dB)	Number Of People Exposed (Thousands)			
	1975	1980	1985	2000
L_{dn} 75 or greater	400	300	150	100
Between L_{dn} 65 and L_{dn} 75	5150	4450	3000	2550
TOTAL: L_{dn} 65 or greater	5550	4750	3150	2650

The tabulated noise exposure forecasts are national estimates that are based primarily on control of noise generated at the source and do not take into consideration the potential benefits of site-specific airport noise-abatement planning and implementation of compatible land-use controls. The site-specific noise-abatement factors not included were optimizing both noise-abatement flight procedures and flight tracks leading into and out of the airport, use of preferential runways, altering service to take advantage of the availability of quieter aircraft, imposing curfews, purchasing land in heavily exposed areas, etc. Therefore, in developing a national program for aviation noise abatement and control and considering resulting costs, the noise-exposure forecasts in the table should be considered probable "high-side" estimates.

The above predictions of air carrier noise exposure assume that the only noise certification requirements are those in effect at the current time. That is, all new types of aircraft after 1975 must comply with Stage 3 noise limits and all older types must comply with Stage 2 limits on or before 1 January 1985. Among the noisiest and least fuel efficient of the air carrier jets are those propelled by JT8D engines (B-727, B-737, and DC-9). These aircraft contribute to the overall noise exposure in excess of their proportion of fleet size and annual operations because of their higher noise levels. The above predictions also assumed that these aircraft would no longer be produced after 1985. That assumption by the FAA, which was adopted in the EPA study, is presumably based upon the belief that increased fuel costs would force these aircraft to be discontinued by 1985 or produced with modern engines that are more fuel efficient and less noisy. However, EPA discussions with the aircraft manufacturers in preparation for this report revealed that the manufacturers are unwilling to indicate any intentions of stopping production by 1985. A new

regulation requiring these aircraft to comply with Stage 3 would apparently be necessary to stop production of these noisy aircraft by 1985.

One of the most important conclusions that can be drawn from the EPA study is that the regulatory actions already taken to control air carrier noise at the source have determined what the noise characteristics of the air carrier fleet will be between now and the year 2000. That is, no matter how stringent future source noise regulations may be (short of further retrofit of the existing fleet), their effects on the reduction of noise exposure will not be large, on a fleet basis, until beyond the year 2000. This conclusion is not to be interpreted to mean that more stringent source regulations will not be effective. On the contrary, the conclusion dramatically points out that, because of the inertia of the system, further source-control regulations must be initiated at the earliest possible time if a quieter fleet is to be achieved in the post-2000 period.

There is a basic principle involved. The introduction of quiet aircraft into the fleet does not by itself bring about a reduction in noise exposure. Such reductions can be accomplished only if the introduction of new quiet aircraft is accompanied by retirement or quieting of older noisy aircraft or by decreasing the number of aircraft operations. The average life of an aircraft is about 20 to 25 years. Noisy aircraft introduced into the fleet now will contribute disproportionately to the noise exposure until they are ultimately replaced about the year 2000 or later by quieter aircraft. Furthermore, all FAA estimates predict the size of the air carrier fleet to increase through the year 2000. Therefore, the noise reduction that will occur in the fleet between now and the year 2000 will be accomplished solely by replacement of noisy aircraft by quieter ones. Thus, primary relief for airport neighbors during the next 20 years must be found in noise-abatement actions at specific airports.

STRATEGY FOR FURTHER REDUCTION OF AVIATION NOISE

A great deal of progress has been made since 1973 to deal with the aviation noise problem from commercial carrier operations. The FAA has promulgated a number of important regulations which when fully effective will provide dramatic relief around our nation's airports for a large number of people exposed to high levels of noise from commercial aircraft operations.

Progress has also been made on the control of noise at the local level. Both the Courts and the Department of Transportation (DOT) have articulated more clearly the rights and responsibilities of the airport proprietor to reduce the noise from his specific facility, and a small start has been made at the Federal level to finance the development of plans which lay the groundwork for such actions.

It would be a very serious mistake, however, to become too complacent about this progress and to lose sight of the substantial portion of the aviation noise problem which remains. Accomplishments to date, though considerable, fall far short of what those who live around our nation's airports had expected at the time Congress enacted the Noise Control Act of 1972, directing the Executive Branch to deal aggressively with aviation noise problems. There is still widespread dissatisfaction on the part of those who live in the vicinity of airports with the current level of aircraft noise-abatement progress. Community objection to aircraft noise has resulted in both proposed and existing airport restrictions involving night curfews, aircraft type restrictions, and limitations on expansion of existing airports. Airport expansion is being slowed in some cases by citizen opposition to the increased noise which would result and construction of new airports is being blocked. Legal action involving noise damage claims is continuing (the total of such claims is estimated to be approximately \$250 million).

THE NEXT 20 YEARS

As shown earlier in this report, we expect that at the end of the century, based on the actions taken to date, there would still be approximately 2.5-million people living in areas exposed to outdoor noise levels, due to aviation operations, of L_{dn} 65 dB or above. Approximately 100 thousand of these will live in areas with extremely high levels of noise (L_{dn} 75 dB or greater). Millions more would be exposed to levels above L_{dn} 55 dB.

What should be said to those who even 20 years from now will still be living in such noisy neighborhoods? Should we tell them that we are sorry that they will not obtain relief and that *no* further relief is forthcoming, or should we seek to design and implement a program to bring relief to them as well?

From a policy point of view, the Federal Government has already taken a position on this issue. The FAA, the EPA, and HUD are all in agreement that having people live in areas exposed to high aviation noise levels of L_{dn} 65 dB or greater is very undesirable and they have established policies to prevent such exposures.

However, the policies of these three agencies have not been translated into a total program to achieve this degree of noise reduction around our nation's airports. Nor has it been decided that the Federal government should assume any financial responsibility for this effort. In the past such a program has been out of the question because of the very large number of people affected and the attendant costs of providing relief for all of them.

Now that several steps have been taken to require quieter aircraft in the future, the number of people remaining to be protected will have been significantly reduced so that a solution seems feasible at some time in the future. Of course, some airports

are at and even below the L_{dn} 65 dB goal level at this time, and others will be, in the year 2000. However, on a nationwide basis, trying to reach such a goal within the next 20 years is probably still too ambitious.

Nevertheless, with one very important modification to this L_{dn} 65 dB goal, we believe that a feasible national program to provide relief to adversely exposed people in the next 20 years could be designed and implemented. This modification to the goal would be that for the period up through the year 2000, protection of people *inside* their houses would be deemed acceptable, if it is not feasible to reduce the outdoor environment to satisfactory levels. Although these people would continue to find the use of their yards and outdoor space severely limited, at least they could escape to the privacy of their homes and have the opportunity to enjoy a good night's sleep, family conversation, and relaxation around the television or stereo without the nerve-racking disruptions of over-flying aircraft.

Of course, providing relief to people only *inside* their homes is not fully satisfactory. Even an L_{dn} 65 dB environment outside the home is destined to give rise to many legitimate complaints. In the past we have offered these people little hope of any relief, partly because we could not offer them *full* relief. Given a choice, partial relief in this instance is clearly preferable, and we believe that if all parties involved committed themselves to this objective, it could in fact be achieved before the year 2000. We believe that these families should be offered such a hope of early relief and that a comprehensive strategy to reach this goal should be put in place.

This concept of protecting people from exposure to noise inside their houses rather than both inside and outside their houses is especially attractive because of the new emphasis on soundproofing of homes, schools, and hospitals in President Carter's Urban Noise Program announced in the Environmental Message of August 1979. Soundproofing benefits can be achieved for very little additional cost when a building is being insulated for energy conservation. In a recent EPA home soundproofing study,²⁶ it was estimated that in addition to an approximate 25-dB reduction in internal noise, an energy saving of approximately 64 percent could be realized due to reduced heating requirements. The

noise reduction shown in the EPA study is approximately the same as that required for the proposed soundproofing effort.

Soundproofing is not suggested here for people whose outdoor noise levels exceed L_{dn} 75 dB. We believe the opportunity should be provided these people to relocate to quieter neighborhoods, thus permitting the vacated property to be converted to uses more compatible with the airport environment.

Of course, soundproofing of all houses exposed to more than L_{dn} 65 dB and purchase of all houses exposed to L_{dn} 75 dB or higher would be very expensive. Providing relief for these families exclusively by the method of soundproofing and purchase would cost approximately \$10 billion for the approximately 2.5-million people affected by aircraft noise in the year 2000.

We believe that there are a number of less costly steps which should be taken which will have the effect of reducing the number of people left in the L_{dn} 65 dB and above area around the airport and hence reducing the funds necessary for soundproofing and purchase of homes. These actions can also assure that no further noise degradation occurs in the residential neighborhoods around airports, including those which are fortunate to be exposed to less than L_{dn} 65 dB today. A national strategy should be developed to exploit these other methods of noise control, where feasible, with soundproofing and purchase of land being carried out for those homes remaining. Although we presently do not know how much the problem could be reduced by these means, we are confident that the total cost of achieving this goal would be considerably less than the \$10 billions required when only soundproofing and purchase programs are implemented. A more accurate cost projection for this national strategy should be developed for public discussion by the Federal agencies involved during the next twenty-four months.

When we say "national" strategy, we do not mean "Federal" strategy. The task of designing and implementing such a strategy, and ensuring adequate funding, should be shared in some manner by the many parties to this problem: the passengers, the airlines, the aircraft manufacturers, the airports, the communities, and those affected by the noise. Federal assistance under existing grant programs is also a possibility.

Although in our view the Federal Government should not shoulder the financial burden of meeting

this year 2000 goal, it does seem appropriate for the Federal Government to take the lead in developing the necessary national strategy. To ask local communities, the airlines, the airports, or the aircraft manufacturers to take the leadership role is unrealistic.

A national strategy for achieving *indoor* protection for airport neighbors by the year 2000 should include the following:

- Optimization of aircraft flight procedures, including throttle and flap management, flight tracks, and preferential runway utilization.
- Airport noise-abatement planning.
- Off-airport land-use management to prevent future encroachment of neighborhoods on airports and remedy present encroachment through soundproofing and purchase of structures.

Optimization of Aircraft Flight Procedures

The estimate of 2.5-million people living in areas exposed to noise levels of L_{dn} 65 dB and above in the year 2000 is based primarily on the implementation of FAA regulations which will ensure that the aircraft in the U.S. fleet will be significantly quieter than in the past. The number of people exposed to such levels could be substantially reduced through the employment of both optimized noise-abatement flight procedures and optimized flight tracks, and preferential runway utilization. Based on the results of our studies, we estimate that the number of people, nationally, exposed to excessive aviation noise could be reduced by up to 25% through the widespread use of optimized noise-abatement *takeoff* procedures alone. With the employment of improved noise-abatement *approach* procedures and other airport-specific measures such as flight-track optimization and the use of preferential runways, the national population exposure could be further reduced.

Ideally, the leadership for this flight procedure optimization should come from the airline pilots and the airlines, with assistance from air traffic controllers and airport proprietors. We believe that noise-abatement procedures are consistent with, and often enhance, the safety and fuel efficiency of aircraft operations. On this basis, a broad consensus should be established among pilots, airline operations managers, air traffic controllers, and airport operators to

employ the available noise abatement flight procedures more vigorously and uniformly and to reduce the wide deviation from these procedures which presently appears to exist. We recognize that the optimum flight procedures are somewhat site-specific, but that from the standpoint of safety, it is important that the number of different noise-abatement flight procedures be kept to a minimum.

We will recommend to the FAA that they take the initiative for establishing this consensus by convening one or more conferences and a series of training seminars with these individuals and that they explore with this group the need for further regulation in this area, as appropriate. While flight-track optimization and preferential runway use are airport specific, sufficient experience has now been gained whereby the successful noise-control procedures developed and being used at several airports can be more universally understood and adopted.

Should the FAA be unsuccessful in developing this consensus, the possibility exists for individual airport proprietors to monitor compliance with noise-abatement procedures and seek enforcement of them. However, this approach is clearly less desirable than a voluntary effort by the pilots and airlines, provided some way of assuring performance can be found.

For its part EPA proposes to initiate a program with several airport operators to monitor approach and departure flight procedures routinely employed by commercial air carriers to determine whether procedures recommended by the FAA are being employed and to determine seasonal weather effects as well as effects of schedule and traffic pattern changes. These data will be provided to the FAA, air carriers, airport proprietors, and pilots in support of the FAA-sponsored conferences and seminars and will be available to support the development and promulgation of regulations, if they are found to be necessary.

A number of site-specific actions should be taken by airport proprietors. These actions and the authority of the proprietor to undertake them were set forth in the Transportation Secretary's Aviation Noise Abatement Policy in November 1976.²⁷ Since 1976, several important precedents have been set which clarify the extent of proprietary authority; these decisions should be used to update the 1976 DOT Aviation Noise Abatement Policy statement so that a clearer statement of responsibility can be available to

airport proprietors and others concerned with airport noise.

Airport Noise Abatement Planning

Mapping of noise-exposure areas and noise-abatement planning are necessary at all air carrier airports, both those with noise problems today and those which could develop problems in the future. Planning can help ensure the continued useful life of the airport site, by preventing premature closing due to noise impact. Because sites for new airports are very scarce and usually impose difficult surface transportation problems, present airport sites are valuable assets. They should be preserved if they can be made compatible with the neighborhoods in which they are located.

The new Aviation Safety and Noise Abatement Act correctly includes local elected officials as well as Metropolitan Planning Organizations (MPOs) as important participants in airport planning and as possible recipients of implementation funds. In addition, to help expand the number of airports protected, the FAA should make noise-exposure mapping and noise-abatement planning a requirement for any airport which must develop a master plan under the Airport and Airway Development Act. EPA will continue its work with State and local elected officials to encourage a broader participation by these persons in airport planning in the future. The Agency's Each Community Helps Others (ECHO) Program will be expanded to assist local officials in this area.

In the past, airport proprietors have argued that airport noise mapping and noise-abatement planning expose them to the possibility of lawsuits because they must admit that the noise extends into the surrounding neighborhood. They have argued that this mapping and planning in fact can cause a "noise problem" where one did not exist before. This rather cynical view of noise as a "political" problem instead of a public health problem may explain why some airport proprietors have done little or nothing to provide relief for airport neighbors. The Aviation Safety and Noise Abatement Act of 1979 lays much of this argument to rest by providing protection to proprietors from spurious lawsuits and from the use of the maps against them in lawsuits. EPA will support the FAA in strongly promoting the voluntary mapping and planning called for in the Act, especially at the noisiest 100-150 airports. If

these maps are not produced voluntarily by the airport proprietors, then at least the mapping, if not the planning, should be done by the Federal Government or other parties in order to identify existing problems and to allow parties other than the proprietors to take corrective actions within the scope of their authority, i.e., the imposition of land-use controls. EPA is now helping several communities to develop noise maps and interpret those results through the Technical Assistance Program. Skilled professional staff at EPA headquarters are available to assist local communities to the extent that resources will allow.

In October 1976 the EPA forwarded a proposal to the FAA for an Airport Noise Regulatory Process. This proposal called for mandatory noise-abatement planning at all air carrier airports with the extent of the planning effort directly related to the severity of the noise impact problem at the specific site. The FAA has yet to make its decision on this EPA proposal which would cause all airport proprietors to assess their noise situation according to a nationally accepted methodology.

At some airports it may be necessary to go beyond optimization of flight tracks and runways and make changes in the airport layout and operations and/or restrict the type of aircraft that can operate at the airport, for either some part of or all of the day. Restrictions on the use of the airport are clearly within the authority of the proprietor so long as they are non-discriminatory, do not violate Constitutional prohibitions against undue burdens on interstate and foreign commerce, and do not interfere with exclusive Federal regulatory responsibilities for safety and airspace management. For instance, carriers presently serving the airport cannot be favored over new entrants to the market. In order to facilitate non-discriminatory actions of this sort, the FAA has published advisory circulars listing the measured or predicted noise levels of various types of aircraft at standard measurement points on the ground. Airport proprietors can then "draw a line," so to speak, at the decibel level deemed necessary for protection of surrounding neighborhoods and thereby close the airport to use by aircraft that exceed this level. If done carefully and thoughtfully, this approach is a reasonable exercise of a proprietor's responsibility to make his facility compatible with the community in which it is located.

The advent of deregulation of the airline industry has resulted in rapid changes to the airport operations in many communities. Increased flights and the entrance of new carriers have created some confusion in the minds of airport proprietors concerning what local noise-control actions are appropriate. Consequently, EPA will ask the FAA and the Civil Aeronautics Board (CAB), with whatever assistance from EPA may be helpful, to develop a coherent and unified statement of Federal policy regarding appropriate noise-abatement actions which local proprietors may take.

In addition, EPA will continue to assist airport proprietors and impacted communities to analyze their noise environment and to utilize available data in an objective and non-discriminatory manner. This activity is mandated in the Quiet Communities Act of 1978 (P.L. 95-609) wherein Sec. 14(c)(1)(C) states that EPA shall "administer a nationwide Quiet Communities Program, which shall include . . . developing abatement plans for areas around transportation facilities (including airports, highways and rail-yards) and other major stationary sources of noise." Quite often, EPA provides this type of technical assistance in cooperation with the FAA. In other situations, where requests for technical assistance come from parties other than the airport proprietor, technical assistance is provided directly to local governments. It is legitimate in our view for these decisions to be made on an airport-by-airport basis because each airport is different in terms of the neighborhoods affected and the traffic volume and flight tracks involved. What is acceptable equipment at one airport need not be acceptable at another.

Off-Airport Land-Use Management

Every year more and more houses are built in neighborhoods which are now or will be severely affected by the noise from our nation's airports, including some of the noisiest ones. As a general rule, very little is done to discourage building these houses or to educate or warn prospective purchasers of what is in store for them. By the time the purchasers really find out what it is like to live under a busy flight path day in and day out, it is too late for them to do anything about it. It makes little sense to launch new initiatives to cure the problem of incompatible development in existing neighborhoods around our airports if at the same time new

residential developments are encroaching on these same airports.

The various parties to the aviation noise problem — the aircraft manufacturers, the airlines, the airport proprietors, the pilots, local elected officials, and the airport neighbors — all have differing views about how to "solve" the aviation noise problem, but on the subject of new encroachment by neighborhoods on noisy airports, we believe there is unanimity. Encroachment by incompatible uses is undesirable and should be prevented. Yet the concerned parties have not spoken with a unified voice to persuade builders, property owners, and elected officials to take steps to prevent this repetition of past mistakes. Each of these parties has stated on separate occasions its strong conviction that future encroachment should be stopped, but the differences between these organizations on other matters apparently have prevented them from joining together in a unified position to persuade local officials and developers to seek compatible uses of land near noisy airports.

We believe that the time is ripe for parties to the aviation noise problem to put aside their philosophical differences on other aspects of the problem and to join together in a "Compact" based on common interests on this issue of future encroachment. A unified voice would probably be "heard" far more often than the occasional protest which is now voiced. Not only should everyone be speaking with one voice on this matter, but together these organizations could offer something more positive to local officials and developers. Members of the Compact could do the research and development work to suggest a variety of alternatives to local officials and developers for use in situations such as these. As an example, the concept of "development rights" has not been carefully explored for use in the airport noise area, and yet it seems to hold some promise for allowing local officials to prevent incompatible development at a price far below the cost of outright purchase of the property. In addition, members of a Compact, by their own actions, could demonstrate that local officials are not the only ones being asked to do their part to control aviation noise. A positive approach by the members of the Compact might be very effective in assisting local decision makers with the difficult problem of saying "no" to residential development near airports.

EPA will take the initial steps to form such a Compact with the expectation that EPA and the rest of the Federal Government would need to play only a supporting role once it is formed. The complexity of developing and implementing land-use programs around airports makes it difficult for local officials to work effectively without technical assistance. In the future EPA's regional offices will expand their efforts in this important area. In addition, EPA's current efforts to develop a model building code for possible adoption by communities should be of considerable assistance in this effort. The model building code will be tested by several communities within the context of their own airport noise situations. Preliminary discussions have been held with several major cities and there is strong interest in this subject.

State actions to legislate, plan, and control aviation noise have emerged as one of the most significant spheres of noise control since our last report to Congress. A large part of the institutional recognition that has been extended airport proprietors to control airport and aircraft noise was the direct result of the leadership of States such as California and, Maryland. In addition, creative actions by local institutions should remain an essential component of comprehensive State plans for aviation noise abatement. State actions for aviation noise planning bring credibility and a sense of permanence to the airport noise abatement effort.

EPA's activity in support of State-level programs will include a series of planning workshops conducted with the Regional Technical Assistance Centers. These workshops will be used to distribute planning concepts and information and to determine future program directions. One such possible direction could be the development of model State-enabling legislation for airport noise-abatement planning and the maintenance of compatible land uses around airports.

Of equal importance to the planning process could be the vigorous enforcement of the provisions of the Federal Aviation Act which require that assurances be given under the Airport and Airway Development Act that the grantee (the proprietor) has taken steps to assure that compatible land use takes place in conjunction with expansion of the airport facilities. A number of years ago the FAA apparently enforced this provision much more vigorously than recently. Obviously, it is a hard provision to enforce since the law puts the pressure on

the airport proprietor rather than the local officials, who may have ultimate control over whether or not the land will be used compatibly; yet, in our view, the problem of future encroachment of incompatible uses on airports is so serious that every effort should be made to discourage it from taking place. For this reason, we will propose that a thorough review be undertaken jointly with the FAA on ways to achieve more effective implementation by the FAA of this provision of law and its other authorities to prevent more of these encroachment problems.

Soundproofing and Relocation

Even after flight operations as well as the equipment serving a particular airport are optimized, and after the possibility of future encroachment is decreased, there will still remain a sizable number of people around airports who will continue to live in environments exposed to L_{dn} 65 dB or greater, through the year 2000. Relocation of those exposed to L_{dn} 75 dB or greater and soundproofing for houses located in environments of L_{dn} 65 to 75 dB would then be necessary to provide these families with privacy *inside* their homes.

There are a number of ways in which the funds for this part of the program might be found. In fact a variety of sources should probably be tapped. For instance, landing fees at airports and the targeting of existing grant programs should be examined.

We will propose to the FAA that the two Agencies work cooperatively to further investigate the various fund sources which should be tapped for the soundproofing and relocation program. The two Agencies should undertake the development of a possible noise emissions charge program at airports, including determining the detailed mechanisms by which noise charges could be assessed, collected, and disbursed and to develop recommendations for appropriate legislation if needed. Such recommendations, including a detailed program plan, should be available for consideration within the Administration by the end of 1982. Concurrent with this activity, the two Agencies should also conduct an in-depth soundproofing study to establish as precisely as possible the number of residences affected, together with cost and time estimates, and to resolve questions pertaining to the stewardship, use, and disposition of those properties which would be candidates for purchase. While we believe that the

FAA's leadership, with full EPA participation, is desirable in developing this program, EPA is prepared to undertake the development of the program alone, if necessary.

LOOKING BEYOND THE YEAR 2000

Twenty years seems like a long time, but in the aviation noise area, solutions which involve equipment changes necessarily take a long time. If we want quieter neighborhoods in the 21st century, or if we even want to maintain the gains we make in this century, actions must be taken now.

The actions previously described in this chapter will not reduce the noise levels of future aircraft, nor will they ensure that the air carrier fleets assumed to be operational at the turn of the century will not become noisier. In addition, leaving the *outdoor* environments in our neighborhoods at L_{dn} 65 dB or above is satisfactory only for the short term and further actions are appropriate to reduce outdoor levels to L_{dn} 65 dB or below, ultimately to L_{dn} 55 dB. Furthermore, future expansion of the national air transportation system is likely, but it should not expand at the expense of airport neighborhoods. It is therefore essential that the following elements be added to the aviation noise program:

- Accelerated research and development to ensure the design and manufacture of quieter engines and airframes.
- Effective regulatory leadership for certification of new types of aircraft, derivative aircraft, and new-production aircraft.

Industry recognizes the need to further reduce aircraft-generated noise. At a recent NASA/industry meeting,²⁸ the following viewpoints were indicative of the industry consensus:

- There is a need for a continued, strong, fundamental, noise research program with emphasis also on advanced concepts to reduce noise from future aircraft with minimal sacrifice in direct operating cost.
- The engine technology to be utilized in the 1990s must be available in the 1980s. The major challenges of the 1990-2000 time frame will be fuel, environmental considerations, critical materials, costs, and performance.

- Public pressure for reduced noise will continue and may even encompass smaller engines with the growth in the commuter market.

Effective regulatory leadership includes the need to establish aircraft noise limits based upon future requirements to achieve realistic goals. It is not adequate to establish limits which are based on "common practice" technology. To achieve *total* land-use compatibility in communities adjacent to air carrier airports requires that environmental noise exposure not exceed L_{dn} 55 dB. This level is unlikely to be attained nationally in the foreseeable future although it is attainable at some airports and therefore should be emphasized as an ultimate goal for air carrier airports. However, L_{dn} 65 dB is considered a realistic national goal. To achieve the latter level on a national basis for outdoor environments would require that the noise levels of future air carrier aircraft be reduced below Stage 3 levels by approximately 10 to 15 dB. It is possible that with aircraft quieted to these levels and with the use of site-specific operational measures, some airports would approach or meet the EPA long-range goal of L_{dn} 55 dB.

Industry participants in last year's Noise Technology Research Symposium²⁹ expressed the belief that up to a 10-dB reduction may be possible by the year 2000 with an aggressive Federal R&D program. Continued expenditures in noise-abatement research will provide benefits in the post-2000 time period and may be necessary to *maintain* the level of environmental compatibility that will result from the proposed national noise-control strategy. In terms of realizing an additional 10-dB reduction in noise generation, detailed component-technology development needs were identified by the Symposium participants. Further, the scope and difficulty of the research needs for engine noise reduction led to the conclusion that present funding levels are insufficient.

Unfortunately, there has been a dramatic reduction in Federally sponsored programs in aviation noise research.³⁰ From a high of \$47 million in FY 1973, Federal expenditures were down 60% to \$18 million by 1978 and this downward trend is continuing.

More than token progress can only be made in aviation noise-control research if there are significant increases in Federal support. Participants in the Noise Technology Research Symposium felt that a

reasonable starting point would be to increase the Federal funding level for noise R & D by a factor of two, starting in FY 81. This increased R&D funding could lead to savings of billions of dollars that might otherwise be spent on land-use change.

EPA recommends that the Congressional Office of Technology Assessment (OTA) undertake a study, with the active participation of both EPA and FAA, to evaluate the existing NASA noise research program and to identify the additional program effort required to develop and demonstrate the necessary technology to realize the long-range goals. In its current study of Advanced Air Transport Technology (initiated at the request of the House Science and Technology Committee and endorsed by the Senate Commerce, Science and Transportation Committee), OTA has identified noise as a constraint to the growth of the commercial air system for both advanced subsonic and supersonic aircraft. Therefore, we believe that this recommendation is a logical extension of OTA's present study.

The 10-15 dB goal should be incorporated in Federal noise regulations so that engine and airframe designers can identify and develop the technology necessary for its attainment and the necessary R & D programs can be undertaken and supported. Meanwhile, technology is now available to establish an interim level, 3 to 5 decibels below current Stage 3 levels. Several commercial aircraft now operating meet such reduced noise levels. These levels should be made mandatory for all new aircraft designed to become operational in the later 1980s and early 1990s. The longer-range goal levels would apply to new aircraft designs which may become operational after the turn of the century, thereby providing adequate lead time to identify, develop, and demonstrate the requisite technology. The FAA should act favorably upon EPA's proposed regulations (Stage 4) which would essentially meet the interim goal level of 3-5 dB reduction and would be effective January 1, 1980. The levels proposed by EPA to become effective January 1, 1985 (Stage 5) should also be favorably acted upon by the FAA. As an alternative to the Stage 5 proposal, the FAA should consider establishing a standard by 1985 which would require a 10-15 dB reduction in some future year. We will discuss this alternative with the FAA.

Also, further noise reduction should be required in the Stage 2 aircraft now in the fleet and those

being added, which will dominate the noise situation for many years in communities adjacent to many of the nation's air carrier airports. Manufacturers have little incentive to improve their products for noise control, whereas they place considerable emphasis on derivative aircraft programs to increase range and payload, lower specific fuel consumption, extend useful life, reduce manufacturing costs, etc. One approach to diminishing the influence of Stage 2 aircraft noise may be to prohibit any change in air carrier fleet makeup after some future date, that would result of itself in an increase in fleet noise level, unless operations are reduced so that fleet noise level remains the same or decreases. If operations are increased, airlines would have to put into service derivative or new-production aircraft which are quieter than their predecessors, thus assuring that noise control becomes an integral element in the product-improvement cycle. The EPA is re-investigating the potential benefits of a Fleet Noise Rule³¹ that would incorporate these considerations and will provide appropriate recommendations to the FAA.

Another approach that has merit, and is being investigated by the FAA, is to issue a rule that after some date certain, e.g., 1982 or 1983, newly produced Stage 2 aircraft would have to meet Stage 3 noise limits ("Stage 2 Production Cut-Off"). This could hasten the purchase of available quieter and more-fuel-efficient engines in the newly produced Stage 2 aircraft. Either a Fleet Noise Rule or a Stage 2 Production Cut-Off should be promulgated by the FAA to deal with this problem of continued production of aircraft which do not provide the degree of noise control which is possible. EPA will work closely with the FAA to achieve a suitable solution to this problem.

GENERAL AVIATION AND MILITARY AVIATION

General Aviation

While primary emphasis has been placed on air carrier noise in this report, we are mindful of the potential problem presented by the growing number of general aviation operations, including business jets. However, until we obtain a better understanding of the noise implications of these growing activities, it is not possible at this time to formulate a general policy and strategy. The results of an

on-going EPA study of general aviation noise, scheduled for completion in the next twelve months, will be the basis for additional national strategy recommendations in subsequent revisions to EPA's Five Year Plan for noise abatement.

Joint Use of Civil/Military Airports

EPA has initiated a study to evaluate the existing military contribution to noise exposure at the joint-use airports and to determine its significance as the civil aircraft fleet becomes quieter. If the results of this study show that the military aircraft fleet is a significant noise source, then further studies with Department of Defense participation may be necessary to determine the best methods for protecting the public health and welfare from military aircraft noise.

Both general aviation noise and civil/military joint-use aircraft noise are discussed in more detail in Appendix A.

ACTION SUMMARY

In summary, EPA will take the following actions to implement its portion of a national strategy for air carrier aviation noise proposed in this Report.

• Optimization of Aircraft Flight Procedures

- EPA will recommend to the FAA that they take the initiative for establishing a consensus among pilots, airline operations managers, air traffic controllers, and airport operators to employ more vigorously the available noise-abatement procedures and to reduce the wide deviations from these procedures which presently exist.

• Airport Noise Abatement Planning

- Pursuant to the explicit directive of the Quiet Communities Act of 1978, EPA will continue to assist airport proprietors and impacted communities to analyze their noise environment and utilize the available data in an objective and nondiscriminatory manner. Where appropriate these activities will be conducted on a cooperative basis with the FAA.
- EPA will develop new mechanisms for delivering airport and land-use compatibility planning assistance, including the Each Community Helps Others (ECHO) concept and the use of regional technical centers.

- EPA will continue its work with State and local elected officials to encourage a broader participation by these persons in future airport planning actions.

- EPA believes that a need exists for a unified coherent interagency statement of Federal policy regarding noise-abatement actions which local airport proprietors may take, and will seek the development of such a statement.

- EPA strongly promotes the voluntary mapping and planning called for in the Aviation Safety and Noise Abatement Act of 1979 at all airports, but especially at the noisiest 100-150 airports.

• Off-Airport Land-Use Management

- EPA will take the initial steps to form a Compact between the various parties to the aviation problem to prevent future encroachment by incompatible land uses on noisy airports.

- EPA will propose to the FAA that a thorough joint agency review of FAA authority in compatible land-use assurance under the Federal Aviation Act and the Airport and Airway Development Act be undertaken.

- EPA will work to involve State and local governments in airport-oriented land-use management activities, e.g., model building codes, model State enabling acts, workshops.

- EPA will propose to the FAA that a joint program be undertaken to develop a plan for soundproofing and residential relocation programs.

• Effective Regulatory Leadership

- EPA will continue to press the FAA to act favorably upon its proposed regulation for Stage 4 aircraft and to establish a 10-15 dB reduction goal for future newly designed aircraft.
- EPA is re-investigating the potential benefits of a Fleet Noise Rule (FNL) and will provide the FAA with appropriate recommendations in their consideration of rules pertaining to new-production cut-off of Stage 2 aircraft.

- ***Accelerated Research and Development***
 - EPA recommends that the Congressional Office of Technology Assessment (OTA) undertake a study, with the active participation of both EPA and FAA, to evaluate the

existing NASA noise research program and to identify the additional program effort required to develop and demonstrate the necessary technology to realize the long-range goals.

APPENDIX A

NOISE EXPOSURE DUE TO GENERAL AVIATION AND TO MILITARY AIRCRAFT AT JOINT CIVIL/MILITARY AIRPORTS

GENERAL AVIATION NOISE EXPOSURE

Population Exposed to GA Operations

The most prominent contributors to aircraft noise exposure are clearly air carrier aircraft. Thus, the air carriers and their airports have received, by far, the greatest attention from communities, industry, operators, and regulatory agencies. However, the size and growth rates of the general aviation (GA) fleet suggest that GA operators may also be a significant contributor to the national aviation noise environment. In terms of numbers of aircraft and airports, GA constitutes the major portion of the civil aviation transportation system. Of about 185,000 aircraft operating from about 14,000 airports in the United States in 1978, only about 3,000 aircraft and 600 airports were certificated for air carriers; the remainder are for GA.

In order to obtain the views on GA noise impacts of a representative group of concerned people from around the country, EPA convened a Conference on General Aviation Airport Noise and Land Use Planning in October 1979. Attendees included members of affected communities, representatives of Federal, State, and local governments, manufacturers and operators of GA aircraft, airport managers, and land-use planners. This group's advice was sought on the potential seriousness of the GA noise problem and on possible planning strategies to cope with it.

The term "general aviation" encompasses all civil aircraft operations not provided by scheduled, certificated air carriers. About 95% of the total GA fleet

The term "general aviation" encompasses all civil aircraft operations not provided by scheduled, certificated air carriers. About 95% of the total GA fleet consists of propeller-driven and jet aircraft not exceeding 75,000 pounds gross weight. The remainder are helicopters and large air carrier-type aircraft converted to GA use. Of increasing significance to community noise is the rapid growth of this fleet. Even more important for noise impact is the rate of introduction of jets and turboprops. They have been added to the domestic fleet in the last few years at a rate twice that of the total fleet. Because many of these jets and turboprops are significant GA noise sources, their noise impacts dominate at many airports.

A critical factor for GA noise is the fact that, in general, background noise levels around GA and most small air carrier airports are lower than the background levels around most large air carrier airports. Accordingly, noise from GA airport operations could be more intrusive on surrounding communities. In addition, the typical small aircraft commonly operated from GA airports are usually the ones which have not yet benefited from the noise-control technology developed for the large commercial aircraft.

It is clear from estimates of GA growth that the FAA's limited actions to date to regulate GA aircraft noise will do very little to prevent a significant increase in noise impact around GA airports. A comprehensive noise-control program is required now.

For these reasons EPA has initiated a study to assess the community noise exposure currently produced by GA operations, and to project this

exposure through the year 2000. This information will form a data base for considering noise-abatement and control actions to protect the public health and welfare from GA noise.

General Aviation Technology For the Future

As indicated above, the fastest growing segment of civil aviation is the small (below 75,000 pounds gross weight) jet-powered aircraft. The first generation of these aircraft were primarily powered by turbojet engines and were relatively noisy. Stimulated by 1969 FAR 36, which applied to all turbojet-powered airplanes as well as transport category airplanes, the development of small, moderate bypass, turbofan engines for business jets was initiated. The first aircraft powered by these engines, the Cessna Citation, was delivered in 1972. Today, this aircraft is still the quietest jet-powered civil aircraft in production. In fact, the Citation is approximately 10 dB below the new Stage 3 requirements. All of the succeeding new-production business jets powered by the moderate-by-pass engines are significantly below the noise levels required by FAR 36 Stage 3.

However, because these aircraft operate out of many smaller suburban airfields contiguous with very quiet residential communities, it is anticipated that they will have to be still quieter in the future.

In 1974, NASA initiated a general aviation turbofan engine program to demonstrate that the technology previously developed for large engines was applicable to small engines. The noise target established for this Quiet, Clean, General Aviation Turbofan (QCGAT) program was 10-20 dB below the FAR 36 Stage 3 levels. Two contractors (AVCO-Lycoming and Airesearch) were funded to produce these experimental engines. The development program was limited because the contractors were required to use an existing core for their engine design. Nevertheless, preliminary results indicate that both contractors surpassed the noise goals.³²

Establishing a challenging noise goal resulted in the demonstration of powerplants for future turbofan-powered general aviation aircraft that can bring about significant reductions in community exposure to aircraft noise.

The continuing growth in the jet-powered business aircraft market has also stimulated the industry to develop advanced engines for new aircraft to be delivered in the early 1980s. These engines,

The continuing growth in the jet-powered business aircraft market has also stimulated the industry to develop advanced engines for new aircraft to be delivered in the early 1980s. These engines, AVCO-Lycoming ALF 502, Airesearch ATF 3, and GE CF 34, are in the 5-10,000-pound thrust class and are medium-to-high-bypass turbofan derivatives of existing engines. The predicted noise levels for aircraft powered by these engines are well below Stage 3. In addition to applications in high-performance general aviation aircraft, these engines are suitable for new commuter aircraft which are likely to be developed in the next decade to service the many smaller communities which are losing carrier service in this era of airline de-regulation.

In 1978, a jointly funded NASA/EPA small-propeller demonstration project was initiated to design, develop, and flight test advanced-design propellers for small general aviation aircraft. The new propellers are to be approximately 5 dB quieter than existing propellers, with no loss in performance. Results from this program are due early this year.

Another recent technology development incorporates bent propeller tips (similar to wing end plates). It has demonstrated up to 5½-dB noise reduction when compared with a similar aircraft using a conventional propeller.³³ Initially demonstrated in an aircraft conversion program, it is currently planned for introduction in new-production aircraft.

Improved airfoil designs and composite-material developments are readily transferable to propeller design. The performance characteristics of various blade shapes and blade loadings that have been incorporated in advanced engine fans and turbines and in advanced wing designs indicate the potential for improved aerodynamic and acoustic performance for future small propeller-powered aircraft.

Another element of the general aviation fleet that needs to be addressed is the expanding civil helicopter market. In recent years, military helicopter requirements have been dramatically reduced and manufacturers are looking more and more to the civil market.

Civil helicopter interior noise and vibration were of so much concern that the early noise research was directed at reducing the transmission of engine, rotor, and gearbox noise into the cabin. As is the case for propeller aircraft, the rotor system is currently the primary source of helicopter noise. Reduced tip speeds and modified blade designs can

bring about lower noise levels. However, the noise-prediction methods for helicopter noise reduction are not as developed or proven as they are for conventional fixed-wing aircraft. Most of the current helicopter noise research activity is related to the development of refined noise-prediction techniques.

MILITARY AIRCRAFT CONTRIBUTION TO NOISE EXPOSURE

Military aircraft operating from purely military bases or from joint-use civil military airports contribute to the national noise exposure. This discussion is limited to the joint-use aspect of the problem.

Population Exposed by Military Operations At Joint-Use Civil/Military Airports

Military aircraft operate into many certificated air carrier airports. The majority of these joint-use airports consist of civil airports that have Air National Guard or Air Force Reserve squadrons stationed at the air field. These joint-use airports have a very wide range in number of air carrier operations. For instance, eight of the airports had no scheduled air carrier operations for 1978 and others are some of the busiest civil airports in the country — Chicago O'Hare, for example. As a result of this diversity in size, the contribution of military aircraft operations to noise exposure is expected to be significant only at the small and medium-sized joint-use airports. However, it is clear that the military contribution to total noise exposure at many of the larger civil airports will become relatively more pronounced as the noise from civil aircraft is reduced.

The Department of Defense has a policy for achieving compatible use of public and private lands in the vicinity of military airfields.³⁴ The policy states that "all reasonable economical and practical measures will be taken to reduce and/or control the generation of noise from flying and flying-related activities." The Secretaries of the Military Departments are instructed to develop Air Installation Compatible Use Zone (AICUZ) programs for each military air installation. The AICUZ programs will study land-use compatibility problems in the vicinity of each air installation and develop solutions, which may include restrictions on land use due to noise characteristics or flight safety. Air Force policy states that the Air

Force will cooperate in land-use compatibility planning at joint-use airports as well as at purely military airports.

In addition, Air Force Regulation 80-36 states that:

"Transport aircraft that the Air Force procures or develops must be designed to comply with civil airworthiness standards when their intended usage is generally consistent with civil operations."

This policy enables the Air Force to:

- a. Take advantage of lower development, production, and operational costs when the civil aircraft design is basically satisfactory for both military and civil use.
- b. Facilitate greater interchangeability of Air Force and civil transport aircraft, to gain maximum airlift capacity and flexibility in emergencies."

The Air Force has been responsive to this policy. For example, the Advanced Tanker aircraft (KC-10) that have recently been procured are similar to their commercial DC-10 counterparts and therefore comply with the FAR 36 Stage 2 civil aircraft noise requirements and are in fact within 1 dB of the Stage 3 levels.

Further, the Air Force has recommended re-engining of the turbojet-powered KC135 tanker. The KC135, predecessor of the commercial 707 transport, is probably the noisiest aircraft in the U.S. In addition to being in the regular Air Force inventory, this aircraft is operated by the Air National Guard (ANG) and the Air Force Reserve (AFR), in many cases from joint-use civil/military airfields. Within the next few years, aircraft noise from joint-use airports may be dominated by Air Force aircraft, which could inhibit the continued use of these airfields to meet the AFR or ANG operational training requirements, unless some remedial action is taken.

In the area of military subsonic trainer or light transport aircraft, there are a variety of general aviation aircraft which meet the FAR 36 Stage 3 requirements that should also satisfy the military operational need. For example, the advanced Falcon 20H, purchased by the Coast Guard to meet their medium-range surveillance requirements, is 2-6 dB below the FAR 36 Stage 3 noise levels.

The EPA has initiated a study to evaluate the existing military contribution to noise exposure at the joint-use airports and to determine its significance as the civil aircraft fleet becomes quieter. If the results of this study show that the military aircraft fleet is a

significant noise source, then further studies with DOD participation may be necessary to determine the best methods for protecting the public health and welfare from military aircraft noise.

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