DRAFT REPORT

ON

REVIEW AND ANALYSIS OF PRESENT AND PLANNED FAA NOISE REGULATORY ACTIONS AND THEIR CONSEQUENCES REGARDING AIRCRAFT AND AIRPORT OPERATIONS

FOR

ENVIRONMENTAL PROTECTION AGENCY
AIRCRAFT/AIRPORT NOISE REPORT STUDY

1 JUNE 1973

TASK GROUP 5

WILLIAM C. SPERRY, CHAIRMAN

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ERRATA SHEET

The Reference and Bibliography page numbers were inadvertantly changed from the original designators. To identify the text reference citations, the following cross reference table is provided. As an example, the text reference 8.5-355 identifies Citation #355 on Page V-R-24 (previously page number 8.5).

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PREFACE

The Noise Control Act of 1972 (Public Law 92-574) directs the Environmental Protection Agency (EPA) to study the adequacy of current and planned regulatory action taken by the Federal Aviation Administration (FAA) in the exercise of FAA authority to abate and control aircraft/airport noise. The study is to be conducted in consultation with appropriate Federal, state and local agencies and interested persons. Further, this study is to include consideration of additional Federal and state authorities and measures available to airports and local governments in controlling aircraft noise. The resulting report is to be submitted to Congress on or before July 27, 1973.

The governing provision of the 1972 Act states:

> "Sec. 7(a). The Administrator, after consultation with appropriate Federal, state, and local agencies and interested persons, shall conduct a study of the (1) adequacy of Federal Aviation Administration flight and operational noise controls; (2) adequacy of noise emission standards on new and existing aircraft, together with recommendations on the retrofitting and phaseout of existing aircraft; (3) implications of identifying and achieving levels of cumulative noise exposure around airports; and (4) additional measures available to airport operators and local governments to control aircraft noise. He shall report on such study to the Committee on Interstate and Foreign Commerce of the House of Representatives and the Committees on Commerce and Public Works of the Senate within nine months after the date of the enactment of this act."

Under Section 7(c) of the Act, not earlier than the date of submission of the report to Congress, the Environmental Protection Agency is to:

> "Submit to the Federal Aviation Administration proposed regulations to provide such control and abatement of aircraft noise and sonic boom (including control and abatement through the exercise of any of the FAA's regulatory authority over air commerce or transportation or over aircraft or airport operations) as EPA determines is necessary to protect the public health and welfare."

The study to develop the Section 7(a) report was carried out through a participatory and consultive process involving a task force. That task force was made up of six task groups. The functions of these six task groups were to:

1. Consider legal and institutional aspects of aircraft and airport noise and the apportionment of authority between Federal, state, and local governments.

2. Consider aircraft and airport operations including monitoring, enforcement, safety, and costs.

3. Consider the characterization of the impact of airport community noise and to develop a cumulative noise exposure measure.

4. Identify noise source abatement technology, including retrofit, and to conduct cost analyses.

5. Review and analyze present and planned FAA noise regulatory actions and their consequences regarding aircraft and airport operations.

6. Consider military aircraft and airport noise and opportunities for reduction of such noise without inhibition of military missions.

The membership of the task force was enlisted by sending letters of invitation to a sampling of organizations intended to constitute a representation of the various sectors of interest. These organizations included other Federal agencies; organizations representing state and local governments, environmental and consumer action groups, professional societies, pilots, air traffic controllers, airport proprietors, airlines, users of general aviation aircraft, and aircraft manufacturers. In addition to the invitation letters, a press release was distributed concerning the study, and additional persons or organizations expressing interest were included into the task force. Written inputs from others, including all citizen noise complaint letters received over the period of the study, were called to the attention of appropriate task group leaders and placed in the public master file for reference.

This report presents the results of the Task Group 5 effort devoted to the investigation of existing and proposed regulatory actions. It also provides a basis for additional regulations as required by Public Law 92-574.

The membership of Task Group 5 was made up of representatives of the Federal Government, airport operators, airlines, airframe manufacturers, general aviation, and environmental groups. The task group met six times in Washington, D.C., during the period February 15, 1973 to June 22, 1973. The members presented information pertinent to the problem of airport noise, presented comments on information supplied by other members, generally discussed the problem and possible solutions, and reviewed and commented on draft reports. EPA requested that all data submitted be

in writing; all documents received are listed under References and Bibliography and are available for inspection in the Airport/Aircraft Study files.

Reference to a specific item in the listing is made by providing the page number and the group acquisition number of the item being referenced. For example, Reference 4.1-56 refers to the document numbered 56 on page 4.1 of the References. Position papers of the task group members are included in Appendix A.

The conclusions and recommendations of this report are the responsibility of the Chairman and are based on the information supplied by task group members and other sources and on consideration of the public health and welfare. The difficult and controversial subjects of the task group assignment precluded complete agreement among task group members. EPA sincerely appreciates the wholehearted efforts that the task group members have put forth, without which this report could not have been prepared.

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INTRODUCTION AND BACKGROUND

The results of the Task Group 2 and 4 studies clearly indicate that the current technology is exceptionally comprehensive and capable of being translated into feasible hardware and flight procedures that would significantly decrease aircraft noise exposure. However, the available technology will not be thoroughly implemented by the manufacturers and operators until they have the necessary incentives. Noise control has been applied over the past 10 years, but essentially only to the extent of preventing the escalation of noise. Much more is needed and can be obtained by hardware and flight operating procedures that are safe and technically practical, and may well be economically reasonable if the costs are shared equitably by the responsible members of the aviation community, the flying public, the noise exposed public, and the taxpayer. All of these elements will benefit in various ways from a less noisy civil aviation system, and likewise, will suffer from a severely limited one.

Regulations are probably the most effective and reliable technique for exploiting the state of the art of noise control at the source (engine and airframe design and modification), at the path (flight operating procedures), and the receiver (airport operating procedures; curfews, restrictions, compatible land use, etc.). However, to reach an optimum balance of noise control and civil aeronautics viability, the regulations must be wisely constructed and enforced.

The purpose of this report is to examine the existing and proposed Federal Aviation Administration (FAA) regulations and to consider their effectiveness in furnishing protection to the public health and welfare and to consider whether they adequately exploit the available technology. This report begins with a review of the legislative history of noise control and briefly identifies the regulatory status of the FAA and relevant noise control actions of several state and local authorities.

The relationships between technology, health and welfare, and regulations are discussed in Section V-2. The results of Task Group 3 are introduced in a qualitative manner and are shown to be necessary in the development of a practical concept for optimizing costs in the protection of the public health and welfare from aircraft noise and sonic boom.

The FAA regulatory and proposed actions are reviewed in considerable depth in Section V-3, and various noise control actions of state and local authorities and the industry are reviewed in Section V-4. The actions are examined in respect to their effectiveness; whether the existing regulations should be modified and whether the proposed actions should be implemented in some form.

A three part plan for the development and implementation of aircraft noise regulations is presented in Section V-5. The plan is designed to permit EPA, FAA, and the airport authorities to work together in a manner that optimally utilizes their special interests and expertise. The objective is to provide incentive to implement all noise control options to the maximum extent feasible and to control the residual noise by compatible land use measures.

General recommendations are presented in Section V-6 for immediate and future FAA and other Federal action. Detailed regulatory proposals will be prepared for the FAA after completion of the report.

LEGISLATIVE EVOLUTION AND DEVELOPMENT

PUBLIC LAW 85-726

The Federal Aviation Act of 1958 (Public Law 85-726) created "...a Federal Aviation Agency, to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety, and to provide for the safe and efficient use of the airspace by both civil and military aircraft, and for other purposes." The FAA, therefore, was created to ensure that civil aviation would be a viable and safe national asset. The Act did not recognize that civil aviation could have any detrimental effects on the public except to be unsafe or uneconomical.

VOLUNTARY ACTIONS

Serious consideration by the aviation community was not given to the control of aircraft noise by regulation until the rapid growth of air commerce in the early 1960's significantly increased community noise exposure near major airports. Tolerance of the noise was strained to the point that large segments of the public objected to the expansion of existing airports or the development of new airports. The aviation community was concerned that aircraft noise, unless it was reduced or effectively controlled, would seriously inhibit the development of new airports necessary to provide badly needed capacity and that air commerce would not realize its full potential of public and private service.

In October 1965, at the request of the President, the Office of Science and Technology sponsored a symposium on the aircraft noise problem, the results of which are presented in Reference 12.1-249. This reference source is commonly referred to as the "Green Book." In his transportation message of March 2, 1966, the President directed that a concerted effort be undertaken by the Federal Government to combat the growing problem of jet aircraft noise in the vicinity of airports. In response, the Office of Science and Technology, in cooperation with the FAA, the National Aeronautics and Space Administration, and the Department of Housing and Urban Development, initiated an Aircraft Noise Alleviation Program. The program was based on implementing specific recommendations contained in the Green Book.

Three governmental committees were established to provide guidance, industry advice, and the means of ensuring interagency cooperation and coordination:

1. The Policy Committee, composed of participating Federal agency and department heads.
2. The Program Evaluation and Development Committee (PEDC), composed of working level members of organizations represented on the Policy Committee, representatives of various aircraft industry organizations, and individual aircraft noise experts participating in an advisory capacity.

3. The Management Committee, composed of working level representatives of participating Federal agencies responsible for the day-to-day conduct and coordination of the program.

One of the recommendations of the Green Book that was emphasized and expanded by the PEDC in Reference 12.1-106 was that certification of aircraft for noise was critical to the solution of the problem. This view was endorsed by the London Conference (12.1-250), and appropriate legislation (which ultimately led to Public Law 90-411) was introduced by the Administration to grant FAA such authority. In September 1966, the FAA Associate Administrator for Development forwarded to industry for comment a concept of noise certification (8.4-251), commonly known as the "Blatt letter." As a result of industry comments on the Blatt letter, and efforts of ad hoc working groups, the concept was refined through a series of drafts, the last of which (sixth revision) was drafted in February 1968, (8.5-252).

In May 1967, a series of tripartite meetings was initiated between representatives of the FAA, the United Kingdom, and France in an attempt to define a mutually acceptable noise certification concept for subsonic aircraft. The goal was to develop a plan of international agreement which could result in the adoption of an essentially identical aircraft noise certification rule in the three countries. The objective included eventual International Civil Aviation Organization (ICAO) adoption and international acceptance. In December 1967, ICAO (12.1-253) indicated its interest in establishing international standards for aircraft noise certification and directed aircraft manufacturing nations to keep ICAO informed as to their progress in developing noise standards.

In October 1967, discussions by the Director of the FAA Office of Noise Abatement (8.5-254) on the advantages and disadvantages of a number of noise certification concepts were forwarded to industry for comment. Industry responded (13.1-255) with a number of suggestions and, as a result, an informal government/industry task force was established to further explore the problems and to recommend the most practical concept of a noise certification rule.

Tripartite discussions in May 1968, developed a concept that adopted effective perceived noise level (EPNL) in units of EPNdB as the measure of subjective response. Also, three points of measurement (approach, takeoff and sideline) were established at which specified noise limits should be met.

In a July 1968 briefing, industry proposed a variation of the same three-point concept and made a strong recommendation for using maximum Perceived Noise Level (PNL) in units of PNdB as the measure of subjective response. After considering and modifying the industry proposals, the FAA issued a Notice of Proposed Rule Making (NPRM) 69-1 (14.2-256) to fulfill the requirements established by the then recently passed Public Law 90-411. The plan of the NPRM was basically that of the tripartite agreement, with modifications to incorporate certain parts of industry proposals or to accommodate valid objections.

PUBLIC LAW 90-411

Public Law 90-411, issued in July 1968, was the first Federal Legislative action directed to the control of aircraft noise and sonic boom. It was generated as the result of pressures on the Administration and Congress by the public who sought relief from noise exposure, and by the industry, who were concerned that their growth potential might be limited. Concurrent with the development of Public Law 90-411, the aviation community (international government and industry without the participation of environmental groups) worked toward developing safe and economical noise control technology and complementary regulatory procedures. Public Law 90-411 required the FAA to prescribe and amend such regulations as the FAA may find necessary to "afford present and future relief and protection to the public from unnecessary aircraft noise and sonic boom." The only constraints on the FAA were that the regulations must be safe, be economical, and be based upon available technology and FAA was the sole judge on whether aircraft noise and sonic boom was unnecessary. Public Law 90-411 did not provide any real environmental incentives or criteria. The only incentive was economical in the sense defined by PL 85-726, that is, "the promotion, encouragement, and the development of civil aeronautics," and if noise interfered with this, then it must be controlled and regulated.

PUBLIC LAW 91-190

The National Environmental Policy Act of 1969 (Public Law 91-190) established a national policy to "...encourage productive and enjoyable harmony between man and his environment; to promote effort which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man;...". While noise was not specifically mentioned, PL 91-190 established the Council of Environmental Quality (CEQ), which chose to consider noise an influence on the quality of the environment.

PUBLIC LAW 91-604

The Noise Pollution and Abatement Act of 1970 (Title IV of Public Law 91-604) directed that "The Administrator shall establish within the Environmental Protection Agency on Office of Noise Abatement and Control, and shall carry out through such Office a full and complete investigation and study of noise and its effect on the public health and welfare in order to (1) identify and classify causes and sources of noise and (2) determine -- "...(D) effects of sporadic extreme noise (such as jet near airports) as compared with constant noise;...(F) effect of sonic booms on property (including values);...". Title IV specifically recognizes aircraft noise and sonic boom as a possible public nuisance that may have a detrimental psychological and physiological effect on the public health and welfare.

PUBLIC LAW 92-574

The Noise Control Act of 1972 (Public Law 92-574) "...declares that it is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health and welfare." Section 7 of PL 92-574 is devoted entirely to aircraft noise and sonic boom and supersedes PL 90-411 by amending Section 611 of the Federal Aviation Act of 1958 to include the concept of "health and welfare" and to define the responsibilities of and interrelationships between the FAA and EPA. Specifically, PL 92-574 requires that "In order to afford present and future relief and

protection to the public health and welfare from aircraft noise and sonic boom, the FAA, after consultation ... with EPA, ... shall prescribe and amend such regulations as the FAA may find necessary to provide for the control and abatement of aircraft noise and sonic boom,...". The regulatory instructions of PL 90-411 are compared with those of PL 92-574 in Figure V-1-1, and it is significant that the latter contains the phrase "health and welfare" and does not contain the word "unnecessary." The full text of Section 611 of the Federal Aviation Act of 1958 is given in Figure V-1-2.

In prescribing and amending standards and regulations, PL 92-574 requires that the FAA shall consider whether any proposed standard or regulation is:

- Consistent with the highest degree of safety in air commerce or air transportation in the public interest;
- Economically reasonable;
- Technologically practicable; and
- Appropriate for the particular type of aircraft, aircraft engine, appliance, or certificate to which it will apply.

The above specifications that must be considered by the FAA in prescribing aircraft noise and sonic boom regulations are identical to those contained in PL 90-411 and form constraints on the regulatory procedures. However, PL 92-574 has introduced a fifth constraint-protection to the public health and welfare.

REGULATORY STATUS OF THE FAA

Based upon the authority and requirements set forth in PL 90-411 and PL 92-574, the FAA has developed and issued regulations, standards, orders, and advisory circulars in its efforts to abate and control aircraft noise and sonic boom.

In the process of prescribing a regulation, the actual issuance of the regulation is preceded by an NPRM, or when more preliminary in nature, an Advance Notice of Proposed Rulemaking (ANPRM). In either case, the public notice is usually preceded by developmental work documented in a project report.

PUBLIC LAW 90-411

IN ORDER TO AFFORD PRESENT AND FUTURE RELIEF AND PROTECTION TO THE PUBLIC FROM *UNNECESSARY* AIRCRAFT NOISE AND SONIC BOOM, THE FAA SHALL PRESCRIBE AND AMEND SUCH REGULATIONS AS THEY MAY FIND NECESSARY TO PROVIDE FOR THE CONTROL AND ABATEMENT OF AIRCRAFT NOISE AND SONIC BOOM.

PUBLIC LAW 92-574 (SUPERSEDES PL 90-411)

IN ORDER TO AFFORD PRESENT AND FUTURE RELIEF AND PROTECTION TO THE PUBLIC *HEALTH AND WELFARE* FROM AIRCRAFT NOISE AND SONIC BOOM, THE FAA, *AFTER CONSULTATION WITH EPA*, SHALL PRESCRIBE AND AMEND SUCH REGULATIONS AS THEY MAY FIND NECESSARY TO PROVIDE FOR THE CONTROL AND ABATEMENT OF AIRCRAFT NOISE AND SONIC BOOM.

Figure V-1-1. Regulatory Instructions Comparison

Section 611: Control And Abatement of Aircraft Noise and Sonic Boom

(a) For purpose of this section:
(1) The term "FAA" means the Administrator of the Federal Aviation Administration.
(2) The term "EPA" means the Administrator of the Environmental Protection Agency.

(b)(1) In order to afford present and future relief and protection to the public health and welfare from aircraft noise and sonic boom, the FAA, after consultation with the Secretary of Transportation and with EPA, shall prescribe and amend standards for the measurement of aircraft noise and sonic boom and shall prescribe and amend such regulations as the FAA may find necessary to provide for the control and abatement of aircraft noise and sonic boom, including the application of such standards and regulations in the issuance, amendment, modification, suspension, or revocation of any certificate authorized by this title. No exemption with respect to any standard or regulation under this section may be granted under any provision of this Act unless the FAA shall have consulted with EPA before such exemption is granted, except that if the FAA determines that safety in air commerce or air transportation requires that such an exemption be granted before EPA can be consulted, the FAA shall consult with EPA as soon as practicable after the exemption is granted.

(2) The FAA shall not issue an original type certificate under section 601(a) of this Act for any aircraft for which substantial noise abatement can be achieved by prescribing standards and regulations in accordance with this section, unless he shall have prescribed standards and regulations in accordance with this section which apply to such aircraft and which protect the public from aircraft noise and sonic boom, consistent with the considerations listed in subsection (d).

(c)(1) Not earlier than the date of submission of the report required by section 7(a) of the Noise Control Act of 1972, EPA shall submit to the FAA proposed regulations to provide such control and abatement of aircraft noise and sonic boom (including control and abatement through the exercise of any of the FAA's regulatory authority over air commerce or transportation or over aircraft or airport operations) as EPA determines is necessary to protect the public health and welfare. The FAA shall consider such proposed regulations submitted by EPA under this paragraph and shall, within thirty days of the date of its submission to the FAA, publish the proposed regulations in a notice of proposed rulemaking. Within sixty days after such publication, the FAA shall commence a hearing at which interested persons shall be afforded an opportunity for oral (as well as written) presentations of data, views, and arguments. Within a reasonable time after the conclusion of such hearing and after consultation with EPA, the FAA shall-

(A) in accordance with subsection (b), prescribe regulations (i) substantially as they were submitted by EPA, or (ii) which are a modification of the proposed regulations submitted by EPA, or

(B) publish in the Federal Register a notice that it is not prescribing and regulation in response to EPA's submission of proposed regulations, together with a detailed explanation providing reasons for the decision not to prescribe such regulations.

(2) If EPA has reason to believe that the FAA's action with respect to a regulation proposed by EPA under paragraph (1)(A)(ii) or (1)(B) of this subsection does not protect the public health and welfare from aircraft noise or sonic boom, consistent with the considerations listed in subsection (d) of this section, EPA shall consult with the FAA and may request the FAA to review, and report to EPA on, the advisability of prescribing the regulation originally proposed by EPA. Any such request shall be published in the Federal Register and shall include a detailed statement of the information on which it is based. The FAA shall complete the review requested and shall report to EPA within such time as EPA specifies in the request, but such time specified may not be less than ninety days from the date the request was made. The FAA's report shall be accompanied by a detailed statement of the FAA's findings and the reasons for the FAA's conclusions; shall indentify any statement filed pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 with respect to such action of the FAA under paragraph (1) of this subsection; and shall specify whether (and where) such statements are available for public inspection. The FAA's report shall be published in the Federal Register, except in a case in which EPA's request proposed specific action to be taken by the FAA, and the FAA's report indicates such action will be taken.

(3) If, in the case of a matter described in paragraph (2) of this subsection with respect to which no statement is required to be filed under such section 102(2)(C), the report of the FAA indicates that the proposed regulations originally submitted by EPA should not be made, then EPA may request the FAA to file a supplemental report, which shall be published in the Federal Register within such a period as EPA may specify (but such time specified shall not be less than ninety days from the date the request was made), and which shall contain a comparison of (A) the environmental effects (including those which cannot be avoided) of the action actually taken by the FAA in response to EPA's proposed regulations, and (B) EPA's proposed regulations.

(d) In prescribing and amending standards and regulations under this section, the FAA shall-
(1) consider relevant available data relating to aircraft noise and sonic boom, including the results of research, development, testing, and evaluation activities conducted pursuant to this Act and the Department of Transportation Act;
(2) consult with such Federal, State, and interstate agencies as he deems appropriate;
(3) consider whether any proposed standard or regulation is consistent with the highest degree of safety in air commerce or air transportation in the public interest;
(4) consider whether any proposed standard or regulation is economically reasonable, technologically practicable, and appropriate for the particular type of aircraft, aircraft engine, appliance, or certificate to which it will apply; and
(5) consider the extent to which such standard or regulation will contribute to carrying out the purposes of this section.

(e) In any action to amend, modify, suspend, or revoke a certificate in which violation of aircraft noise or sonic boom standards or regulations is at issue, the certificate holder shall have the same notice and appeal rights as are contained in section 609, and in any appeal to the National Transportation Safety Board, the Board may amend, modify, or reverse the order of the FAA if it finds that control or abatement of aircraft noise or sonic boom and the public health and welfare do not require the affirmation of such order, or that such order is not consistent with safety in air commerce or air transportation.

Figure V-1-2. Section 611 of the Federal Aviation Act of 1958 as Amended by PL 92-574.

As of this writing, the FAA has issued two regulations:

1. "Federal Aviation Regulation (FAR) Part 36: Noise Standards: Aircraft type Certification" became effective 21 November 1969.

2. "Federal Aviation Regulation (FAR) Part 91: General Operating and Flight Rules: Civil Aircraft Sonic Boom" became effective 23 March 1973.

In addition to these two regulations, the FAA has issued two NPRMs and three ANPRMs that have not yet resulted in regulations as proposed. The notices, the general titles, and the dates of issue are:

1. ANPRM 70-33; Civil Supersonic Aircraft Noise Type Certification Standards, 4 August 1970.

2. ANPRM 70-44; Civil Airplane Noise Reduction Retrofit Requirements, 30 October 1970.

3. NPRM 71-26; Noise Type Certification and Acoustical Change Approvals, 13 September 1971.

4. NPRM 72-19; Newly Produced Airplanes of Older Type Design; Proposed Application of Noise Standards, 25 July 1972.

5. ANPRM 73-3; Civil Airplane Fleet Noise (FNL) Requirements, 24 January 1973.

The FAA has also developed at least three project reports preliminary to the issuance of notice of proposed rulemaking. These project reports constitute part of current FAA developments. Draft version titles and dates for these project reports are:

1. "Amendment to Federal Aviation Regulations to Provide for a Takeoff Noise Control Operating Rule," 21 November 1972.

2. "Noise Certification Rule for Quiet Short Haul Category Aircraft," 29 December 1972.

3. "Propeller Driven Aircraft Noise Type Certification Standards," 22 January 1973.

In addition, the FAA has implemented what is commonly known as the "Keep-'em-High" program. In this program, procedures for controlling the arrival and departure of high performance aircraft are designed to reduce noise exposure levels in addition to reducing the time that IFR aircraft exposed to VFR aircraft at lower altitudes. The FAA issued an Advisory Circular (AC 90-59) on February 1972 making reference to an FAA Order (7110.22A) relating to the air traffic controllers handling of the high performance aircraft.

In an attempt to derive an airport sound descriptor, the FAA has developed a Draft Order (Undated) entitled "Aircraft Sound Description System." This draft order "states policy and establishes the procedures and guidance for the calculation and dissemination of aircraft sound data."

All of the preceding regulations, notices, project reports, and orders are described in detail and reviewed in depth in Section V-3.

NOISE CONTROL ACTIONS OF OTHERS

Effective aircraft noise control actions in the form of regulations, rules, resolutions, specifications and standards by organizations other than the FAA are notably few. Most of those that have been promultaged have been developed in conjunction with the FAA.

The first, established in 1957, by the Port Authority of New York and New Jersey specifies a maximum noise level at specific locations for takeoff operations at the three major airports in the New York City area.

The most noteworthy operative aircraft noise regulation imposed by a state government is that developed and brought into effect on December 1, 1972 by the State of California (15.1-34). This regulation accomplishes its ends by controlling and reducing noise exposure levels, in addition to single event noise levels, in the communities in the vicinity of the airport. This is accomplished principally through

enforcement by the county in which the airport resides and placement of a large portion of the implementation upon the airport proprietor. Recently announced resolutions by the Los Angeles International Airport Board of Commissions (15.2-265) to establish a five-point noise abatement program with airport management enforced regulations and penalties stems directly from the authority and responsibility established under the state aeronautical laws.

Other California airports may be expected to follow the lead provided by Los Angeles International (15.1-64) and the California law relating to aircraft noise is being given consideration by other states.

Another noise control area in which there has been potentially effective rules established is in the area of control of aircraft operating procedures; especially noteworthy are those endorsed and promulgated by the National Business Aircraft Association (NBAA) and the Air Transport Association (ATA) (13.1-150 and 188 and 13.1-266, respectively). Both procedures were developed in conjunction and with the support of the FAA. However, these rules are self-imposed, unenforced, bear no real and direct penalties, and are not endorsed by all of the group membership.

Similar operating rules adopted by the California intrastate aircraft carriers (4.1-267, 268) in response to requirements under the state noise laws are probably more effective because of the airport monitoring and the potential penalties for vilations.

Special aircraft operating rules that have been jointly developed by the airlines and the airports for specific situations have also been promulgated and are in effect on a self-imposed basis (4.1-269, 270).

The preceding specific citations are not to be construed as being either complete or even possibly the best examples; however, they do serve to illustrate the general types of noise control actions being taken by organizations other than the FAA and provide a framework for some of the review, analysis and recommendations in the other sections of this report.

SECTION V-2

TECHNOLOGY, HEALTH AND WELFARE, AND REGULATIONS

NOISE CONTROL OPTIONS

The abatement of aircraft noise is accomplished by exercising one or more of the control options identified in Figure V-2-1. In general, for new designs of any product, the most sensible and preferred approach for noise abatement is to attempt to control the source to the extent that it will be acceptable in any environment. Path and receiver control options should always remain the second and third choices, respectively. For the existing aviation system, however, the older equipment has only minor application of source control technology and the newer equipment, while having substantially more, does not have enough to yield noise levels acceptable in all environments in which they operate. Technology capability for complete control of all aircraft noise at the source is not yet available and lies somewhere in the future, perhaps the far distant future. The solution, therefore, is to implement the source, path, and receiver control options concurrently, each to the extent feasible, and, finally, to contain the remainder of the noise within noise compatible boundaries. Figure V-2-1 is intended to represent a flow diagram of the four options capable of independent, but concurrent, implementation.

SOURCE CONTROLS

Source control options are the result of the scientific and engineering capability of the airframe and engine manufacturers and those shown in Figure V-2-1 are intended to be significant examples of current technology and not necessarily a complete list. The null or "do nothing case" is included as a baseline for economic evaluations, assuming that even if no source control option is utilized, costs would still accrue as a result of public hostility being translated into higher airport fees, curfews, restrictions, etc. The fleet replacement case is included as the upper boundary for

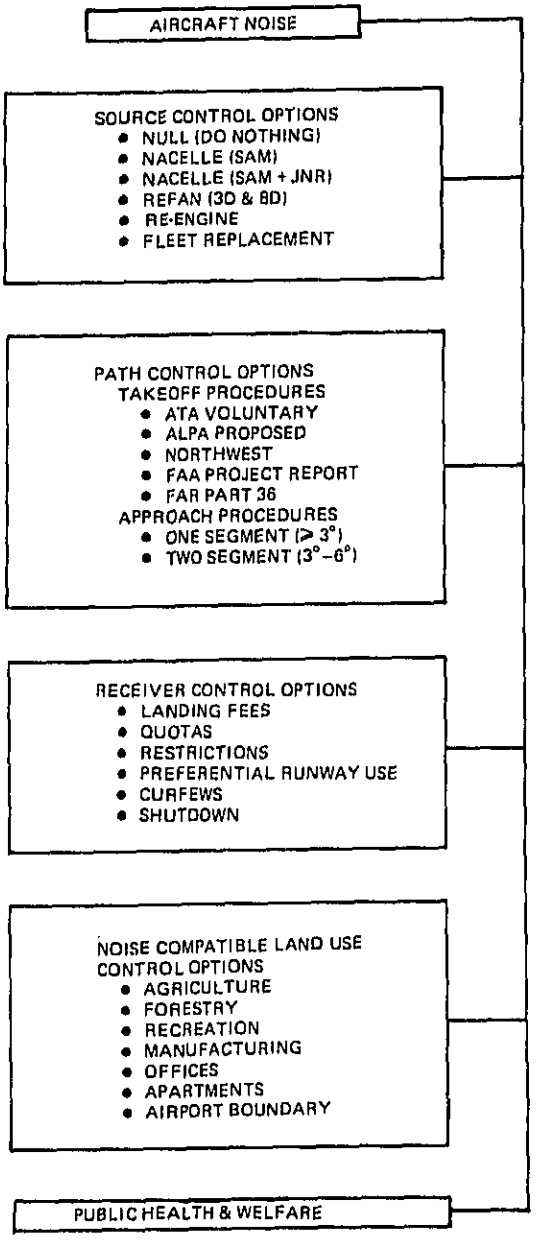

Figure V-2-1. Aircraft Noise Control Options.

economic evaluations of current technology by assuming that replacing all turbojet and low-bypass ratio turbofan propelled aircraft by the latest technology high-bypass turbofan propelled aircraft would be more costly than any of the intermediate source control options. Also the fleet replacement option can be considered to represent future technology applied to aircraft not yet designed and would include such design features as higher thrust/weight ratios than those of present conventional aircraft.

The nacelle (SAM) and (SAM + JNR) options represent the nacelle retrofit technology with "sound absorption material" and "sound absorption material plus jet noise reducer," respectively, developed for FAA by Boeing and McDonnell Douglas. The refan options represent the modified fan engine and nacelle technology under development for NASA by Partt and Whitney, Boeing, and McDonnell Douglas and are intended to include both the JT3D and JT8D engines for consideration, both of which are assumed to include SAM. The re-engine options represent the "quiet engine" technology developed for NASA by General Electric both with and without the SAM developed by Boeing. The NASA "quiet engine" is not considered seriously for retrofit but should be considered available technology for future aircraft. Also the re-engine options are intended to include the replacement of turbojet with turbofan engines, especially for the business jet category.

PATH CONTROLS

Path control options are dependent to a great extent upon aircraft operator (airlines and general aviation) and pilot willingness to fully exploit all available operational capability of their aircraft. The options shown in Figure V-2-1 are examples of current technology and not necessarily a complete list. However, the responsibility for implementing these options must be shared by the Federal Government (FAA) because of its authority over and control of approach and departure rates, patterns, and guidance and surveillance equipment. Some of the more sophisticated path control options would require the installation of new electronic guidance equipment at the airports (Government responsibility) and compatible equipment in the aircraft (operator responsibility) because the highest degree of safety must be maintained.

RECEIVER CONTROLS

The receiver control options are generally the responsibility of the airport operator with some exceptions that are shared with or can be overruled by the Federal Government (e.g., preferential runway use, bilateral agreements, interstate commerce). It is apparent that the airport operator, if sufficiently motivated and with adequate legal authority, has the tools to control the noise to any required level.

LAND USE CONTROLS

The noise compatible land use control options shown in Figure V-2-1 are far easier exercised in the development of new airports than as remedial measures for existing noise impacted airport communities. For the latter case, the costs for land use control alone are so high that maximum effort must be devoted to implementing the source, path, and receiver control options. The responsibility for exercising land use control options are shared by the airport operators and the Federal, state, and local governments depending upon the size of the noise impacted areas and the political jurisdictions that control its welfare.

PUBLIC HEALTH AND WELFARE

The flow diagram of Figure V-2-1 represents four sets of control options protecting the public health and welfare from aircraft noise. The extent to which the control options must be utilized is dependent upon the meaning and quantification of public health and welfare. Until the advent of Public Law 92-574, the motivation for exploiting the technology control options (source and path) was limited by the constraints on the FAA noise abatement regulatory procedures delineated in Public Law 90-411. That is, in prescribing and amending standards and regulations, the FAA shall consider whether any proposed standard or regulation is consistent with the highest degree of safety and whether any proposed standard or regulation is economically reasonable, technologically practicable, and appropriate for the particular type of aircraft to which they apply. The Noise Control Act of 1972 (PL 92-574), however,

has added an additional constraint: protection to the public health and welfare. This additional constraint has not yet been quantified and, consequently, is difficult to apply in judgments and evaluations of the adequacy of the FAA flight and operational noise controls and adequacy of noise emission standards on new and existing aircraft.

Although the former constraints were essentially safety, economics, and technology, some degree of public health and welfare has been considered. The basic noise evaluation measure, Effective Perceived Noise Level (EPNL) in units of EPNdB was developed after extensive experimentation and analysis was devoted to psychoacoustic effects of noise on human beings (e.g., loudness; annoyance, intrusiveness). The widely used noise exposure measure, Noise Exposure Forecast (NEF), is another example of psychoacoustic consideration. Physiological effects of noise on human beings and other ecological systems, such as temporary and permanent threshold shift (hearing loss), cardiovascular damage, fetal impairment, must now be considered. And the functional degradation effects of noise (speech interference, signal masking, etc.) must also be examined. Detailed investigations are being conducted under the sponsorship of EPA, and the concept of public health and welfare will ultimately be quantified. Also, the Task Group 3 report contains recommendations specifically for the use in this report.

Several definitions and quotations useful for a qualitative understanding of public health and welfare follow.

1. "In law, the suspect is innocent until his guilt has been proven beyond a reasonable doubt. In the protection of human health, such absolute proof often comes late. To wait for it is to invite disaster, or at least to suffer unnecessarily through long periods of time." W. H. Stewart, Noise as a Public Health Hazard, Proceedings of the Conference, ASHA Report No. 4, February 1969.

2. "Health. A state of physical, mental, and social well being, and not merely the absence of disease or infirmity." The Noise Around Us, Findings and

Recommendations, Report of the Panel on Noise Abatement, U.S. Department of Commerce Publication, September 1970. (Note: this is the World Health Organization definition.)

3. "All language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation as well as effects on economic values and on personal comfort and well-being." Clean Air Act of 1970, PL 91-604, Title IV - Noise Pollution.

4. "Public health and welfare includes not only all direct effects upon human health but also any effects upon personal comfort and well being, and upon economic values, materials and property, animals, wildlife and any other ecological components." Noise Program Work Plans, EPA Office of Noise Abatement and Control, 10 November 1972.

Two important points must be clearly understood. First, the FAA regulations have two sets of constraints, the first one pertaining to safety, economics, and technology and the second pertaining to protection of the public health and welfare. The point is that the second set of constraints does not necessarily override the first. The second point is that aviation is a national asset and that ill conceived regulations, purportedly designed to protect the public health and welfare, might actually endanger the public welfare if they would result in destroying, seriously crippling, or severely limiting the viability of the national aviation system. On the other hand, well conceived regulations, while protecting the public health and welfare directly, might actually accelerate the development of aviation by minimizing public hostility.

Possible effects of noise on human beings and other ecological systems that must be considered in developing a quantitative measure defining protection to the public health and welfare from aircraft noise and sonic boom are listed in Figure V-2-2. This is not meant to be an all-inclusive list nor is it intended to imply that all of the items are significantly affected by the levels of noise exposure found in typical noise

- PSYCHOLOGICAL
  - LOUDNESS
  - ANNOYANCE
  - INTRUSIVENESS
  - FRUSTRATION
- PHYSIOLOGICAL
  - HEARING LOSS
  - NERVOUSNESS
  - ETC.
- FUNCTIONAL INTERFERENCE
  - SPEECH
  - SIGNALING
  - SLEEP
- ECOLOGICAL DEGRADATION
  - SOIL
  - WATER
  - CROPS
  - ANIMALS
  - ETC.
- FINANCIAL LOSS
  - PROPERTY
  - INCOME
  - ETC.

Figure V-2-2. Considerations in Defining Protection to Public Health and Welfare

impacted communities. Figure V-2-2 is simply an itemized listing of some of the characteristics affecting the quality of life that could conceivably be influenced by aircraft noise and sonic boom exposure.

The results of the Task Group 3 study will include the recommendation of a measure and the methodology for determining the limiting cumulative noise exposure for human beings over a 24-hour period. The measure can be represented by a curve such as shown qualitatively in Figure V-2-3. However, the Task Group 3 data will be quantitative in the sense that there will be numerical scales, and the recommendations will include specific values such as defined by point A in Figure V-2-3. The noise control options listed in Figure V-2-1 cannot be properly exercised until such a pair of numbers as defined by point A are chosen.

METHODS OF EXPLOITING TECHNOLOGY

The following discussion is based upon the assumption that a decision will be made by an appropriate Federal Government body supported by the scientific community on the choice of point A in Figure V-2-3.

The flow diagram in Figure V-2-4 represents public health and welfare protected from aircraft noise and sonic boom by all four of the noise control options shown in Figure V-2-1. The methods for exploiting the noise control options are designated as public service, incentives, and regulations, all of which are applicable to manufacturers of the airframe and engines, the operators of airlines and business and other general aviation aircraft, and also to the airport operators and political jurisdictions of the airport neighborhood communities.

Public service as a method for exploiting noise control is meant to imply that the corporate management must accept the concept that the aviation community is not exempt from providing environmental protection and must be willing to volunteer effort to that end. Also public service is meant to imply that communities, citizens' groups, environmentalists, and individuals must accept that aviation is a national asset and that their welfare may be dependent upon, to a considerable extent, a viable national aviation system.

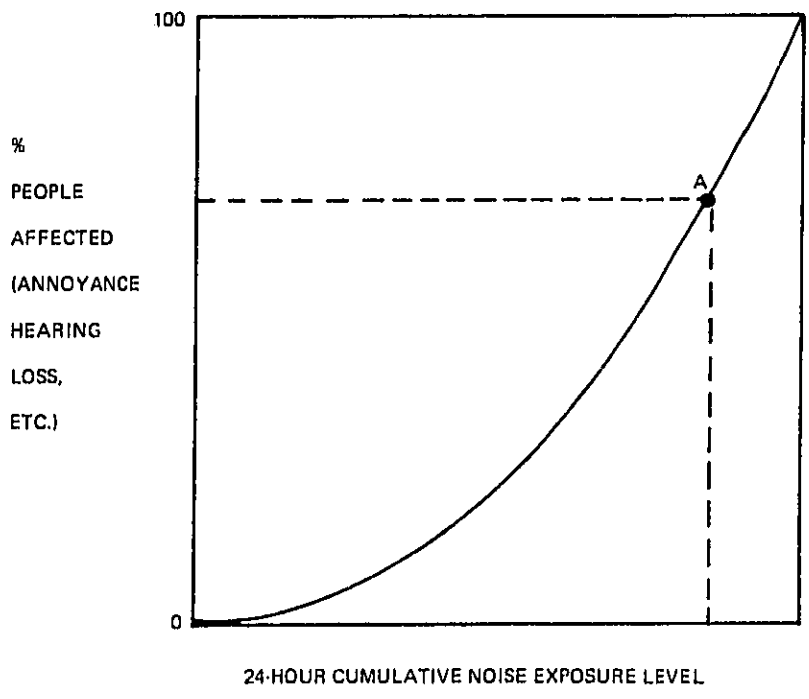

Figure V-2-3. Generalized Curve for Determining Limiting Cumulative Noise Level For the Protection of Public Health and Welfare

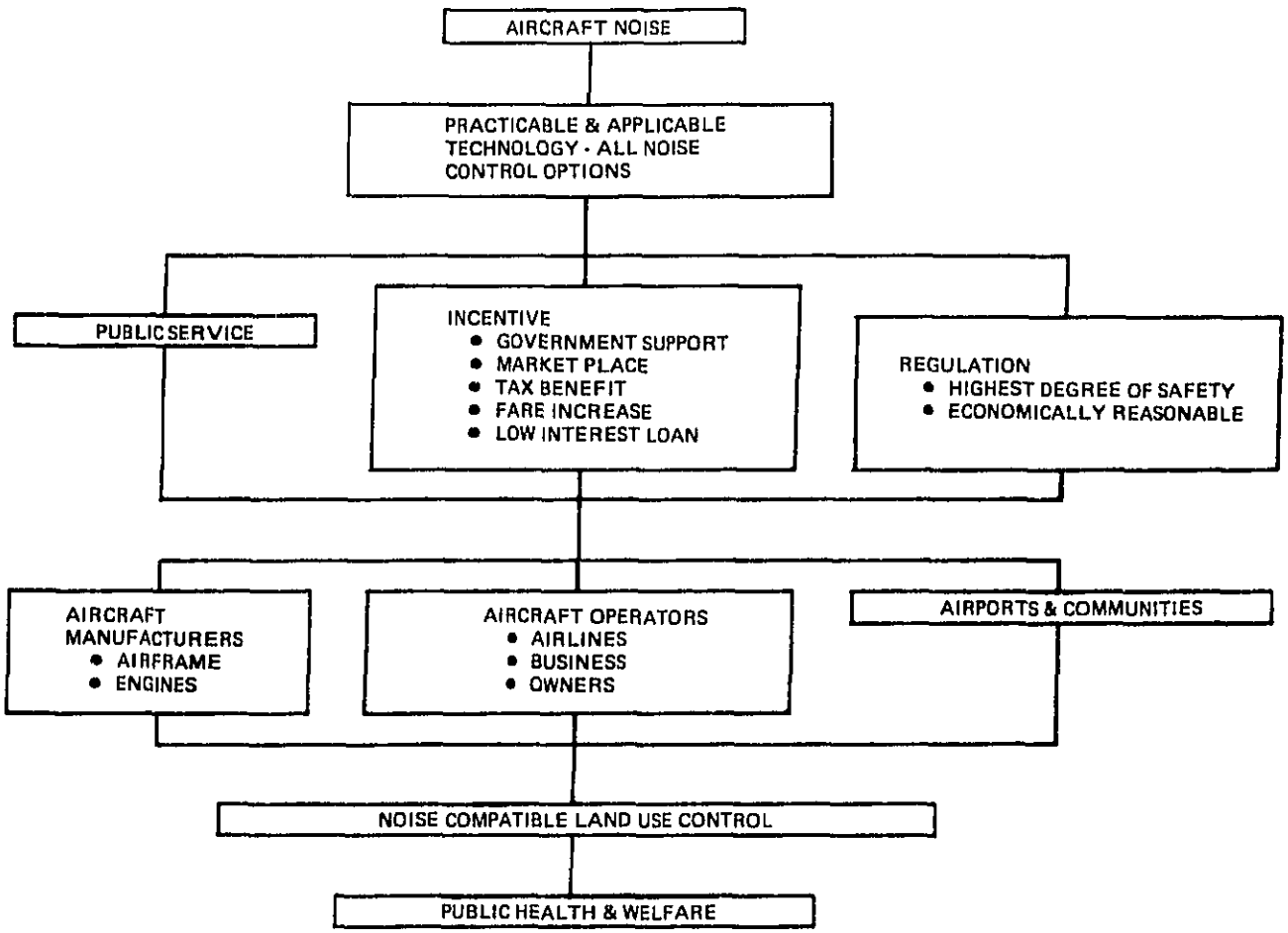

Figure V-2-4. Exploitation of Source Control Options.

Incentive as a method for exploiting noise control includes the usual ideas of competition, tax relief, fare increases, low interest loans, etc., which may be dependent upon some sort of government support, generally of an implicit nature. The term "Government Support" as used in Figure V-2-4, however, is meant to imply more direct or explicit assistance, such as the design, development, and installation of guidance, surveillance and navigational equipment necessary to safely implement noise abatement operating procedures. Also, the Government should maintain a continuing high level support for noise abatement research and development.

Regulation as a technique for exploiting noise control possibilities is probably the most effective of the three presented in Figure V-2-4. They must, however, be carefully developed to assure that the control options conform to the highest degree of safety and are economically reasonable in both installation and application.

After all the practicable and applicable noise control options have been adequately exploited, and if the noise exposure at any airport neighborhood community exceeds the level designated as the limit for protection to the public health and welfare (point A in Figure V-2-3), then the only recourse is to exercise noise-compatible land use control measures. For new airport developments, the costs of land use control only may be reasonable, but for some existing noise impacted airport communities, the costs may be astronomical unless the source, path, and receiver control options are exploited to the optimum.

Figure V-2-5 represents an airport surrounded by noise exposure contours intended to represent the extremes of noise control, that is, do nothing and maximum feasible. The interior area represents the residue of noise exposure that must be controlled in order to protect the public health and welfare. Obviously, the ideal case would be for the inner contour to lie within the airport boundary, thus representing optimum noise compatible land use control.

Figure V-2-6 presents a qualitative example of the need to fully exercise the source, path, and receiver control options in order to minimize the cost (to the entire aviation community, the airport neighborhood communities, and the tax payer) that

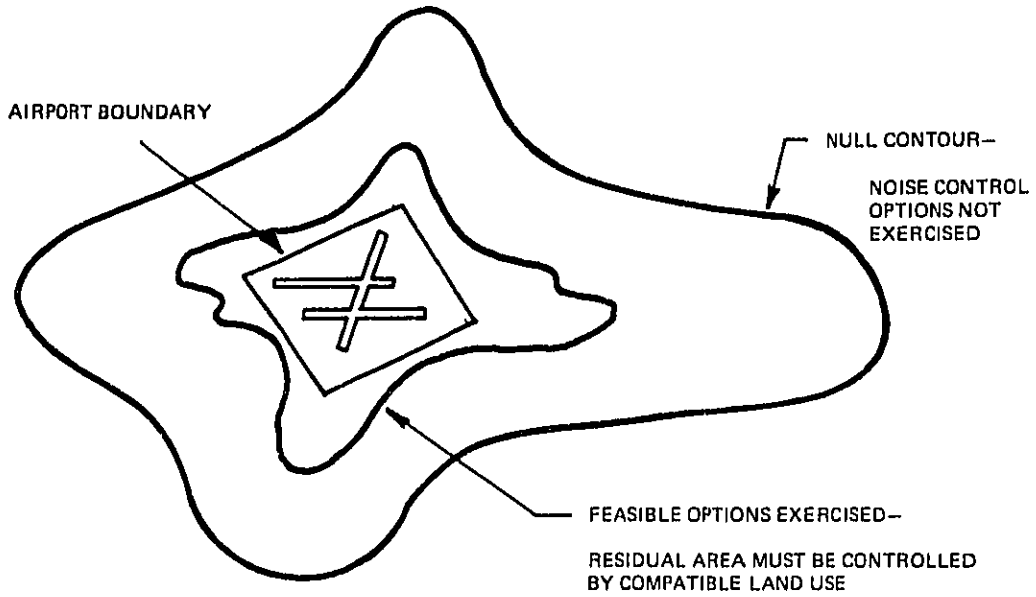

Figure V-2-5. Noise Exposure Contours for Levels Representing Various Options

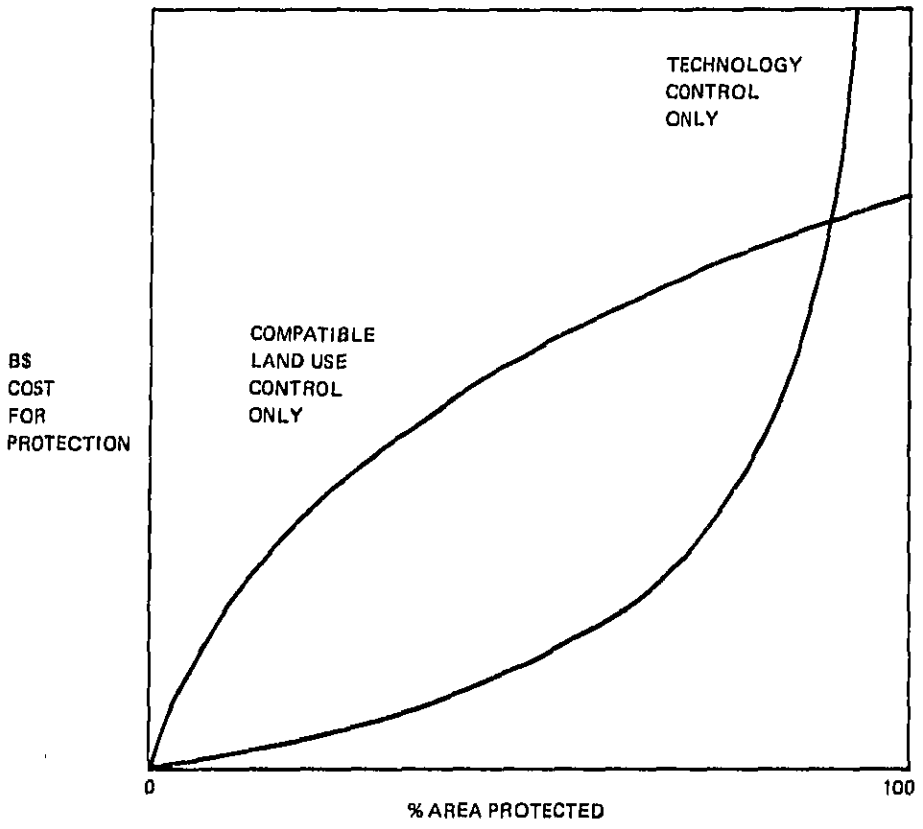

Figure V-2-6. Qualitative Cost Comparison Between Technology & Land Use Noise Control

would accrue in providing protection to the public health and welfare from aircraft noise. The land use curve represents the costs for the null case, in which the source and path (technology) noise control options were not exercised and the protection to the public health and welfare was accomplished solely by land use control. While it is possible for 100 percent of the area to be protected, or controlled, by noise compatible land use, the ultimate costs would be high. The technology curve represents the other extreme, where no effort was made to implement land use control, and protection is accomplished solely by the technology control options. Initially, technology is effective. Considerable area reduction results from small cost compared to land use control. Ultimately, however, the technology costs become excessive and the technology options never do achieve the objective of 100 percent protection.

The solution to the problem is to determine, by cost-effectiveness studies, the optimum balance of costs for protection among the various options. Section IV-4 of the Task Group 4 report includes the results of such studies.

REGULATIONS

The concept of protection to the public health and welfare is capable of broad interpretation, depending upon the interests of the public and the specific threat against their health and welfare. The necessity for public protection is clearly obvious for such potential hazards as explosives, nuclear fuel, poisons, and high-speed transportation, which, if uncontrolled, can have an immediate and cataclysmic effect upon the public. For these potential hazards, there are Federal, state, and local regulations designed for public protection, and there is general acceptance of their need.

There is, however, controversy, even for the most fearful hazards, as to the extent of protection the regulations must require. Assuming these potential hazards (explosions, radiation, etc.), in a controlled form, are necessary and beneficial to the public, the controversy is not simply a conflict between good and evil. Instead, the issue is usually between segments of the public without a vested interest in the source of the hazard who want 100 percent protection and other segments of the public

with a vested interest in the source but who cannot afford the cost of absolute safety. In general, 100 percent safety or protection is an unreachable goal, and the issues must be resolved by regulations that provide protection to the public to a degree at least commensurate with their other environmental influences.

In the case of degrading environmental influences that are not usually considered fearful hazards, the controversies over the stringency of regulations, or even whether regulations are necessary, are more complex and less easily reconciled. The fact that a degrading environmental influence does not cause immediate noticeable and irreversible damage, does not mean that it is not a health hazard after long exposure. On the contrary, degrading environmental influences may be more of an ultimate threat to the public health and welfare than the more obvious hazards because they tend to be overlooked or neglected, and hence, not adequately controlled or regulated.

Aircraft noise, at the least, is a degrading environmental influence and PL 92-574 requires that regulations be prescribed for its control. But the breadth and strictness of these regulations will be governed by judgments of the extent to which aircraft noise is capable of being a hazard to the public health and welfare. How should this judgment be made? How much protection is necessary? Segments of the public without a vested interest in aviation want maximum regulatory protection while other segments of the public with a vested interest want considerably less. The decision must and will be made by the Government. But which Agency, EPA or FAA, should have the major responsibility for the health and welfare aspects of aircraft noise regulations?

The Environmental Protection Agency has sole responsibility for the control of all noise sources except aircraft, and has begun extensive effort on the determination of the effects of noise from all sources on man and other ecological systems. The EPA studies will be comprehensive and will ultimately consider all possible health and welfare effects (psychological, physiological, functional, etc.) such as indicated in Figure IV-2-2. Although aircraft have noise signatures composed of unique spectral, temporal, and frequency and amplitude modulation characteristics compared with other noise sources, they are not a truly independent source in most airport neighborhood communities. In many cases, aircraft are the major sources of noise, but their

environmental effects must be considered along with those of other kinds of sources and the evaluation measures must be capable of application to all. No other Government agency has the responsibility for, nor is attempting the development of, criteria and evaluation measures applicable to all noise sources.

The Air Force, FAA, and NASA have been responsible for the development of most of the existing information on human response to aircraft noise. Other segments of the aviation community, mostly the airframe and engine manufacturers, have made substantial contributions as well. This work has been invaluable and more extensive than that produced by all other sections of the national economy combined. However, the effort by the aviation community has been devoted principally to psychological and sociometric studies, and it appears that the aviation community is convinced that aircraft noise exposure is basically an annoyance phenomena. This supposition may be true, but it is necessary that, in order to protect the public health and welfare, thorough investigations of other effects (such as shown in Figure V-2-2) must be conducted, criteria must be established, and evaluation measures must be developed that are suitable for all noise sources, either singly or combined. Noise must be investigated as to its capability of being an authentic health hazard, both for short and long term exposures.

SECTION V-3

REVIEW OF FAA REGULATORY STATUS

The Federal Aviation Act of 1958 created the FAA for the promotion, encouragement, and development of civil aeronautics and to ensure that civil aeronautics would be a safe and viable national asset. Although subsequent legislation dealt with environmental quality and noise, it was not until PL 92-574 that the FAA had any really definite guidelines for noise control that would indicate that the original purpose of PL 85-726 would not be compromised by noise control actions. Despite the lack of criteria, the FAA has devoted substantial effort to the necessary technological, economic, and legal background support required to prescribe regulations that prevent the escalation of aircraft noise and sonic boom. In addition, the FAA has other proposed regulatory actions that, if properly implemented, will make a significant contribution to the reduction of aircraft noise exposure in the airport neighborhood communities.

REGULATIONS

NOISE STANDARDS: AIRCRAFT TYPE CERTIFICATION — FAR PART 36

FAR Part 36, issued on 3 November 1969 as a new part to the Federal Aviation Regulations, was based upon NPRM 69-1, issued on 3 January 1969. FAR Part 36 prescribes noise standards for the issue of type certificates, and changes to those certificates, for subsonic transport category airplanes, and for subsonic turbojet powered airplanes regardless of category. This regulation initiated the noise abatement regulatory program of the FAA under the statutory authority of PL 90-411.

FAR Part 36 makes a significant contribution in the form of three appendixes that have come to be used as standards or recommended practices in the measurement and

evaluation of aircraft noise. Appendix A of FAR Part 36 prescribes the conditions under which noise type certification tests must be conducted and the measurement procedures that must be used to measure the noise made by the aircraft for which the test is conducted. Appendix B prescribes the procedures that must be used to determine the noise evaluation quantity designated as effective perceived noise level (EPNL). Appendix C of FAR Part 36 provides the noise levels, noise measuring points, and airplane test conditions for which compliance must be shown with noise levels measured and evaluated as prescribed, respectively, by Appendixes A and B.

A qualification or limitation statement is included in FAR Part 36: "...the noise levels in this part have been determined to be as low as is economically reasonable, technologically practicable, and appropriate to the type of aircraft to which they apply. No determination is made, under this part, that these noise levels are or should be acceptable or unacceptable for the operation at, into, or out of, any airport." The statement, therefore, implies that the regulatory constraints of PL 90-411 were maintained in the development of FAR Part 36, to protect the aircraft industry without consideration of the airport operator. In addition, the preamble states: "Under the... statutory constraints, socially acceptable noise levels can only be required insofar as they involve economically reasonable burdens on the aircraft industry and are technologically practicable." This statement clearly supports the previous contention that the FAA interpretation of PL 90-411 is that "economically reasonable" applies to the industrial segment of the aviation community and not the airport operator who must, apparently, fend for himself. As final support for this contention, the preamble states "...the actual noise generated at a given airport in operation is not a question for type certification, but involves the right of airport proprietors to limit the permissible levels of noise that can be created by aircraft using the airport. If further noise reduction must be achieved at a given airport, the judicial decisions and legislative history of Public Law 90-411 have made it clear that this is a matter for the airport proprietor."

Regardless of whether the FAA feels more responsibility for protecting the aircraft industry than satisfying the airport in promulgating noise regulations, the purpose of FAR Part 36 as stated in the preamble ("... the purpose of this rule is to prevent, at the earliest possible date, any escalation of aircraft noise,...) is worthy and results to date indicate success. Also, the preamble states: "Further noise reduction will be required as the technology of noise abatement progresses." FAR Part 36 is a major technological achievement that is flexible and capable of being adjusted to conform to any statutory requirements. It is an excellent first step.

CIVIL AIRCRAFT SONIC BOOM — FAR Part 91.55

Part 91.55, issued on 23 March 1973 as a new section to Part 91 of the Federal Aviation Regulations, was based upon NPRM 70-16, issued on 10 April 1970. The purpose of this rule is to afford the public protection from civil aircraft sonic boom by prohibiting supersonic flights of civil aircraft, except under terms of an authorization to exceed Mach 1.

The rule is explicit and should be effective in protecting the public health and welfare from routine sonic boom exposure. Civil aircraft, however, may obtain authorization to operate at a true flight Mach number greater than unity over a designated test area, for limited special test purposes including:

- Compliance with airworthiness requirements.
- Determining sonic boom characteristics.
- Determining conditions under which speeds greater than a true flight Mach number of unity will not cause a measurable sonic boom overpressure to reach the surface.

Authorization for a flight outside of a designated test area at supersonic speeds may be made if the applicant can show conservatively that the flight will not cause a measurable sonic boom overpressure to reach the surface.

NOTICES AND ADVANCE NOTICES

CIVIL SUPERSONIC AIRCRAFT NOISE TYPE CERTIFICATION STANDARDS — ANPRM 70-33

This advance notice, issued on 4 August 1970, announces that the FAA is considering rule making to establish noise standards for the type certification of civil supersonic aircraft. The stated reason for an advance notice is that it would be helpful to invite early public participation in the identification and selection of tentative alternate courses of action. The preamble to FAR Part 36 (which is currently limited to the noise type certification of subsonic airplanes) stated that additional rule making concerning the noise type certification of supersonic airplanes would be proposed. This advance notice is the first step in implementing this objective.

The notice solicits public comment on a number of issues and problems and does not include suggestions or recommendations although the claim is made that much research has been done, that is: "It should be noted that much research has been done within the Office of the Secretary of Transportation and the Federal Aviation Administration to identify the best possible regulatory approach to the type certification of supersonic aircraft, and to insure that this new generation of aircraft is developed in a manner that is compatible with the total environmental objectives of the Department."

The Boeing Commercial Airplane Group, as well as others, at the fourth meeting of Task Group 5 indicated that:

1. The noise levels specified in the current FAR Part 36 (29 November 1969) would be appropriate for application to any future SST designs.
2. The three-point measurement concept used in the current FAR Part 36 should be maintained.
3. The terminal operating characteristics of a supersonic type aircraft are, and probably will be, significantly different from conventional, subsonic aircraft characteristics. Due to this essentially different design feature, the noise regulations would require greater flexibility than the current rules allow in the takeoff and landing procedures.

In view of (3), above, they also suggested that the noise standards for the supersonic transport type aircraft be a separate section of the Federal Aviation Regulations.

Boeing also suggested, in Reference 3.5-178, that "An aircraft whose application for certification predates the creation of certification standards should be certified at its initial production noise level, but only after demonstrating that it incorporates the full noise reduction technology that was economically reasonable and appropriate at the time of its proposed certification."

The Anglo-French Concorde is the only supersonic transport for which there is an FAA application for certification at this time and it was submitted prior to the establishment of noise certification standards for new aircraft.

CIVIL AIRPLANE NOISE REDUCTION RETROFIT REQUIREMENTS — ANPRM 70-44

This advance notice, issued on 30 October 1970, announces that the FAA is considering rule making to establish noise reduction requirements that would involve modification (retrofit) of currently type certificated subsonic turbofan engine powered airplanes, regardless of category, as a condition to further operation of these airplanes. Two reasons are given for the need for noise reduction retrofit:

1. "The first reason is the obvious public need for relief. It was the noise of current fleet of aircraft that, in large part, led to the enactment of Public Law 90-411 and with respect to which the public need for protection is clearly the most urgent. The near-total noise saturation of hundreds of airport neighborhoods has been well documented and needs no further elaboration other than to restate the FAA's commitments to using every legal regulatory technique at its disposal to reduce the noise impact of aircraft through source noise reduction."

2. "The second reason for an agressive noise reduction retrofit program is that the noise of the current fleet of aircraft is a deterrent to the development of new airports, the extension of existing runways, and the continued full use of the airport system in the United States. The airport system is a vital

national asset and its health directly affects the health of the entire air transportation system. The FAA, therefore, regards an effective noise reduction retrofit regulatory program as being necessary in the broad public and national interest not only because of the relief it will bring to airport neighbors under Public Law 90-411 and the National Environmental Policy Act of 1969, but also because aircraft noise reduction retrofit is directly related to the further promotion, encouragement, and development of civil aeronautics."

The above quoted reasons clearly indicate FAA awareness that the public needs protection from noise and that the growth of aviation will be inhibited unless noise reduction is accomplished. Furthermore, the FAA believes that current technology is available for a feasible retrofit program: "In summary, research and development done to date has demonstrated that the basic concepts of noise suppression of turbofan engines are valid acoustically, and that materials and fabrication technologies may be developed to translate these concepts into hardware that could provide economically reasonable and technologically practicable means of significantly reducing the noise generated by certain currently certificated turbofan powered airplanes."

NOISE TYPE CERTIFICATION AND ACOUSTICAL CHANGE APPROVALS — NPRM 71-26

This notice, issued on 13 September 1971, announces that the FAA proposes to amend FAR Part 36 to require altitude and temperature accountability for the test conditions, to strengthen the test conditions for acoustical change approvals, and to make miscellaneous amendments to the appendixes. This proposed regulation would correct the following deficiencies in FAR Part 36:

- FAR Part 36 now permits compliance to be shown for one specific sea level condition only, without altitude and temperature accountability. This permits the airplane to be approved on the basis that it meets the noise levels of Appendix C of FAR Part 36 under a specific reference day sea level condition even though compliance with those noise limits may not be achievable under other conditions of altitude and temperature.

- The absence of temperature and altitude accountability permits approval of an acoustical change upon a showing that the aircraft after a change in type design is no noisier than the aircraft prior to the change under a specific reference day sea level condition, even though such a showing has not been made throughout the altitude and temperature conditions approved for the aircraft.
- Miscellaneous features in the appendixes tend to be confusing and misleading without specific interpretations by the certificating authorities.

NEWLY PRODUCED AIRPLANES OF OLDER TYPE DESIGN, PROPOSED APPLICATION OF NOISE STANDARDS — NPRM 72-19.

This notice, issued on 7 July 1972, announces that the FAA proposes to issue regulations requiring new production turbojet and transport category airplanes to comply with the noise standards of Appendix C of FAR Part 36, irrespective of type certification date.

FAR Part 36 currently applies specific noise standards only to airplanes type certificated on or after the 1 December 1969 effective date. The only current regulatory impact of Part 36 on airplanes type certificated prior to that date (and do not meet the specified noise limits) is the acoustical change provision, which prohibits changing the type design of those airplanes so as to result in further escalation of noise.

This proposed regulation would merely establish dates (1 July 1973 for airplanes with maximum weights of more than 75,000 pounds and 1 July 1974 for airplanes with maximum weights of 75,000 pounds or less) for which new production airplanes must comply with Appendix C of FAR Part 36. The stated purpose is: "... to address the separate question whether the older generation of airplane types whould continue to be manufactured, and added to the fleet, with noise levels higher than required for new type designs under Part 36."

CIVIL AIRPLANE FLEET NOISE LEVEL (FNL) REQUIREMENTS — ANPRM 73-3.

This advance notice, issued on 24 January 1973, announces that the FAA is considering proposing the adoption of regulations that would prevent escalation of fleet noise levels (FNL), would require a reduction in FNL on or before 1 July 1976, and would require airplanes to comply with FAR Part 36 on or after 1 July 1978. The proposal would apply to aircraft operated in interstate commerce by air carriers, supplemental air carriers, and commercial and air taxi operators operating turbojet powered airplanes with maximum weights of 75,000 pounds or greater. The proposal would not apply to airplanes engaged in foreign air commerce and airplanes operated in overseas air commerce.

The major elements of the FNL concept are:

1. Determining the noise levels for each airplane in the fleet.
2. Determining the total number of operations (takeoffs and landings), for each airplane type for a representative 90-day period.
3. Calculating a fleet noise level based on a mean logarithmic equation.
4. Establishing a precise limit on fleet noise levels.

Beginning on its effective date, the impact of the rule would be to immediately "freeze", and prevent any further escalation of, the FNLs that are now being generated and to achieve a positive FNL reduction on and after 1 July 1976. This would be done by:

1. Requiring each operator to submit the data information necessary to establish the FNLs actually generated by the operator during a representative 90 consecutive days during the 12 months preceding the date of the rule.
2. The FAA determination of the initial FNLs.
3. Requiring that the initial FNLs not be exceeded.

Beginning on 1 July 1976, the rule would require that the FNLs originally established for each operator would be required to be reduced to a level that is halfway between the original level and the level that would exist if each airplane covered by this proposal was type certificated under FAR Part 36.

Beginning on 1 July 1978, the FNL concept would expire. In its place, the regulation would require each operator to restrict all of his operations covered by this proposal to airplanes type certificated under Part 36, Appendix C.

This advance notice was published after consideration of comments received in response to ANPRM 70-44, Civil Airplane Noise Reduction Retrofit Requirements. The responses to that advance notice were categorized in three basic groups:

1. City and State governmental authorities
2. Foreign states and manufacturers
3. Domestic industry groups and associations.

The members of the first group almost unanimously support the early implementation of retrofit requirements. However, the FAA states: "...the responses do not address the technological practicability or economic reasonableness of early implementation."

The members of the foreign group expressed the opinion that any retrofit requirements should be developed in the international forum. The advance notice 73-3 states: "The FAA supports the concept that it is desirable to obtain uniformity of regulatory action through the ICAO procedure, and, ... is working in support of that international effort. Accordingly, this FNL proposal would supplement the establishment of international standards, while providing early relief to the public from aircraft noise generated by interstate operators."

The members of domestic industry groups were divided on the question of retrofit. The United Automobile Workers of America, the Air Line Pilots Association, the American Association of Airport Executives, the Airport Operators' Council International, the National Association of State Aviation Officials, and the National Academy

of Sciences all endorsed the early initiation of an aircraft acoustical retrofit requirement. Their position, essentially, is that existing studies are adequate to establish technical and economic feasibility and that noise reduction would be meaningful to airport neighbors.

However, the Aerospace Industries Association and the Air Transport Association express the opposing opinion that adequate information is not available to proceed with an acoustic retrofit program. Additionally, they argue that regulations should not be promulgated until the term "meaningful relief" is defined, until complete acoustical modifications are available for each airplane type, and until specific financing means are resolved.

PROJECT REPORTS AND ADVISORY MATERIALS

This section concerns FAA project reports and draft FAA orders informally issued to the aviation community or issued formally to EPA as part of the consultative process. These materials are preliminary documents developed preparatory to the announcement of notices or advanced notices of proposed rule making and do not necessarily constitute or represent FAA policy. Some of the material discussed here may have been superseded by subsequent drafts, reports, or proposals and should not be assumed to represent current FAA work. This section is presented only to provide information on possible directions of future regulatory actions or ideas under preliminary consideration.

AMENDMENT TO FEDERAL AVIATION REGULATION TO PROVIDE FOR A TAKEOFF NOISE CONTROL OPERATING RULE (21 NOV 1972): PROJECT REPORT.

The objective of this project report (14.1-320) was stated to be "to provide information for the development of a Notice of Proposed Rule Making to amend the Federal Aviation Regulations to include takeoff noise control operating procedures for civil transport category and civil turbojet powered airplanes."

The background section of this project report provides a synopsis of the efforts (since 1960) by both the air transport industry and Federal agencies (FAA and NASA) to define a takeoff procedure that would simultaneously:

1. Provide a uniform procedure which would reduce the cockpit departure workload and enhance safety during this key phase of flight.

2. Produce uniformly "controlled and/or reduced noise levels" (underscoring added).

The concluding section of the background material states, "The FAA's past issuances of guidance/criteria documents, noise abatement rules, and the endorsement of the airlines' recent recommended takeoff procedures have not to date effected the goals desired. It is therefore deemed appropriate and warranted in further fulfilling our response to P.L. 90-411 in the control of aircraft noise that a Notice of Proposed Rule Making prescribing an operational noise control prodcedure be developed." Thus it appears clear that the FAA objective i making a rule on takeoff procedure is directed toward control in order to ensure safe and constant results while achieving some noise relief along the takeoff flight path.

A constant and simple takeoff operating procedure on a system-wide basis may very well be justified for safety and economic considerations. However, maximum relief of community noise problems requires a high degree of flexibility and variation from one airport to another and is often different between runways at the same airport. The proposed rule is therefore not optimum from a noise standpoint for all airports.

NOISE CERTIFICATION RULE FOR QUIET SHORT HAUL CATEGORY AIRCRAFT, 29 DEC 1972: PROJECT REPORT.

The reference project report had been under internal review and revision within the DOT/FAA since December 1970. From the front cover of the draft version it appears that the report is subject to internal review and revision at least annually.

The latest revision (29 December 1972) changed the scope of the category of aircraft to be covered from the Short Takeoff and Landing (STOL) (e.g. Ref 8.2-100) to a much broader category designated Quiet Short Haul (QSH). The QSH category includes not only the STOL but the Reduced Takeoff and Landing (RTOL) and the Vertical Takeoff and Landing (VTOL) types of aircraft. This includes fixed and rotary wing aircraft with stage lengths under 500 miles.

The background and historical sections of the project report takes cognizance of the impact on noise rulemaking by the National Environmental Policy Act of 1969, the Airport and Airway Development Act of 1970, as well as the Noise Control Act of 1972 (PL 92-574). In spite of the recognition of these Acts, in a section devoted to a discussion of alternative methods of providing QSH noise certification, the project report states: "Noise exposure certification--This method would control QSH noise by means of a noise measuring system concept tailored perhaps to specific land uses and/or existing ground noise environment. This would essentially constitute a certification of the airport, heliport or STOLport with respect to maximum allowable noise source and path options. The chief problem here is that the Federal Government does not fully have the authority, and perhaps should not, to exercise absolute control over local airport operations."

The stated objective of the project "is to establish the foundation for a rule limiting the maximum noise emission for the types of aircraft commonly designated as Quiet Short Haul. The rule should be effected as soon as practicable because of the prospect of this class of aircraft developing into a fast-expanding segment of local and regional commercial short haul air transportation. It is therefore urgent that noise reduction concepts are instilled as quickly as possible in the design and development of this class of aircraft. In this way, quiet short haul aircraft will be more compatible with the communities they are intended to serve and this mode of transportation will be better able to fulfill the promise of its future role."

In addition to the wide variety of aircraft with the inherent wide variety of possible "configurations, combination of propulsion systems, and operational capabilities," the

project appears to be faced with an equally wide variety of possible terminal facilities and attendant variable noise sensitivities.

The project report (14.2-323) includes a list that illustrates the wide variation in aircraft types considered to be included in the QSH category. For convenience, this list has been extracted and is as follows:

"(a) Turboprop Aircraft

(1) Deflected slipstream

(2) Tilt-wing

(3) Nonpowered lift CTOL

(b) Rotary Wing Aircraft

(1) Conventional Helicopters

(2) Advanced helicopters, i.e., compound type with slowed, stopped, trailing, stowed or other variable geometry rotors.

(c) Turbofan and Jet Flap Aircraft

(1) Fully internal flow

(2) Internally blown flap

(3) Externally blown flap

(4) Augmentor wing

(5) Overwing blown flap

(d) Lift Pod Aircraft

(1) High bypass ratio, high thrust/weight turbofans, either concentric or turbotip drive, in wing or fuselage lift pods or swingout/stowed within fuselage; separate cruise propulsion turbofans.

(c) Fan-In-Wing Aircraft

(1) Turbotip lift fans powered by turbojets or low bypass turbofans which also afford cruise propulsion."

The project report review also states that the subject types of aircraft are not covered under the current FAR Part 36 "Noise Standards: Aircraft Type Certification;" inasmuch as the Part 36 rule was directed toward a wide variety of Conventional Takeoff and Landing (CTOL) aircraft the operational characteristics, thrust modes, environments, and economics of which are substantially dissimilar from the envisioned QSH type of aircraft. Thus a regulation "tailored" to and clearly appropriate to the type (as required by law) should be considered.

One of the project report conclusions is stated to be "since the QSH system development is in such a state of flux during its present embryonic stage, it is concluded that the issuance of an ANPRM on QSH noise would best suit the FAA's purposes in establishing a firm structure upon which to base specific QSH noise standards. Reliable specific data on various QSH aircraft noise characteristics and economics are urgently needed to construct an effective and viable QSH noise rule."

Other conclusions are stated to be:

"1. Second generation QSH aircraft should be no noisier than first generation of STOL aircraft.

2. Noise regulations should be developed with a view to the impact of environmental provisions of the Environmental Policy Act, the Airport and Airways Act and the Noise Control Act of 1972.

3. Most noise certification concepts lack the capability of matching aircraft noise to airport, heliport or STOLports. The potential for this matching exists through the new environmental legislation.

4. Enroute noise for quiet short haul routes should be given regulatory consideration.

5. The aircraft industry repeatedly stresses caution both in the premature issuance of a QSH noise rule and in regulatory noise limits which inhibit the development of the many types and sizes of QSH aircraft now in view. On the other hand, the Rule's entire objective would be negated if the FAA were to structure the regulation so as to permit a wide spectrum of noise emissions from all possible types of QSH aircraft. Further, it would seem that the noise sensitive task of establishing new metropolitan heliports and STOLports together with the demands of new environmental laws, would require QSH aircraft to accede to even more of an economic sacrifice in the cause of noise reduction than has been the case for CTOL aircraft."

The project report makes only one recommendation; that is, prepare a notice of advanced proposed rule making (ANPRM). According to the recommendation, the ANPRM should serve three functions:

1. Provide emphasis of the FAA intent to require standards of maximum noise for QSH type aircraft.
2. Provide notice of intention to follow the general philosophy of the present subsonic noise regulations.
3. Solicit specific information from all segments of interested aviation sources, municipal, local, state, Federal and public entities and individuals on the specifics of R/V/STOL designs, physical and operational characteristics, environmental impacts, economic limitations, evolutionary development and alternatives.

The project report further provides a list of 19 specific areas of inquiry and, for convenience, all nineteen have been extracted and are listed below.

"(1) How best to envelop the class of aircraft known as QSH for noise certification purposes.

(2) The extent to which the class of QSH aircraft should be divided into subclasses, i.e., rotary wing, VTOL, STOL, RTOL, etc. for the purpose of establishing noise limits and measurement procedures.

(3) The extent to which the class of QSH aircraft should be further categorized for purposes of assessing the economic impact and technological feasibility of noise regulations.

(4) The extent to which noise level characteristics of present day and future types of QSH aircraft and their propulsion system can be predicted.

(5) The extent to which present conventional noise reduction techniques can be incorporated in the various types of QSH aircraft now envisioned.

(6) Specification of noise measurement points for certification purposes to ensure that noise information recorded in the flight manual will have maximum utility for long-range land use planning and future airport development.

(7) The variation in noise characteristics and operating economics associated with the various types of STOL aircraft now envisioned.

(8) How best to regulate noise for QSH aircraft (amend Part 36, promulgate new Part, etc.).

(9) The minimum time for compliance with a QSH noise rule.

(10) The expected market range for various classes of QSH aircraft if the development of metropolitan heliports and STOLports is not impeded by non-technological factors.

(11) An equitable method of establishing a relationship between maximum noise certification levels for QSH aircraft and economic and technological feasibility.

(12) The quantitative benefits associated with QSH operation from metropolitan airports, heliports and STOLports with relatively high background noise levels and with nonresidential nighttime communities.

(13) The extent and effect on total operating economics of larger classes of QSH aircraft foreseeably designed for both QSH and CTOL route structures.

(14) The economic penalties associated with minimum and maximum levels of noise reduction for various classes of QSH aircraft.

(15) The limitations on the utilization of the V/STOL aircraft's capability of high maneuverability by reason of airline practice due to passenger comfort, pilot acceptance, navigational equipment safety margins and operating economics.

(16) The need for enroute QSH noise restrictions.

(17) The alternative methods of QSH noise regulation.

(18) The development and placement of economic incentives in the Rule for reducing the noise of future QSH aircraft.

(19) The applicability of subjective noise rating concepts to rotary wing, RTOL, STOL and VTOL aircraft (ASDS, CNR, etc.)."

PROPELLER DRIVEN AIRCRAFT NOISE TYPE CERTIFICATION STANDARDS (NOTICE OF PROPOSED RULE MAKING): 22 JAN 1973; PROJECT REPORT.

The stated objective of the subject project "is to support a Notice of Proposed Rule Making to amend Part 36 to provide type certification standards for propeller driven aircraft (other than transport category already covered under Part 36)."

The proposed standards are stated to have been "designed to halt the escalation of noise from propeller aircraft and to ensure that new designs are substantially quieter."

The project report (14.1-322) does take cognizance of and references the Noise Control Act of 1972 (PL 92-574).

The proposed standards are stated to be applicable "to propeller driven aircraft normally certificated for airworthiness under FAR 23, including normal, utility and

acrobatic aircraft having a maximum certificated takeoff weight not exceeding 12,500 pounds (5,700 kg.). Within this range are included single- and multi-engined aircraft equipped with various types of powerplants and that derive the major portion of their propulsive thrust by means of a propeller. Standards herein relating to noise certification for these propeller driven airplanes apply to all affected types of basically new design or modification to existing designs for which a type certificate is required. These standards will not be made retroactive to the extent of requiring modification of individual airplanes already in service but will embrace continued production of earlier types. It is proposed that all aircraft produced after 1 year following the issuance date of this FAR will meet a basic noise limit; whereas, after 31 December 1975, all original type certificates will meet a lower level. Original type certificates granted through December 1975 will also conform to the basic limit.

"It is noted that the noise produced by a light airplane belonging to a given basic model can, in some cases, be influenced to a significant degree by the installation of approved alternative equipment or by the incorporation of subsequent modifications, with particular reference to propeller and engine exhaust system. Therefore, the provision of FAR 36, covering the incorporation of acoustically significant changes, shall apply."

A particular guideline applied to this project led to recommending deviations from standards previously established under Part 36. The guideline was stated to be, "Any noise certification scheme for such aircraft should be as simple as possible, in consonance with the ability to produce consistent and reproducible results over the range of ambient test conditions likely to be encountered in practice."

The significant deviations are noted to include:

- The basic unit of noise measurement is based upon an A-weighted network (dBA) as opposed to the previously established Effective Perceived Noise Level (EPNdB).

- The noise is measured at a single point under the aircraft, which shall fly at constant altitude and power setting as opposed to the previously established three points of noise measurements (takeoff, approach and sideline), with the aircraft operating in the appropriate (takeoff or landing) mode.

The project report states that, "The basic approach taken in setting noise limits for general aviation propeller driven aircraft was to establish noise limits as a function of aircraft gross weight, using as a guide the current noise levels, limits previously established by Switzerland and Germany, and an estimate of reductions that are technically feasible and economically reasonable. These basic limits would apply for "standard" performance aircraft, having a "standard" power loading. Correction factors, based on power loading, would be allowed to credit higher performance aircraft for their abilities to climb faster and to fly the pattern at a lower percent power."

The proposed noise limits are shown in Figure V-3-1. As shown, the proposed standard noise levels, as in the original Part 36, are a function of aircraft weight. The allowable corrections are based upon the aircraft power loading and the correction is proposed to be limited to 5 dB, initially, and 3 dB at a future date.

This report appears to be well developed, consistent with other similar standards for this type aircraft and capable of providing a noise limit with probable future reduction of noise generated by this type aircraft. Deviation from previously established standards under FAR, Part 36 appears to be unwarranted, except on the basis of simplicity and the economics resulting from the simpler measurements and procedures. The adoption of these simple standards to this type aircraft should in no way effect a change in those already established for turbojet powered transport category aircraft.

AIRCRAFT SOUND DESCRIPTION SYSTEM (DRAFT, 3 AUG 1972): Order 7040.

This draft order "states policy and establishes procedures and guidance for the calculation and dissemination of aircraft sound data." In addition, it is intended to

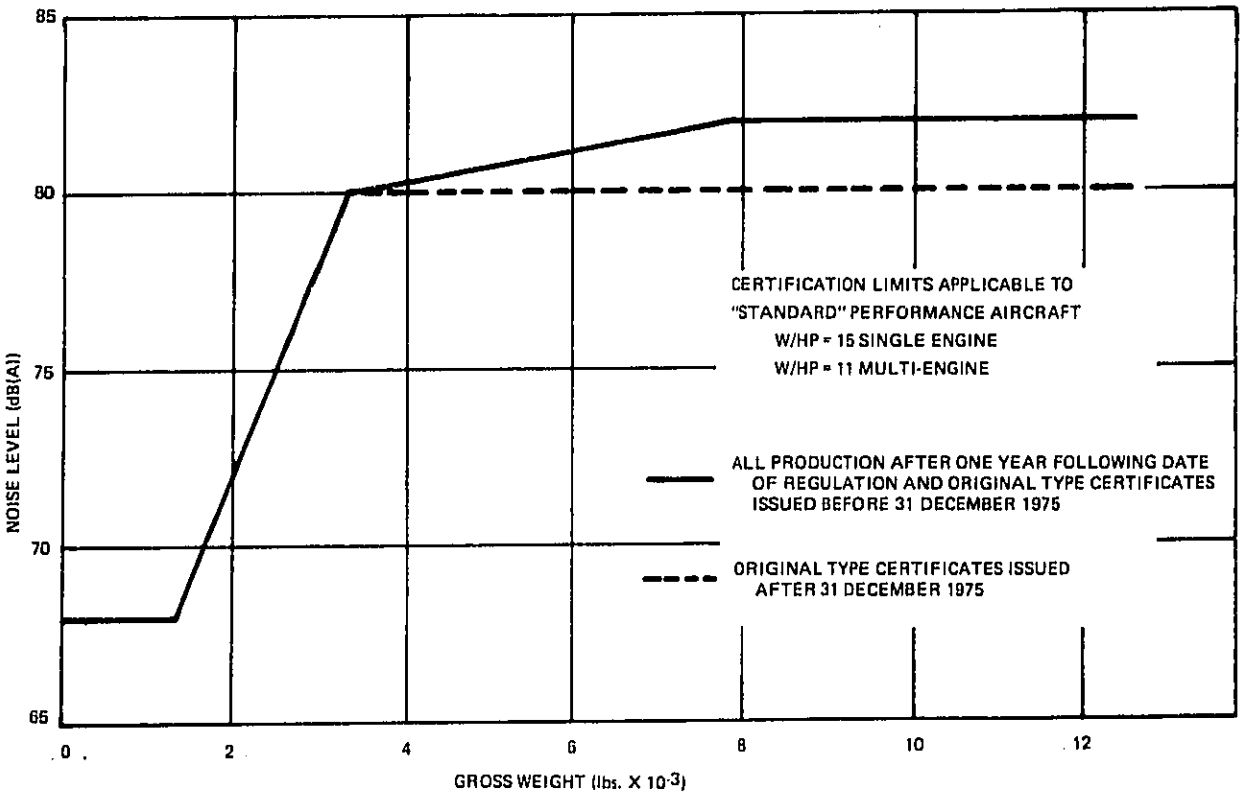

Figure V-3-1. Proposed Noise Limits for Propeller Driven Aircraft

cancel Order 7040.1, 27 October 1965, Technical Report: "Land Use Planning Relating to Aircraft Noise."

The background section of this order states, "the Federal Aviation Administration does not have authority to promulgate or enforce aircraft sound standards in the vicinity of airports. However, by virtue of the authority described in Paragraph 1 of this order, it does seek to promote, encourage and support, to the extent practicable, sound abatement plans and compatible land use planning and control by the responsible local and state authorities where the legal authority and responsibility rests."

The authorities cited in the above paragraph include:

- Public Law 90-411, Section 611 (a), an amendment to title VI of the Federal Aviation Act.
- The National Environmental Policy Act of 1969 (PL 91-190) together with Executive Order 11514.
- The Airport and Airway Development Act of 1970 (PL 91-258).

The order further states that, "the techniques for measuring and describing the physical characteristics of sound are highly developed and extensively used by members of the scientific community. However, methods for quantifying and describing sound exposure had not been developed that are readily understandable and generally usable."

The Aircraft Sound Description System (ASDS) developed by the FAA Office of Environmental Quality and described in the handbook referenced by this order is intended to provide a "readily understandable and generally usable" sound descriptor.

The order has not been officially distributed but has been given wide unofficial distribution as witnessed, for example, by the resolution passed by the Board of Airport Commissioners of the Los Angeles International Airport (1.1-278). This resolution states:

> "WHEREAS, by Draft Order No. 7040, dated August 3, 1972, the Department of Transportation, Federal Aviation Administration, distributed a proposed aircraft sound description system (ASDS); and

"WHEREAS, said Draft Order contains proposed procedures and guidance for the calculation and dissemination of aircraft sound data; and

"WHEREAS, it is in the best interest of the City of Los Angeles, the Department of Airports, and of airport operators generally that a national system of sound measurement be adopted for use by airport operators;

"NOW, THEREFORE, BE IT RESOLVED that the Board of Airport Commissioners of the City of Los Angeles approves the adoption of said aircraft sound description system and respectfully memorializes the Department of Transportation, the Federal Aviation Administration to expedite the proceedings necessary to adopt said system and to order the same at the earliest possible date."

Airport operators may welcome a sound description system to replace a noise exposure forecasting system, but the system described in the draft order requires considerable rework as indicated by the following analysis (8.3-149).

Introduction to ASDS Analysis

The draft order for the ASDS presents procedures for the "calculation and dissemination of aircraft sound data." The result of the calculation process is given in each of the following three forms:

1. A single-number rating of airport noise assigned units of acre-minutes but which, in reality, are units of acre-minutes per event-day.
2. A graph or chart, called an acre-minute graphic chart, for which the vertical scale is in units of minutes and the horizontal scale is in units of acres, indicating for each class of aircraft, the area enclosed by its 100 EPNdB contour related to an arbitrary duration time.
3. Curves, called sound exposure maps, the coordinates of which represent downrange and crossrange distances on aircraft flight tracks described as "a set of lines of constant time exposure."

The calculation procedure is described in the Draft Order in Appendix 1, page 2, and illustrated by example on a special form presented in Attachments C and D. No recommendation is made in the Draft Order concerning which of the three forms is the preferred way of describing aircraft noise exposure. Although all of the three forms can be constructed from the same computational data (such as Attachment D), each presents the results in ways that are subject to different interpretations, some of which are misleading.

Analysis of the Acre-Minute Concept

The primary element in the ASDS consists of single-event equal noise level contours of 100 EPNdB assigned to various classes and operational modes of aircraft. There is no explanation in the draft order of the input used to construct these contours. The usual procedure for calculating noise level contours is dependent upon the following three relationships:

1. A set of takeoff profiles and takeoff roll distances identified for each class of aircraft (e.g., four, three, and two jet engines) and takeoff weight or stage length, also, one or more approach profiles and distances to touchdown.
2. The variation in noise level at a reference distance (e.g., EPNL at 200 feet) with engine power setting (e.g., engine pressure ratio, fan speed, or thrust).
3. The variation in noise level with slant range at closest point of approach for each power setting of interest (e.g., takeoff, cutback, and approach).

The preceding relationships represent extremely comprehensive sets of data that, because of the flexibility in aircraft operational procedures, are impossible to predict for each specific aircraft. The usual procedure, therefore, is to assume relationships for each type of class of aircraft that are meant to be representative of average performance, both for noise level and aircraft operations.

Even if the ASDS were judged to be a valid concept, there is no way to evaluate its accuracy unless the input assumptions are described. For example, can any portion of the input data be related to FAR Part 36 measurements? Is thrust cutback assumed at takeoff? If not, then the ASDS may be incapable of adequately describing the noise of aircraft operating in the manner for which they have complied with the Federal noise regulations.

The ASDS uses the area only within the 100 EPNdB contour for each class and operational mode of aircraft as the basic measure of noise exposure in units of acres per event. The second element in the ASDS is an assumption, for each class of aircraft, of the number of operations in a 24-hour day in units of events per day. There is no explanation in the draft order of the method used to predict number of events per day. For example, does it represent a busy day, an average summer day, or the number of events per year divided by 365?

The next element in the ASDS is an arbitrary assumption of a duration time of 20 seconds per event which translates to three events per minute. There is no explanation in the draft order of the meaning of this duration time. What is it the duration of? If the implication is the duration of 100 EPNdB, the concept is erroneous because there is no such thing as a duration of EPNdB. There is a duration time correction included in the methodology for computing EPNdB, which is an integrated value over time of the tone corrected noise as it rises and falls. Therefore, the ASDS includes a double duration effect that, without a proper explanation, makes no sense at all.

The ASDS procedure multiplies the three elements together to yield a single number rating of airport noise in units of acre-minutes per event-day, which, however, is denoted as acre-minutes in the draft order. Another way of looking at the single number result is that it is merely a number in acres per day divided by the constant "3." In other words, the assumption of an arbitrary duration time has no substantial effect at all. So why use it? The term acre-minutes is misleading in that there is an implication that the time element is an influential and logical part of

the ASDS, which is simply not true. No justification can be made for an assumption of three events per minute as it is used in the ASDS, or for that matter, any number of events per minute. As used in the ASDS, the fewer number of events per minute, the larger the ASDS acre-minutes will be or, conversely, the larger number of events per minute, the smaller the value of acre-minutes will be, which is not logical since it is the inverse of what one would expect from a noise exposure descriptor.

The ASDS is influenced equally by acres per event and the number of events per day in the sense that if one is halved and the other doubled, the number of "acre-minutes" remains the same. In all of the international procedures for predicting aircraft noise exposure, developed by acoustical experts throughout the world, the effect of number of operations is included as some form of logarithmic relation and not linear. There are differences of opinion as to the particular logarithmic form that is most appropriate (e.g., whether 10 log or 15 log) but there is no justification whatever for the assumption of a linear relationship. The ASDS would penalize aircraft traffic growth far more than is realistic: doubling the number of operations would double the number of acre-minutes. On the other hand, for the concepts that incorporate numbers of operations logarithmically (e.g., NEF and NNI), doubling the number of operations would increase the result by only three to five units, which is reasonable and much less severe.

The aviation community expects to grow in numbers of aircraft and operations and also in the production of noise controlled aircraft. The ASDS could indicate, erroneously, that the benefits gained from quieter aircraft (e.g., DC-10, L1011, 747, and noise retrofit) are offset by the increase in numbers of operations. The preclusion of subjective interpretations of the ASDS, such as annoyance factors, in the draft order will not prevent the making of such evaluations. It should be expected that the ASDS acre-minutes predicted for an airport vicinity in 1980 that are less than, equal to, or greater than those predicted for the same airport in 1972 will be judged to mean less, equal, or greater annoyance, respectively.

Analysis of Acre-Minute Graphic Chart

The graph or chart presented in Attachment E contains all of the erroneous elements inherent in the acre-minute concept, because it is based upon the same data. However, the chart does not lend itself to rapid or easy interpretations, hence, some of the pitfalls or dangers in the ASDS might be overlooked. It is difficult to see what useful purpose the chart serves.

Analysis of Sound Exposure Maps

Attachment G, titled "Sound Exposure 1970", is a figure showing three curves, one inside the other, each labeled in minutes. The discussion of Attachment G, given on page 3 of Appendix 1, does not adequately explain the meaning of these curves other than "a set of lines of constant time exposure." The question is—exposure to what level of noise? From the discussion throughout the Draft Order, the assumption can be made that the three curves represent the single-event 100 EPNdB contours for the DC-8/707, 727, and DC-9/737 classes of aircraft, respectively. If this assumption is correct, this form of the ASDS is erroneous if the intent is to indicate that the curves are a set of lines of constant time exposure to 100 EPNdB. In fact, the curves have no logical meaning. The only conclusion that can be made is that the three curves represent lines for which there will be 60, 48, and 20 "minutes," respectively, of noise that will not be less than 100 EPNdB. No information is presented on how much the noise would exceed 100 EPNdB, but for the two innermost curves, it could be considerable, possibly as much as 110 to 120 EPNdB. Furthermore, the level of noise along any one curve would not be constant, so it does not represent an equal noise contour except for a single event of a particular class of aircraft. If time in minutes is to be assigned to these curves based upon numbers of operations of other classes of aircraft as well, then these curves have no significance for noise exposure.

Conclusions of ASDS Analysis

The ASDS acre-minute concept is based upon two false premises that have no scientific basis, lead to confusion, and make the concept a hazard to the growth of aviation. The first premise is the assumption of a linear, instead of a logarithmic, relationship for the number of operations, which can have the effect of severely deemphasizing the noise reduction benefits that would result from quieter aircraft. The second premise is the assumption of an arbitrary constant duration time, which makes no sense but implies sophistication and logic that do not exist.

The ASDS acre-minute graphic chart simply compounds the fallacies in the acre-minute concept by adding to the confusion.

The ASDS sound exposure maps are single event equal noise level contours for various classes of aircraft that are misrepresented as equal time exposure contours for multiple event operations. In reality, the maps have no logical meaning. They are simply lines indicating positions on the ground for which noise levels will not be less than 100 EPNdB during some aircraft operations.

Even if the ASDS were based upon valid scientific principles, the draft order provides no information or guidelines for its use. The draft order implies that the ASDS, by virtue of serving as the agency aircraft sound descriptor, is capable of being used for sound abatement plans, compatible land use planning, and in environmental impact statements. However, without recommendations for the meaning or interpretation of the acre-minute values, the ASDS will be of no use in the preparation of environmental impact statements, noise-compatible land use planning, and noise evaluation and control.

SECTION V-4

REVIEW OF NOISE CONTROL ACTIONS OF OTHERS

STATE AND LOCAL

STATE OF CALIFORNIA

On November 10, 1970 the California State Aeronautics Board adopted airport noise standards which became effective as State Department of Aeronautics Regulations on December 1, 1972. The regulations are contained in Subchapter 6, Title 4 of the State Administrative Code (15.1-34).

The regulations were "designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the department to work cooperatively to diminish noise. The regulations accomplish these ends by controlling and reducing the noise in communities in the vicinity of airports."

The regulations are applicable to all existing and future airports in California required to operate under a valid permit issued by the state aeronautics department.

With the exception of the specification of a Single Event Noise Exposure Level (SENEL), the regulation is concerned with noise exposure, which combines measures of noise and time at specific locations. That is, the regulation is primarily concerned with the totality of the aircraft noise at a particular location without specific regard for or an assessment of a particular event, source, or operation.

The enforcement of the California state regulations is delegated to the county in which the airport is located. Review of data and findings are maintained at the state level. Implementation, beyond that of the enforcing county, is the responsibility of the airport proprietors, except for complying with the SENEL, which is the responsibility of the aircraft operator.

The regulation specifies (but does not limit) the methods of controlling and reducing the noise impact to the following:

"(a) Encouraging use of the airport by aircraft classes with lower noise level characteristics and discouraging use by higher noise level aircraft classes;

(b) Encouraging approach and departure flight paths and procedures to minimize the noise in residential areas;

(c) Planning runway utilization schedules to take into account adjacent residential areas, noise characteristics of aircraft and noise sensitive time periods;

(d) Reduction of the flight frequency, particularly in the most noise sensitive time periods and by the noisier aircraft;

(e) Employing shielding for advantage, using natural terrain, buildings, et cetera; and

(f) Development of a compatible land use within the noise impact boundary.

Preference shall be given to actions which reduce the impact of airport noise on existing communities. Land use conversion involving existing residential communities shall normally be considered the least desirable action for achieving compliance with these regulations."

LOS ANGELES INTERNATIONAL AIRPORT

The management of Los Angeles International Airport have taken actions in order to alleviate their noise problem. The Board of Airport Commissioners has recently adopted a five point noise abatement program. The program includes:

1. A preferential runway use program that allows preferential treatment of aircraft certificated under FAR Part 36, Appendix C.

2. Planning of landing fees giving preferential treatment to aircraft certificated under FAR Part 36 and fees somewhat proportional to type noise levels.

3. A fleet noise rule making reference to FAR Part 36 noise levels. A stated goal of 40 percent of all aircraft using the airport being in compliance by July 1, 1977, and a rule of 100 percent compliance by December 31, 1979. The rule will stand as a regulation at the airport "unless and until a more stringent rule is adopted by the Federal Government, or by any one or more of its agencies authorized to do so."

4. Establishment of an airport Noise Reduction Enforcement Division with the staff and equipment required to measure aircraft noise to ensure compliance with standards fixed by FAR Part 36.

5. Revocation of airline operating permits when carriers are shown to be repeatedly in violation of the preferential use runway program.

The regulations in the cited resolution of the Board of Commissioners of the Los Angeles International Airport (15.2-265) reflects the use of some of the noise control options available to the airport operator. The use of these options is undoubtedly related to California airport noise regulations (15.1-34).

Other options that may appear to be available for use in rulemaking are those which would tend to regulate, control, or standardize certain aircraft operational alternatives such as two-segment approaches, reduced thrust takeoffs, and landings without the use of thrust reversers. Controls placed upon flight operations invariably involve the safety of the particular aircraft and often other aircraft in "the system"; therefore, the successful development and application of aircraft operational noise rules often require the combined efforts of the FAA, the aircraft manufacturer, the airlines, and the flight crews. Specific examples of type of noise control action by the aircraft industry are reviewed in the following paragraphs of this section.

INDUSTRY NOISE CONTROL ACTIONS

The takeoff operational procedures developed and promulgated by the Air Transport Association of America (ATA) and the National Business Aircraft Association, Incorporated (NBAA) are contained in References 13.1-150, 188 and 266. These procedures were developed with the assistance of the FAA. The ATA procedure has been in effect since 1 August 1972; however, the FAA Project Report relating to the Noise Control Operating Rule for Takeoff (Reference 14.1-180) dated 21 November 1972 indicates that "the endorsement of the airlines' recent recommended takeoff procedure have not to date effected the goals desired." The project report does not explain which goals or how the failure manifests itself. In any case, the ATA Flight Operations Committee efforts, as well as those made by the staff of NBAA, are representative of the noise control actions which have and are continuing to be taken by the air transport industry. These are voluntary actions resulting in self-imposed rules.

Inasmuch as there appears to be no organization or agency, with the possible exception of the FAA, monitoring and assessing the results, the degree to which the effort is effective, in terms of actual reduced noise levels or exposure, is not known at this time.

Noise control actions taken by another segment of the air transport industry, the intrastate carriers operating in the State of California, are reported in References 4.1-267, 268. These actions appear to be developed on a case-by-case basis in cooperation with the California airport operators in response to the previously cited state airport regulations. These actions, as well as those proposed or taken by ALPA, ATA and NBAA have been thoroughly reviewed by the EPA Aircraft/Airport Noise Report Study Task Group 2 and are extensively discussed in the draft report (10.2-285) of that group.

SECTION V-5

SUMMARY AND CONCLUSIONS

The Noise Control Act of 1972 (Public Law 92-574) amends the Federal Aviation Act of 1958 to include the concept of "health and welfare" and to define the responsibilities of and interrelationships between the Federal Aviation Administration (FAA) and the Environmental Protection Agency (EPA) in the control and abatement of aircraft noise and sonic boom. Specifically, PL 92-574 requires that, in order to afford present and future relief and protection to the public health and welfare from aircraft noise and sonic boom, the FAA, after consultation with EPA, shall prescribe and amend such regulations as the FAA may find necessary to provide for the control and abatement of aircraft noise and sonic boom.

In prescribing and amending regulations, PL 92-574 requires that FAA shall consider whether any regulation is:

1. Consistent with the highest degree of safety.
2. Economically reasonable.
3. Technologically practicable.
4. Appropriate to the type.

The above considerations form a set of constraints oriented to safety, economics, and technology. However, PL 92-574 has introduced a fifth constraint: protection to the public health and welfare.

The abatement of aircraft noise is accomplished by exercising, to the extent feasible, the noise control options available to the aircraft manufacturers and operators, and the public authorities in the airport neighborhood communities. Finally, the remainder of the noise must be contained within noise compatible boundaries.

Regulations are the most effective technique for exploiting available noise control technology and, if properly constructed and implemented, can provide the incentive to ensure continuing effort directed to technological advancements.

THREE PART REGULATORY PLAN

Public Law 92-574 amends the Federal Aviation Act of 1958 (superseding PL 90-411) to include the concept of health and welfare. The full text of the amendment is given in Figure V-1-2. In effect, a fifth regulatory constraint has been added as discussed in Section I and shown in Figure V-1-1. The FAA has the authority to prescribe aircraft noise regulations and is well qualified to develop them effectively within the original four constraints. The fifth constraint (health and welfare) is the responsibility of both FAA and EPA; but EPA has the capability, by virtue of broader noise control responsibility and greater objectivity, for coping more effectively with that constraint. In fact, no member of the aviation community, by virtue of its vested interests, should be put in the position of having major responsibility for the possible limitation of the growth of aviation. A perplexing question, therefore arises. That is, how can EPA and FAA most effectively work together and reconcile any differences in interpretation of what constitutes protection to the public health and welfare? A solution to this problem is presented in the following three part plan.

REGULATIONS PRESCRIBED AND ENFORCED BY FAA

The FAA shall continue to prescribe and enforce aircraft noise regulations for the aircraft manufacturers and operators, considering the principal regulatory constraints to be safety, economics, and technology. The purpose or objective for the FAA in prescribing regulations shall be as stated in PL 92-574; that is, "In order to afford present and future relief and protection to the public health and welfare from aircraft noise and sonic boom...". The FAA shall be considered to have the best expertise in prescribing regulations within the constraints and, although EPA shall be consulted for advice and recommendations, the FAA shall have the responsibility and authority for their content and enforcement.

The noise control regulation prescribed by the FAA for the aircraft manufacturers and operators shall be expected to reflect the latest state of the art of safe and economical technology and shall be expected to effect a decrease in noise exposure, but not necessarily to the extent of full protection to the public health and welfare. The regulations shall be of the "umbrella" type in the sense that those regulated can all comply by use of available technology but some may be capable of achieving lower noise levels than others by virtue of their greater technological capability. An airworthiness or operation certificate shall be contingent upon compliance with the noise control regulations.

REGULATIONS PROPOSED BY EPA

EPA shall, when necessary, present to the FAA proposals for noise control regulations that EPA determines to be needed to increase the protection of the public health and welfare. The proposals shall be in the form of project reports containing the substance of recommended noise control actions but that may not have been thoroughly analyzed regarding safety, economics, and technology. The FAA shall have the authority to reject the EPA proposals on the basis that the constraints of safety, economics, and technology have been violated.

If, however, EPA has reason to believe that FAA rejection of the proposed regulations is unwarranted, EPA shall consult with the FAA and may request the FAA to review their decision. Any such request shall be published in the Federal Register in accordance with the detailed illumination procedure required by PL 92-574 (see Figure V-1-2).

AIRPORT REGULATIONS (PERMITS) PRESCRIBED AND ENFORCED BY EPA

EPA shall have the authority and responsibility to develop criteria and noise evaluation methodology sufficient to establish a noise exposure level such as point A in Figure V-2-3. That numerical level shall establish the meaning of protection to the public health and welfare based upon the current state of the art of determining

the effects of noise on man and other ecological systems and shall consider that 100 percent protection is unreasonable. As studies continue over the years, this number may be lowered, particularly if evidence should indicate that noise is a hazard to health in ways not apparent at this time.

The number establishing protection to the public health and welfare shall represent a level (or dose) of cumulative noise exposure over a 24-hour period that, if exceeded for a finite period of years, would constitute lack of protection or eventually may be classed as a hazard, depending upon length of exposure. A point to be emphasized, however, is that mere exceedance of this number only indicates that the noise exposure is a degrading environmental influence and not a cause of immediate noticeable irreversible damage.

All airport operators shall be required to predict their aircraft operations for a typical 24-hour day and to construct equal noise exposure contours for the numerical levels and in conformance with the methodology specified by EPA. The land area within the contours for each airport neighborhood shall be examined for noise-compatible usage based upon a scale determined by EPA with advice and recommendations from other interested Federal, state, and local agencies. Wherever land areas are considered to be incompatible with the noise exposure, the airport operator shall be required to begin to restrict the aircraft operations by all regulatory means at his disposal (curfews, quotas, weight and type limitations, preferential runway use, landing fees, etc.). The restrictions shall be in effect until all land areas within specified contours have noise-compatible use. Full compliance with land use compatibility shall be specified in a reasonable time period, permitting the aircraft operators and manufacturers to implement the current and near future source and path noise control technology and permitting land areas within these contours to be converted by the appropriate authorities (airport operators, and/or federal, state, and local governments) to noise compatible use (insulated buildings, manufacturing, recreation, etc.).

SUMMARY OF THREE-PART PLAN

The three part regulatory procedure discussed presents a logical plan for controlling aircraft noise exposure to levels that afford protection of the public health and welfare. The procedures would permit the FAA to exercise their considerable expertise in safety, economics, and technology without conflicting influences resulting from their need to interpret the meaning of protection to health and welfare. EPA would have extensive consultations with FAA and would, on occasion, propose new or modified regulations in the form of project reports. In general, however, EPA would recognize and defer to the FAA expert judgment but would have available, in the case of serious disagreements, the public dissemination procedure specified in PL 92-574. The controls on noise exposure, to the extent of protection of the public health and welfare, would be implemented at the airport by the airport authorities, because the airport neighborhood is where the environmental degradation exists and where the ultimate controls should be. The airport authorities would impose restrictions on the aircraft operators as needed to ensure that the airport neighborhood communities have noise-compatible land usage. The restrictions would provide incentive for the aircraft operators to conduct thorough investigations and consider maximum utilization of the available source and path noise control options. The fact that an aircraft manufacturer or operator has barely complied with an FAA "umbrella type" regulation would not ensure the acceptance of a particular airplane at all airports. The airport restrictions would, therefore, encourage the aircraft operators and manufacturers to satisfy the FAA regulations with their best effort and not to just comply with specified limits.

The airport permit plan is similar in concept to the plan incorporated in the airport noise standards of the State of California, which became effective as State Department of Aeronautics Regulations on 1 December 1972. Legal precedent has been set, and many functional details that have been worked out for the State of California would be applicable here.

SECTION V-6

RECOMMENDATIONS

The FAA, since the advent of FAR Part 36, has been concerned with the development of a considerable number of noise control regulatory actions. As discussed in Section V-3, there are two regulations, two NPRMs, three ANPRMs, and three project reports. The two existing regulations, FAR Part 36 for subsonic transports and turbojets and FAR Part 91.55 for sonic boom, effectively prevent the escalation of source noise. Considering the recent rapid growth of civil aeronautics (size and thrust, as well as quantity), holding the line on source noise is a noteworthy achievement. Furthermore, the remaining eight proposed regulatory actions, if implemented with only relatively slight modifications, would effect significant reduction in noise exposure within the next few years. The land areas within the noise exposure contours representing protection to the public health and welfare, such as shown in Figure V-2-5, would experience substantial shrinkage, thus minimizing the residual land areas requiring noise-compatible usage.

In addition, there are other potential noise control actions not necessarily explored in depth by the FAA, such as discussed in detail in the report of Task Group 2, that would further reduce substantially the noise exposure areas.

IMMEDIATE FAA REGULATORY ACTION

ANPRM 70-33 - SUPERSONIC AIRCRAFT NOISE

The noise problems relating to supersonic transports can be identified with current and future types of these aircraft. For the current types (Concorde and TU-144), some models exist, others are in production, and additional models including growth versions may be produced. The future types are defined as those that have no applications for type certificates and may not have been designed nor even thought of.

Many manufacturing members of the aviation community believe that the basic differences in the design characteristics of subsonic and supersonic aircraft preclude the use of noise standards applicable to both types of aircraft. Even though supersonic transports will share the same airports with subsonic transports that will have complied with the FAR Part 36 noise standards current at that time, they believe that separate noise regulations should be developed for supersonic transports permitting them to exceed the required levels for the subsonic aircraft. Unless this is done, they maintain, the development of supersonic transport aircraft will be severely inhibited. In support of this position, the International Civil Aviation Organization (ICAO) recommended (CAN 3, Agenda Item 3) Ref. 8.4-185 that future supersonic transport airplanes be designed to minimize the noise levels below the approach path, below the takeoff path, and to the side of the airplane during takeoff climb. Annex 16 noise certification standards for subsonic turbojet airplanes (which are practically the same as FAR 36), current at the time the application for certificate of airworthiness for the prototype was accepted, should serve only as a general guideline.

The ICAO recommendations, however, do not appear to be compatible with the requirements of PL 92-574. On the one hand, it is not unreasonable to allow limited numbers of existing supersonic aircraft (or whose construction is committed) to share airports with subsonic aircraft providing they comply with the airport "permit" requirements. On the other hand, it is not reasonable to issue a noise "carte blanche" to the manufacturers allowing them freedom to design future aircraft with the degree of noise source control they think best.

In consideration of the above discussion and the requirements of PL 92-574, the Task Group 5 report recommendation is that the regulatory process be expedited by the FAA to insure that there will be no escalation of noise exposure. The recommended approach is that existing SST aircraft types (Concorde and TU-144) be regulated to noise levels as low as they are capable of achieving by best effort available through technology or operational controls. Future SST aircraft types should be regulated to noise levels conforming to the FAR Part 36 Appendix C levels current at the time of type certificate application.

Existing SST aircraft cannot comply with Part 36, but if the airport permit plan discussed in Section V-5 is implemented, the noise exposure will be maintained within compatible land use boundaries. Some airports might be able to accept numerous SST aircraft operations per day without jeopardizing public health and welfare, while other airports might be forced to limit them to a very few per day or none at all.

NPRM 72-19 — NEWLY PRODUCED AIRPLANES OF OLDER DESIGN

It is recommended that the regulatory process be expedited. The technology is available to ensure that all new production aircraft by either design, retrofit, or both, can comply with Appendix C of FAR Part 36.

ANPRM 70 - 44 AND ANPRM 73 - 3 CIVIL AIRPLANE NOISE REDUCTION RETROFIT AND FLEET NOISE REQUIREMENTS

Two notices of proposed regulations have been issued having essentially the same objective — retrofit of currently type-certificated subsonic turbofan powered aircraft. The earlier "straight retrofit" notice merely discusses the need for noise reduction and emphasizes that current technology is available for a feasible retrofit program. The later notice on fleet noise level (FNL) was published after consideration of comments received in response to the first notice and presents a detailed methodology and implementation procedure that permits and encourages other alternatives as well as retrofit. The FNL proposal is well developed and could be converted to a regulation in a short time, while the straight retrofit proposal might require considerable additional development before it could be structured as a regulation.

Most of the members of Task Group 5 indicated that the FNL concept was preferable to a straight retrofit rule but that the FNL proposal as written should be modified with respect to some of the details. The most common objection was that the proposed formula for calculating FNL, using a logarithmic summation, does not give sufficient incentive to airlines to acquire aircraft having noise levels significantly below the FAR Part 36 Appendix C levels. For example, sufficient credit would not

be given to airlines that purchase new widebody aircraft. This objection does not appear to be compatible with PL 92-574 requiring protection to the public health and welfare. Noise exposure reduction cannot be accomplished by adding numbers of lesser noise sources. The major noise sources must be reduced first, then the minor sources become important. Merely purchasing and using widebody aircraft will have no significant effect on the overall community noise exposure unless the noisy narrow-body aircraft are retrofitted or replaced. The logarithmic summation procedure is much more representative of the physical and subjective characteristics of noise than is a linear summation procedure.

The point raised on incentives to acquire aircraft having noise levels lower than the criteria of FAR Part 36 is, however, a good one. The way to accomplish this is to have the FNL regulation continue, and not terminate in 1978, with a number of goals (or "gates" as one manufacturer suggests) that decrease in time, reflecting or exploiting technology advancements. The first gate would be the original value of the fleet noise level for each air carrier, which would establish his upper limit and which he would not be permitted to exceed. The second gate would occur on 1 July 1976 where the FNL originally established for each operator would be required to be reduced to a level that is halfway to the FAR Part 36 level applicable to his fleet.

The third gate would occur on 1 July 1978, when all of the aircraft for each operator would be required to comply with the FAR Part 36 Appendix C levels. At the third gate, the FNL for each operator would be somewhat below the FAR 36 levels applicable to his fleet, because many of his aircraft individually would have levels below the criteria, and none would be above. Also, the third gate would represent the situation to be expected if a straight retrofit rule were prescribed. The fourth, and all future gates, would be dependent upon future technological developments. For example, a fourth gate specified for 1985 might require FNL values to be five EPNdB below the values for the third gate.

The concept and structure of the FNL proposal appears adequate to effectively exploit the current technology (nacelle retrofit) and to allow and encourage the near

future technology (refan retrofit) to contribute as it becomes operable. In addition, the FNL concept would periodically provide a great deal of useful information to the Government on air carrier fleet size, mix, and utilization. However, there are several features in the proposal that weaken its effectiveness and should be removed. There are several features that would add strength if included.

In consideration of the preceding discussion and of the requirements of PL 92-574, the Task Group 5 report recommendation is that the FNL proposal (ANPRM 73-3) be prescribed as a regulation with the following exceptions:

1. Omit exemption for airplanes engaged in foreign air commerce,
2. Omit exemption for airplanes engaged in overseas air commerce,
3. Omit expiration date of 1 July 1978 and continue the FNL concept indefinitely,
4. Include airplanes engaged in intrastate air commerce,
5. Include FNL requirements for sideline noise as well as takeoff and approach.

A fleet noise level rule would be superior to and obviate the need for a straight retrofit rule such as considered in ANPRM 70-44.

PROJECT REPORT. TAKEOFF OPERATING RULE

Noise abatement takeoff operating procedures have two important requirements. First, they must be safe, standardized, and capable of being included in routine operation at any airport. Second, they must be capable of effecting significant noise reduction for critical noise impact areas. Unfortunately, no single takeoff procedure is capable of providing the necessary noise relief for all airport neighborhood communities. Consequently, more than one departure procedure should be considered for standardization, so that each airport can decide which procedure and runway combination best protects the public health and welfare of their neighborhood communities.

Individual airports, or runways of the airports, can be placed into three main categories regarding community noise exposure:

1. Sideline noise sensitive,
2. Near downrange noise sensitive,
3. Far downrange noise sensitive.

Consequently, three standardized noise abatement takeoff operating procedures should be developed so that all airport neighborhood communities can be assured of the minimum noise exposure that available safe flight operational procedures can bring. Various flight operational procedures are discussed in detail in the Task Group 2 report, and specific regulations in the form of project reports will be proposed, subsequent to this report, to the FAA, for noise abatement takeoff procedures. However, in brief, a sideline noise sensitive departure procedure would require a reduced-thrust takeoff. A near downrange noise sensitive departure procedure would require a steep initial climb and sharp thrust cutback (such as detailed in FAR Part 36 Appendix C). A far downrange noise sensitive departure procedure would be as presented in the FAA Project Report discussed in Section V-3 of this report and listed as Reference 14.1-320.

The recommendation of the Task Group 5 report is that the FAA proceed with all actions necessary to bring into effect the proposed turbojet powered takeoff operating rule as provided in Reference 14.1-320. The proposed rule is not optimum from a noise standpoint for all airports, but it does assure minimal noise in areas at relatively long distances from the airport, and, in general, some relief resulting from non-standardized departure procedures. Therefore, it is also recommended that the FAA continue to develop additional departure flight control rules that will provide minimum noise exposure for all airport communities while maintaining safe individual aircraft and system operations.

PROJECT REPORT. PROPELLER DRIVEN AIRCRAFT

The project report 14. 1-322 represents the basis for a rule that will halt the escalation of noise generated by propeller driven aircraft. However, for noise type-certification purposes, the public health and welfare would be better protected if the FAR 36 noise evaluation measure, Effective Perceived Noise Level (EPNL) in units of EPNdB, were specified instead of the A-weighted network in units of dBA and if three noise certification points were required instead of one.

In consideration of the preceding discussion and the requirements of PL 92-574, the Task Group 5 report recommendation is that the project report be developed as soon as possible into a regulation including the EPNL evaluation measure and a three-point measurement system similar to FAR 36, but with levels and distances chosen to fully exploit the availability of current source and flight path noise control technology for propeller driven aircraft.

DRAFT ORDER. AIRCRAFT SOUND DESCRIPTION SYSTEM

The Task Group 5 report recommendation is that the FAA provide public notice that the Aircraft Sound Description System (ASDS) as described in a draft order of 3 August 1972, which has evidently been given fairly wide but somewhat unofficial distribution, either is undergoing revision or will be cancelled. Consideration should be given to the noise exposure methodology developed by Task Group 3, which will be applicable to all major sources of noise and which will be used by EPA to define the limits of protection to the public health and welfare.

ADDITIONAL FAA REGULATORY ACTION

FAR PART 36

This rule, applying to subsonic transport category airplanes and for subsonic turbojet powered airplanes regardless of category, has been in effect for over 3 years. The levels of Appendix C provide an "umbrella" for aircraft propelled by the new

high-bypass ratio engine in the sense that the noise from such aircraft can be controlled to levels considerably below that criteria. Consideration should be given to lowering the criteria levels for all new aircraft. However, the existing criteria levels are reasonable (in the technologically practicable sense) for aircraft that are propelled by the existing low-bypass ratio engines and that cannot comply, except with the aid of some sore of retrofit modification.

The Task Group 5 report recommendation is that the criteria levels for Appendix C remain in effect as an "umbrella" for the existing low-and high-bypass ratio fleet. However, future FAR 36 category aircraft should be regulated by the FAA to levels of Appendix C minus five to ten. Caution must be exercised for the approach condition, as discussed in References 3.2-5, 3.2-18, and 3.5-190 to ensure that the criteria level is not lower than those that can be achieved by available source noise control technology.

It would be appropriate to include in the revised regulations the "Acoustical Change" adjustments proposed in NPRM 71-26 as determined necessary to make the rule clearer and more effective.

PROJECT REPORT — QUIET SHORT HAUL AIRCRAFT

The current effort to gather all possible types and varieties of R/S/VTOL aircraft (with their attendant variability in propulsion and lift systems, types of terminal facilities, probable route structures and economies) into one noise envelope appears to be impractical. This is especially true if the rule is to be established in time to properly influence design, development, and introduction of a truly quiet short haul aircraft system.

The Task Group 5 report recommendation is that the regulatory process be initiated to provide a noise rule for short haul aircraft that would require only a simple modification to FAR Part 36. The three-point measurement concept and Appendixes A and B are recommended for short haul aircraft. Only the criteria levels at the three points need be modified to reflect the lower noise levels required for city and suburban center operations and for comparatively low altitude cruise paths.

MISCELLANEOUS FEDERAL ACTION

The three-part regulatory plan presented in Section V-5 introduces the airport permit concept in which the controls on noise exposure, to the extent of protection of the public health and welfare, would be implemented at the airport. Such a permit can be incorporated in an airport certificate issued by the FAA under Title VI of the Federal Aviation Act of 1958. An alternative method of implementing airport noise standards, discussed by the Task Group I report, would be to transfer this authority to EPA.

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Appendix A

TASK GROUP POSITION PAPERS

Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

May 15, 1973

Mr. William C. Sperry
Office of Noise Abatement and Control
Aircraft/Airport Task Force
Environmental Protection Agency
Washington, DC 20460

Dear Bill:

During the meetings of your Environmental Protection Agency Task Group 4, you requested position papers from the members commenting on the various possible source control options for reducing aircraft noise.

The attached comments from Pratt & Whitney Aircraft are divided into two sections. The first section covers the various options for noise retrofit of the narrow-body commercial transport fleet. We do not believe that sufficient data is yet available to make a decision on the feasibility of retrofit. Our comments are based on the technical information available. The second section provides comments on the development of new quieter engines, including a comparison of the JT9D and NASA Quiet Engine.

These comments along with the previously provided report, "Noise Reduction Programs at Pratt & Whitney Aircraft," comprise the information we wish to provide to Task Group 4. We hope this information will be of assistance to you.

Sincerely,

PRATT & WHITNEY AIRCRAFT

W. E. Helfrich

W. E. Helfrich
Project Engineer - Noise Reduction

WEH:caz

Enclosure

EAST HARTFORD, CONNECTICUT 06108

NOISE RETROFIT OF THE NARROW-BODY COMMERCIAL TRANSPORT FLEET

The Environmental Protection Agency Task Group 4 is considering the various possible options for retrofit of the current narrow-body commercial transport fleet to reduce aircraft noise. Because the JT3D and JT8D powered aircraft comprise a large part of the current U.S. fleet, and have many more years of useful life, a decision on how to best provide noise reduction for these airplanes involves a complex array of economic and technical factors.

The FAA treated nacelle programs have not yet been completed and the NASA refan programs are still in the design stage. Results of these programs will provide comparative data on economics, performance and noise reduction. These results will determine whether a noise retrofit program is feasible which meets the requirements of Public Law 90-411. The following are Pratt & Whitney Aircraft's comments based on the technical information available.

General

Noise levels of the current narrow-body airplanes along with various retrofit schemes are shown in Figures 1, 2 and 3 at approach, takeoff and sideline conditions. Noise levels of the wide body aircraft are shown for comparison.

Summaries of the various retrofit schemes for a 727-200 and a 707-320B are given in Boeing reports, references 2 and 3, showing the estimated trade-offs between noise footprint area, airplane range and retrofit cost.

Nacelle Treatment

Treated nacelles which will meet FAR 36 noise levels have been developed and certified by Boeing for the 727 and 737 and are being developed by Douglas for the DC-9. As may be seen in Figures 1, 2 and 3, the untreated JT8D powered aircraft are close to FAR 36 noise levels, and consequently these treated nacelles will only provide small noise reductions. A typical case for the 727 shown in the reference 2 Boeing report indicates a modest retrofit cost and a small change in airplane range, but the noise footprint area for a 90 EPNdB contour is only reduced from 29.4 to 26.4 square miles. This comparison implies that treated nacelles for JT8D powered aircraft will not provide meaningful noise reduction to the airport communities in a retrofit program.

Treated nacelles are being developed for the 707 in a Boeing/FAA program. Flight tests to demonstrate performance and noise levels are currently in progress. Predicted flyover noise levels would provide significant noise reduction, as shown in Figures 1, 2 and 3. This would be equivalent to a reduction in noise footprint area from 54 to 21 square miles. The estimated retrofit cost is approximately 0.75 million dollars and the estimated reduction in range is 2.7% as shown in reference 2.

Nacelle Treatment and Jet Suppressor

A Boeing/FAA program to develop an ejector-suppressor and treated nacelle for the 727 was completed. As shown in reference 2, this configuration gave a siginficant reduction in the 90 EPNdB noise footprint area from 29.4 to 6.6 square miles but the range penalties were not considered reasonable for airline operation.

Boeing developed a plug nozzle suppressor for the 707, but the final configuration did not give any significant noise reduction.

Based on the adverse results of these extensive programs, it does not appear that the nacelle treatment and jet suppressor concept is currently a satisfactory candidate for retrofit.

Refan Engines and Nacelle Treatment

A detailed description of the JT8D and JT3D refan engines was given in reference 1.

The JT8D refan engine is expected to provide a 13% increase in static takeoff thrust, a 5% increase in max cruise thrust and a 3% reduction in cruise fuel consumption compared to the present JT8D engine. Primary jet velocity is reduced by 16%, giving a 9 dB reduction in jet noise. Predicted noise levels for JT8D refan engines with treated nacelles in 727, 737 and DC-9 airplanes are shown in Figures 1, 2 and 3 for approach, takeoff and sideline. These are NASA predicted noise levels, based on input from the aircraft companies, and are well below FAR 36 levels. As shown in reference 2, the 90 EPNdB noise footprint area for a 727-200 would be reduced from 29.4 to 3.9 square miles with refan engines, which would place the noise footprint almost within the boundary of many airports. This would provide significant noise reduction to airport communities.

The JT8D refan engine development program is in progress and a demonstration ground test is scheduled in early 1974.

The JT3D refan engine is estimated to provide a 17% increase in static takeoff thrust, a 7% increase in max cruise thrust and a 7% decrease in cruise fuel consumption compared to the present JT3D engine. Primary jet velocity is decreased by 14% resulting in a 7 dB reduction in jet noise. NASA predicted noise levels for JT3D refan engines with treated nacelles in the 707 are shown in Figures 1, 2 and 3. Where the FAA treated nacelles for the 707 are predicted at FAR 36 noise levels for approach and takeoff, the refan predictions are 6-7 EPNdB below FAR 36 at approach and takeoff, and sideline is 12 below FAR 36. The refan engines would reduce the 90 EPNdB footprint area from the baseline of 54 to 8 square miles and would provide a small improvement in maximum range as shown in reference 3.

The JT3D refan engine development has been terminated by NASA due to lack of funds. This refan program could still be completed in a reasonable time if it were reinstated in the near future, since the engine redesign has already been completed.

Re-engine

Retrofit of the JT3D and JT8D powered commercial transport fleets with new quiet engines is not feasible. There are no high bypass ratio replacement engines available in the 20,000 lb. thrust class, and engines of this type will not be available during the next few years which is the critical period for retrofit. Even if new engines were available, the retrofit cost of new engines and new treated nacelles would be considerably higher than the other retrofit options.

Fleet Replacement

There are no suitable aircraft available to replace the JT3D and JT8D powered fleet. The current large wide-body aircraft with high bypass ratio engines would not be efficient replacements for the many short range and long range airline routes where smaller passenger capacity is required. It is anticipated that a new 100-200 passenger aircraft with new technology engines may be introduced in the late 1970's which will gradually replace the current 707, DC-8 and 727 aircraft during the following decade.

DEVELOPMENT OF NEW QUIETER ENGINES

Pratt & Whitney Aircraft has been conducting noise reduction research and development programs for jet engines since the beginning of the jet era. Programs at P&WA in this field currently include basic noise research, development of noise reduction hardware for current engines, and development of new quieter engines. The current P&WA noise research programs along with retrofit programs for current engines were covered in reference 1. Some comments on the development of new quieter engines are included here.

JT9D Engine Noise Reduction Features

The JT9D high bypass ratio turbofan engine which powers the 747 and DC10-40 wide-bodied transports was designed in 1965, well before Federal aircraft noise standards were established. Because public concern over airplane noise was recognized at that time, noise suppression was included among the design objectives for the JT9D engine. Significant reductions in jet noise were achieved because the high bypass cycle chosen for the JT9D had lower jet velocities than earlier engines. Discrete tone noise from the single stage fan of the JT9D was minimized by reduction in fan tip speed, the omission of inlet guide vanes, providing ample spacing between the fan rotor blades and exit guide vanes, and the selection of the optimum number of fan blades and exit vanes. Acoustical treatment was incorporated in the fan exhaust cases. The low noise design features of the JT9D were selected based on prior P&WA fan noise research work. In addition to the low noise features of the engine, acoustical treatment is incorporated in the nacelles of both the 747 and the DC10-40 to provide aircraft noise levels below the requirements of FAR Part 36.

Comparison of the JT9D and NASA Quiet Engine

The NASA Quiet Engine Program has utilized the core from a current high bypass ratio engine as a vehicle to ground test the effects of fan tip speed on noise. One of the demonstrator engines, known as "Quiet Engine A", incorporated similar noise reduction features to the JT9D high bypass ratio engine and went one step further by lowering the tip speed of the fan. Whereas the fan RPM of the JT9D and the other high bypass ratio production engines was selected to ensure subsonic tip speed at approach thrust and hence the absence of combination tone noise from the inlet, the tip speed of the Quiet Engine A fan was selected to be subsonic at takeoff as well as approach. Because of the lower fan speed, the Quiet Engine A demonstrator has fan noise about 5 PNdB quieter than an engine such as the JT9D when both are installed in a nacelle that does not incorporate acoustical treatment. Comparisons between the takeoff noise level of Quiet Engine A and the JT9D scaled to the same size are shown in the following table at ground test conditions:

	Quiet Engine "A"	(De-Rated) Scaled JT9D	Scaled JT9D
Fan Pressure Ratio	1.4	1.4	1.50
200 Ft. Sideline Peak PNdB	121	121.5	125
Fan Tip Speed, Ft/Sec.	1040	1225	1370

Two columns are shown for the JT9D; one when the fan is operated derated at the same pressure ratio as the Quiet Engine A, and one for operation at the rated JT9D takeoff condition that reflects the higher design pressure ratio of the JT9D. As shown by the table, the "derated" scaled JT9D produces similar noise to the Quiet Engine A but the scaled engine is about 4 PNdB louder because of the higher tip speed and fan pressure ratio.

Noise levels of the scaled JT9D and the Quiet Engine A at approach thrust conditions are compared below:

	Quiet Engine A	Scaled JT9D
Fan Pressure Ratio	1.15	1.15
Fan Tip Speed, Ft/Sec.	695	850
200 Foot Sideline, Peak PNdB	107.5	112.5

At this part power condition, the lower fan tip speed of Quiet Engine A provides a noise level about 5 PNdB lower than the scaled JT9D with an untreated configuration.

P&WA/FAA Fan Research Program

The effects of fan tip speed on noise generation were also measured in an FAA sponsored research program at P&WA. High, medium and low tip speed fans were tested in a large scale outdoor fan noise rig. These results also showed that the lower fan tip speeds could reduce aft arc fan noise by about 5 PNdB. Noise levels from the low tip speed fan were very close to those measured on NASA Quiet Engine A, when scaled to the same size, as shown below:

	Takeoff		Approach	
	Quiet Engine A	Scaled FAA Fan	Quiet Engine A	Scaled FAA Fan
Fan Pressure Ratio	1.4	1.4	1.15	1.15
Fan Tip Speed, Ft/Sec.	1040	910	695	585
200 Ft. Sideline, Peak PNdB	121	118.5	107.5	106.5

Future Engine Technology

Both the NASA Quiet Engine Program and the PGWA/FAA Fan Research Program demonstrated that source noise reductions could be achieved by lower speed fans. However, this technology cannot be arbitrarily applied to all new engine designs. The low speed fan gives a heavier, larger and more expensive engine design with present technology because of the larger low turbine required. This leads to a larger, less efficient aircraft for the same mission. Conversely, a high speed fan gives a lighter, less expensive engine and a more efficient aircraft. The amount of acoustic treatment required and the associated performance losses are significant in determining the optimum engine cycle. An airplane/engine system trade study is essential to determine the best economics for a given set of requirements.

Each airplane/engine installation presents unique problems and specific design requirements. The type of engine installation has a significant effect on the aircraft noise level. Choice of the optimum engine design for a particular installation requires a thorough study of all approaches to obtaining a given noise objective. As noise research programs provide new techniques for reducing engine noise generation, these will be included in the engine cycle trade studies.

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APPROACH NOISE LEVELS AT 1 N.MI.

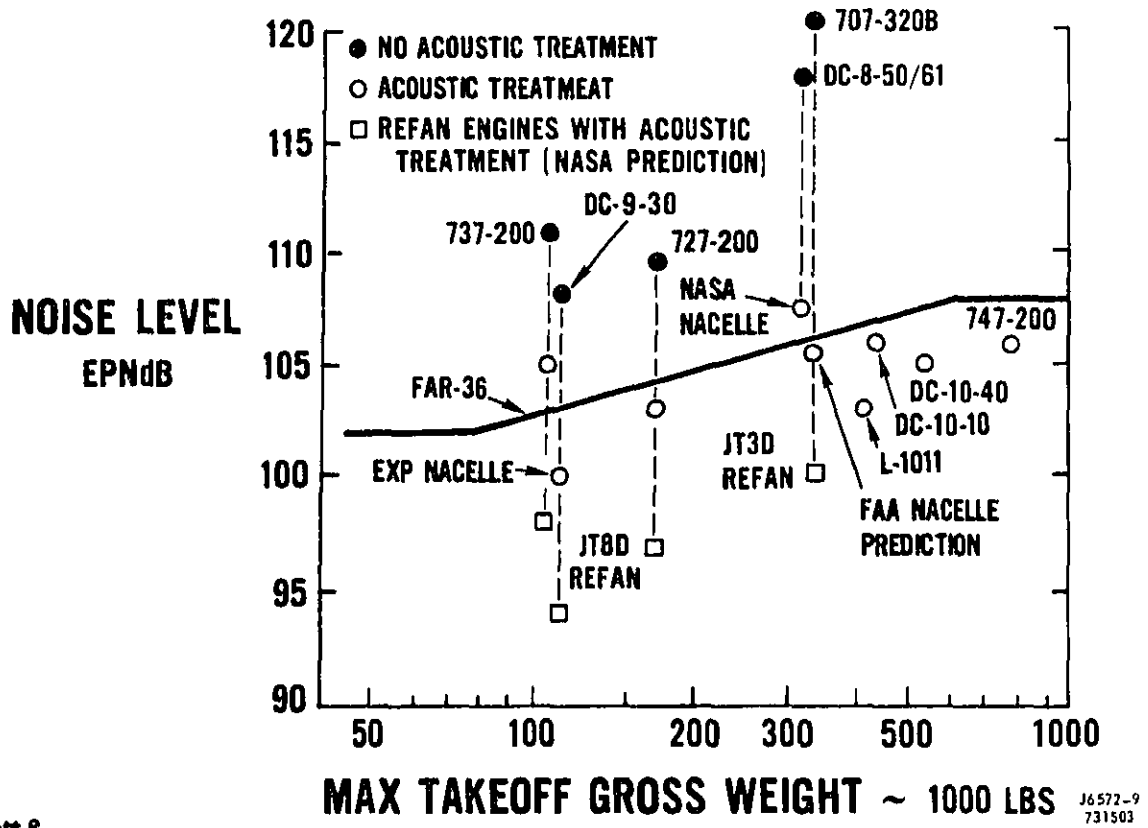

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FIGURE 1

TAKEOFF NOISE LEVELS AT 3.5 N.MI.

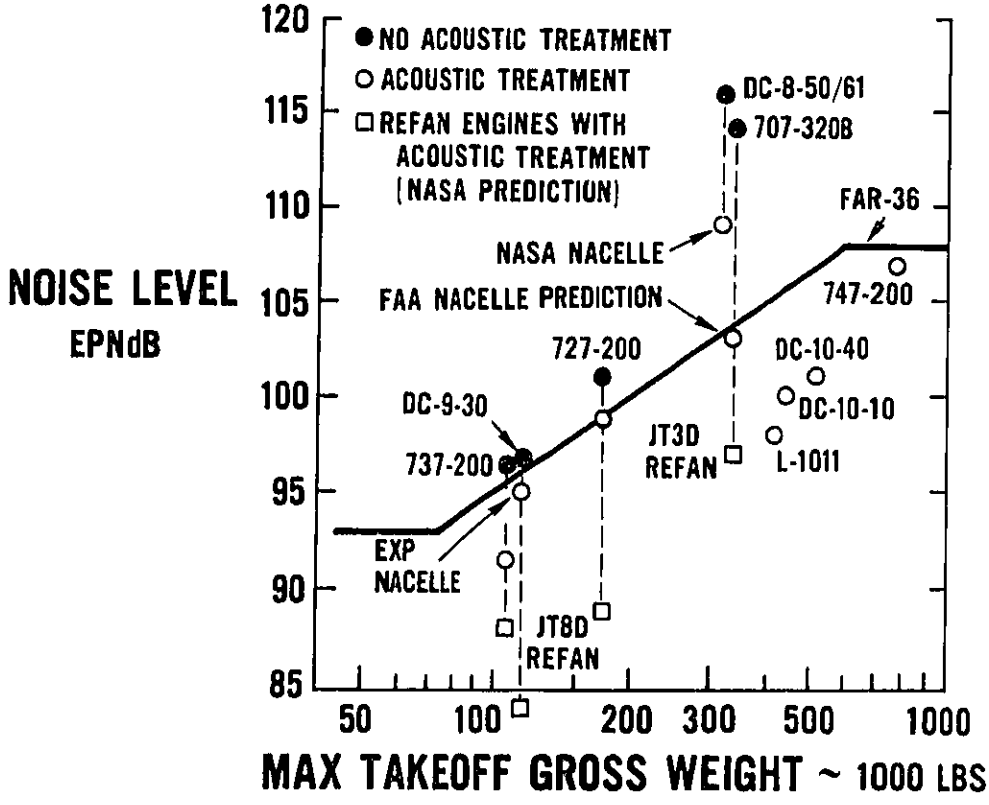

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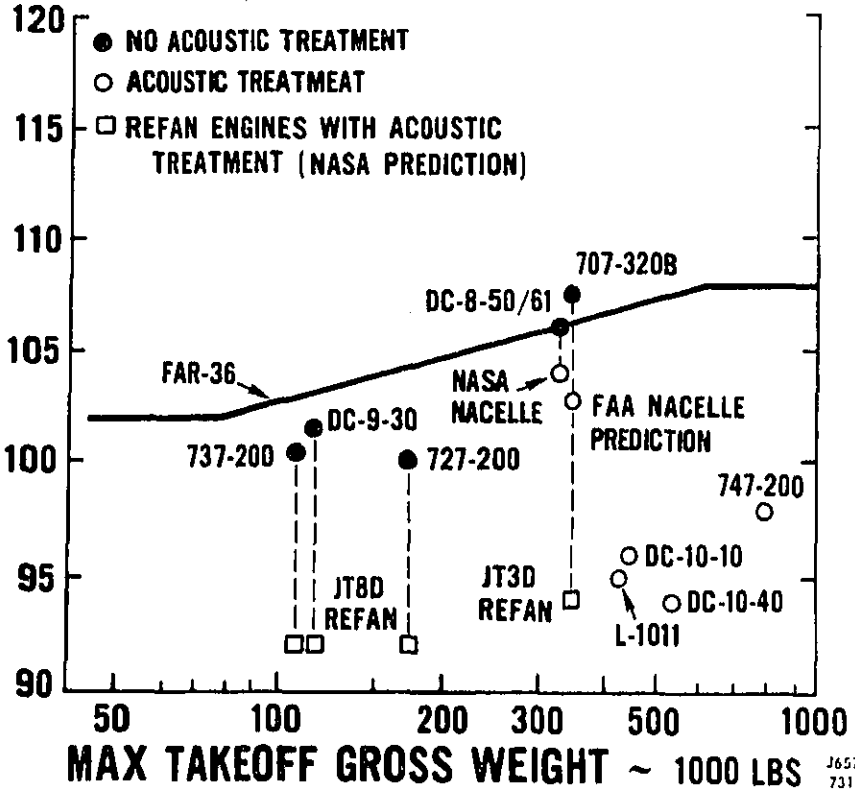
FIGURE 2

SIDELINE NOISE LEVELS — 1500 FT FOR 2 AND 3 ENGINES; 2100 FT FOR 4 ENGINES



Pratt & Whitney Aircraft — Division of United Aircraft Corporation

FIGURE 3

16 April 1973

CONSIDERATIONS RELEVANT TO QUIETENING OF AIRCRAFT NOISE IN THE IMMEDIATE FUTURE

The noise environment around airports is governed almost entirely by aircraft powered by engines designed about a decade ago. With less than 5% of world fleets currently comprising the newer more quiet Trijets, the L-1011 and DC.10, this situation is likely to prevail until at least 1978, when the FAA propose that all types comply with FAR Part 36 Standards. Even then the improved standard of the high bypass engines over modified earlier counterparts will ensure that newer types cannot be cited as the main offenders. There would therefore appear to be little justification for demanding unduly improved standard from new equipment, for the effect would not be reflected in the overall environmental picture.

However, some improvement in noise standard for new types entering service in the second half of this decade is desirable, to ensure that the problem is largely solved during the 1980's. Having said this, two important problems to be addressed are how much the improvement should be and when new regulations should be enacted. The following paragraphs express our view and are offered to the EPA for their consideration.

The RB.211 is a prime example of the new breed of quiet engines. Its main features were designed in 1966, development commenced in 1967, and the first production engines entered service in early 1972. Any radically new engine can be expected to follow approximately the same cycle of events, and therefore it would be unrealistic to apply stringent new regulations before the end of this decade, since the technology to meet such standards is not developed today.

What is available today is the technology to make limited, but nevertheless, worthwhile improvements. The improvements possible are limited by the new problems that have been revealed in the developments of the newer engines, a prime example being the noise floor created by the core engine. This fact has already been recognised by U.S. Government Agencies in the Research and Development Contracts offered to Industry in the recent past, and clearly the answers will not appear without considerable research, involving in some cases new test facilities.

We therefore see two clearly defined stages in improving the noise environment, viz:

a) limited improvements possible with todays technology, for implementation on engines entering service in the second half of this decade.

b) further improvements made possible by ongoing research, over the next three to five years, for implementation on engines entering service during the early to mid 1980's.

Let us consider each category in turn.

LOCKHEED-CALIFORNIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION
BURBANK, CALIFORNIA 91503

April 25, 1973

Mr. W. C. Sperry
Chairman, Task Groups 4 & 5
Aircraft/Airport Noise Study Task Force
Office of Noise Abatement and Control
Washington, D.C. 20460

Dear Bill:

As part of the Lockheed effort in support of the EPA Aircraft/Airport Noise Task Force, we some time ago asked Rolls-Royce to provide their evaluation of the potential for further engine noise reduction. I feel that consideration of the Rolls-Royce input by EPA is appropriate both because of the pre-eminence of Rolls-Royce in aircraft engine noise technology and because Rolls-Royce engines power a growing proportion of the U.S. air transport fleet.

The attached statement was prepared by Mike Smith, Manager of the Rolls-Royce Noise Department, and approved for submission to EPA by Mr. E. M. Eltis, Director of Engineering, RB.211 Programme. I hope you will find it useful.

Sincerely,

H. Drell

H. Drell
Flight Sciences Division
Commercial Engineering

HD:JRT:jg
Attach.

a) Improvements possible using todays technology

On an engine of the RB.211 type there are two important flight conditions to be considered in defining the improvement afforded by engineering action. These are the high power case for lateral and Take-off noise, and part power for Approach.

The RB.211 noise source distribution has been defined as shown in Figure 1. Without resorting to major changes to the rotating machinery improvements are possible by virtue of better aerodynamic standards and improved liner performance. The latter may result from improved design of the liner structure, or the introduction of extra surfaces in the main air-flow passages.

Already we are proposing modest improvements for developed versions of the RB.211, and estimate that such action will improve the standard by about 2 EPNL. Even these improvements are not, however, without penalty. The weight change alone would cost the Tristar the equivalent of five passengers (unless the aircraft weight can be increased by an equivalent amount). On an aircraft already bettering Part 36 standards by 10 EPNL at full power and 4 EPNL at approach it is difficult to see the extra cost being readily borne by the operator.

Further improvements are possible, at an increased operating penalty. The Company entered a partnership with the U.K. Government nine months ago to produce a quiet engine demonstrator based on the RB.211. This programme is directed at improving the noise standard by 5 PNdB, but the modifications are not in any way designed for the production powerplant. Some of the modifications could eventually be incorporated in a saleable powerplant, but others like the full length bypass duct splitters, would involve major redesign, performance penalties and mechanical complication. For example the whole thrust reverser system would need replacing. To integrate all the improvements in a powerplant would cost around 350 lbs weight per engine, and the cruise sfc penalty would probably be of the order of 1/2%. Furthermore if significant modification were required to the inlet system, for example by the introduction of a splitter ring, the full effect would be a further increase of sfc of at least 1/2% and 200 lb in weight per engine. Moreover such devices would require careful consideration of the vibration problems of the fan assembly and may necessitate changes to the fan design.

We would estimate that a 5 PNdB package would take not less than four years to develop and apply to a production standard engine. Assuming a go-ahead early in 1974, quieted production engines could be available in the late 1970's.

The overall result, taking installed performance into account, would probably be a Trijet some 3 - 4 EPNL better than the standard of the TriStar today.

b) Further improvements in newly designed engines

Our research programmes are indicating that basic improvements, other than the extensive use of sound absorbing materials, will only come from more extensive redesign.

Even so the potential for such further basic improvement does not, at the present time, appear to be more than about 3 PNdB, and it is our belief that the contribution of the powerplant alone cannot be regarded as the ultimate solution to the noise problem. It will be necessary for the airframe design to be even more closely integrated with the powerplant to ensure full benefit from shielding by wing and fuselage structures, and such constraints may well dictate the design of future airplanes. Another factor clearly affecting potential noise reduction is the noise generated by the airframe itself, and unless this can be reduced it is unprofitable to demand an improved standard from the engines alone.

CONCLUSIONS

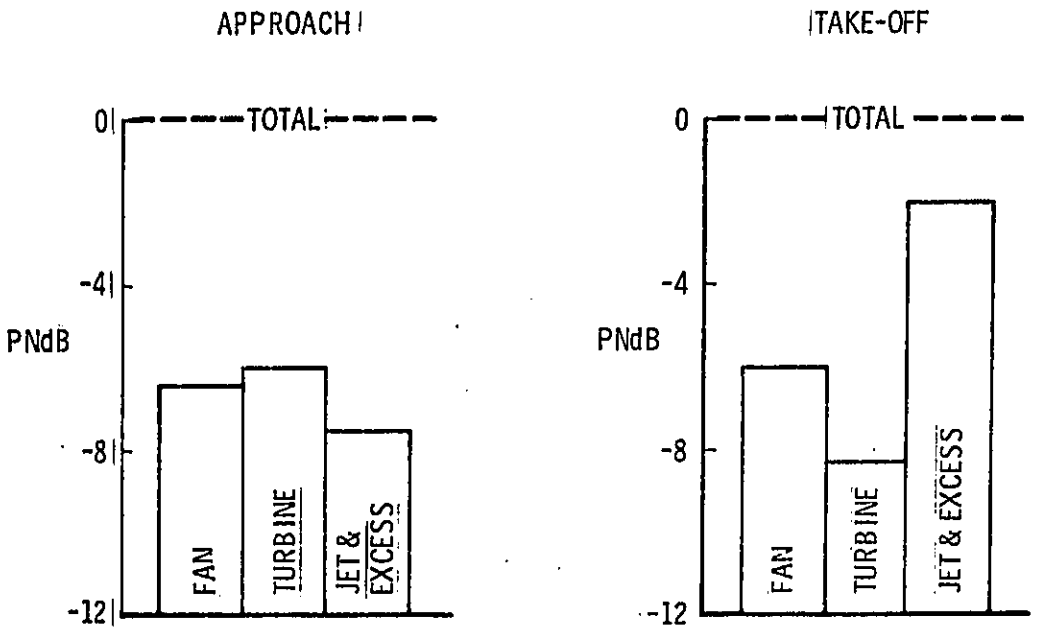
We see two distinct stages relating to future noise legislation;

1. A reduction in Part 36 standards during the latter part of this decade, probably of the order of 4 - 8 EPNL with the provision that the measuring points are modified to remove the current inequality between the landing and take-off measuring distance. Such reduced levels could be demanded from all new aircraft, including developed versions of existing types. The relationship between the two, three and four engined aircraft would however need careful consideration.

2. A further reduction of the order of 5 EPNL during the early part of the 1980's, to be applicable to completely new types only. The practicality of this reduction, of course, depends upon the level to which airframe noise can be reduced.

Beyond that point it is necessary to define both the technically feasible noise floor and the noise level beyond which community exposure is not longer a problem. Assuming that these two criteria are not coincident, it will be necessary to carefully balance technical feasibility and economic impact against any long term legislation proposals.

RB.211-22C IN FLIGHT NOISE SOURCE DISTRIBUTION



Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

May 11, 1973

Mr. William C. Sperry
Office of Noise Abatement and Control
Aircraft/Airport Task Force
Environmental Protection Agency
Washington, D.C. 20460

Dear Bill:

During the meetings of your Environmental Protection Agency Task Group 5, you requested position papers from the members commenting on various FAA regulatory actions on aircraft noise.

The attached enclosure provides brief comments from Pratt & Whitney Aircraft on several regulatory actions proposed by the FAA. The comments include suggested revisions and recommended action for each regulatory notice. These regulatory actions will contribute toward the protection of public health and welfare provided the final noise rules are truly economically reasonable so they do not disrupt the national aviation system.

Sincerely,

PRATT & WHITNEY AIRCRAFT

W. E. Helfrich

W. E. Helfrich
Project Engineer - Noise Reduction

WEH:m

Enclosure

EAST HARTFORD, CONNECTICUT 06108

COMMENTS ON FAA NOISE REGULATORY ACTIONS

ANPRM 70-33: SST NOISE TYPE CERTIFICATION STANDARDS

No action is recommended on this ANPRM at the present time since it is too early to consider firm requirements for SST noise certification. After additional research is completed and second generation SST design studies have progressed to the point where the noise/economics/performance trades are better known, then an NPRM could be considered. Any SST rule should be a separate part of the FAA standards, not a revision to Part 36, because SST operating characteristics will be completely different from those of subsonic aircraft.

ANPRM 70-44: AIRPLANE NOISE REDUCTION RETROFIT REQUIREMENTS

Comments from Pratt & Whitney Aircraft on the various possible options for retrofit of the JT3D and JT8D powered commercial transport fleet are given in Reference 1. It is our opinion that this ANPRM should be dropped and retrofit options be incorporated in a modified version of the fleet noise level concept in ANPRM 73-3.

NPRM 71-26: NOISE TYPE CERTIFICATION & ACOUSTICAL CHANGE APPROVALS

The temperature and altitude accountability section would present serious limitations. The present FAR 36 certification method of taking noise data over a limited range of conditions and then correcting the data to a reference day is a satisfactory method for comparing aircraft noise levels to a certification standard. Requiring Appendix C noise level compliance at all airline operational temperatures and altitudes would impose unreasonable operational restrictions on payload and range for an airplane which would meet Appendix C at reference conditions. The effect of this section would be to severely restrict airplane performance by highly suspect extrapolation techniques with little community noise benefit.

The proposed elimination of cutback thrust during takeoff and sideline noise tests to certificate acoustical changes for older aircraft which do not meet FAR 36 noise levels is not economically reasonable. This proposal would seriously curtail development of aircraft growth versions. It is suggested that thrust cutback be allowed if the noise tests before and after an acoustic change are made on a comparable basis.

We agree that the 90 PNdB "floor" should be eliminated for calculation of aircraft noise levels by FAR 36, but the duration correction factor should be limited to a range of +5 to -10 dB.

The effective date of an amendment resulting from this NPRM should be at least 60 days after the amendment is adopted. The FAA proposal for a retroactive effective date the same as the NPRM issue date is unreasonable and without justification.

NPRM 72-19: NEWLY PRODUCED AIRPLANES OF OLDER TYPE DESIGNS

The proposed compliance dates of July 1, 1973 for aircraft over 75,000 lbs. TOGW, and July, 1974 for aircraft under 75,000 lbs. are both too early. The compliance dates should be established to provide the aircraft manufacturers reasonable time to complete development, certification and production lead time for the aircraft/engine modifications required.

Parts intermix should be allowed in airline operations to eliminate the requirement for two separate spare parts systems.

ANPRM 73-3: CIVIL AIRPLANE FLEET NOISE REQUIREMENTS

The basic Fleet Noise Level (FNL) concept provides a choice of several alternatives for meeting lower noise requirements. The ANPRM as written, however, presents a number of serious problems which without some major revisions could create an unreasonable economic burden for most airlines.

The proposed formula for calculating FNL with a logarithmic summation does not give sufficient credit to the airlines which purchase new widebody aircraft which are below FAR 36 noise levels. We recommend that the formula for calculating FNL be revised to a summation of noise levels which would allow aircraft having noise levels below FAR 36 limits to offset aircraft above FAR 36. This would give airlines the incentive to purchase new quiet aircraft and to retrofit with the quietest configurations to reduce their FNL.

The concept of not allowing the initial FNL number to increase is unreasonable since it would prevent replacement of smaller aircraft with large widebody aircraft if the noise level increases. An allowable adjustment should be made as the operator's fleet mix changes in takeoff gross weight.

It is inconsistent for the FNL rule to specify no trade-offs between takeoff and approach noise levels when FAR Part 36 does permit trade-offs.

The FNL concept will not be feasible until it is determined that there is an economic method for the 707 and DC-8 to meet FAR 36 noise levels. Forced premature retirement of JT3D powered aircraft would be too severe an economic penalty. Therefore, this technology question must be settled before any FNL rule can be proposed.

Another deficiency in the proposed FNL is that it incorporates no incentives to utilize noise abatement operational procedures. It is recommended that some provision be made in the FNL to account for the noise reductions available from both approach and takeoff operational procedures.

FAA PROJECT REPORT: NOISE CERTIFICATION RULE FOR QUIET SHORT HAUL CATEGORY AIRCRAFT

We agree with the statement in this Project Report that the Quiet Short Haul system development is in such a state of flux that is too early to establish QSH noise standards.

As noted in the report, QSH aircraft types include rotary wing, turboprop, turbofan with blown flap or augmentor wing, lift pod, and fan-in-wing aircraft. These can probably be divided into VTOL, STOL and RTOL types which would operate from different length runways. These aircraft will also vary by the number of passengers, range and cruise speed.

It would appear that QSH aircraft will have to be divided into numerous classes for certification with different noise limits and different measurement locations. The noise limits for each class should probably vary with the number of passengers.

It is obvious from the recommended items to be included in the ANPRM that a vast amount of specific data is needed from the aircraft manufacturers on QSH aircraft noise characteristics and QSH economics before a viable noise rule can be constructed. The list of required information in the Recommendations appears to be quite complete, but would require considerable time to collect and digest. It is our suggestion that this information be collected by the FAA prior to any rulemaking activity on QSH.

Reference 1: Letter from W.E. Helfrich to W.C. Sperry dated 5-14-73 providing comments from Pratt & Whitney Aircraft for EPA Task Group 4.

GENERAL ELECTRIC
COMPANY
CINCINNATI, OHIO 45215

AIRCRAFT ENGINE GROUP

22 May 1973

Dr. Alvin Meyer
Environmental Protection Agency
401 M Street, N. W.
Washington, D. C.

Dear Dr. Meyer:

In reference to discussions at the meetings of the EPA Aircraft/Airport Noise Study Task Force, the views of the Aircraft Engine Group of General Electric on aircraft noise regulations can be briefly summarized as follows:

1. FAR 36 (as issued on 23 November 1969) has been effective in stimulating noise reductions. For example, new wide-bodied aircraft have been certified at or below Appendix C levels.

2. We suggest the promulgation of the subsonic CTOL Fleet Noise Rule we proposed in our comments on ANPRM 73-3, sent to the FAA Rules Docket on 12 March 1973, rather than a series of separate, incomplete and possibly conflicting regulations. For example, we favor regulations which would require all newly-produced aircraft to comply with FAR 36 at reasonable dates, depending on the aircraft type. The suggested Fleet Noise Rule would accomplish this. We do not favor regulations which would require all of the current fleet of older types of aircraft now in service to be retrofitted with nacelle acoustic treatment or refanned engines. The suggested Fleet Noise Rule would promote some retrofit of some aircraft types, depending on the particular airline operator's constraints.

   A proper Fleet Noise Rule would allow an airline a decreasing "noise quota" with time, out into the 1980 period. We believe that such a method would offer the airline operators maximum flexibility to control noise through a combination of off-loading, operating procedures, retrofit and fleet replacement in the most economic and practical way for each airline and aircraft type. It is important to note in this connection that most airline fleets use a mixture of two, three, and four engine aircraft across a wide range of different stage lengths and numbers of operations.

We suggest promulgation of an FAA regulation of the generic type of the Fleet Noise Level (FNL) proposed by FAA in ANPRM 73-3, but with important modifications proposed by General Electric, as follows:

a. The noise measure in such a rule should be weighted to give considerable incentive to airlines to acquire aircraft having noise levels significantly below Appendix C levels. This was not the case with the noise measure proposed in ANPRM 73-3.

b. Rather than the interim nature of the FNL rule of ANPRM 73-3, which would terminate in 1978, we suggest a rule with a number of "gates" at specified times, requiring aircraft "on-the-average" to get half-way-down to FAR 36 by some date, down to FAR 36 by a later date, and down to levels below FAR 36 by some still later date. The noise levels shown on the attached figure are suggested as typical certification levels for new aircraft in the late 1970's, based on our views of possible noise reduction, available technology and economic reasonableness, over the wide range of aircraft types covered. The suggested approach noise levels are for the flap settings used in normal operating practice, rather than the maximum flap settings as required currently in FAR 36. The use of normal flap settings is a worthwhile noise abatement operating procedure in itself.

It should be noted that separate certification rules will be required for supersonic transport aircraft and for quiet short-haul aircraft, due to the different characteristics of these aircraft types.

It is also suggested that FAR 36 be modified to encourage the use of two-segment approach procedures, by specification of an additional special reference point, such as a 3 1/2nm approach point, and maximum allowable noise levels at this point. If this method were used, the FAR 36 tradeoff provisions should be maintained at the normal three reference points only.

3. EPA has proposed airport regulations as such. The cognizant authority for such regulations should be a Federal agency, in order to assure that this vital and integral part of the national transportation system is not adversely compromised by local piece-meal actions. Therefore, such definitive Federal pre-emption of airport noise

regulations should be a part of the proposed action in order to afford equitable treatment for all airport users, including airlines. Appropriate FAA noise source control and aircraft path control regulations should separately provide final "design requirements" for manufacturers, as FAR 36 has done in the past.

4. An increased level of aircraft noise reduction research and development is needed in the following areas:

   a. Development of noise technology for advanced CTOL engine/aircraft systems which emphasize reduction of the economic penalties of lower noise, i.e., lower cost, weight and performance losses.

   b. Identification of improved measures of airport community noise annoyance for aircraft operations making noise equal to or less than required by FAR 36.

   c. Determination of aircraft-alone noise levels and identification of means to control this noise source.

General Electric has been active in aircraft noise reduction since the middle 1950's, in both the civil and military aircraft areas. Substantial progress has been made, as evinced by the civil fleet introduction of the new wide-bodied aircraft, which are much quieter than their predecessors. We believe that Federal aircraft noise regulations and additional research and development of the types suggested above will achieve further reductions in airport community noise exposure.

Very truly yours,

J N Krebs

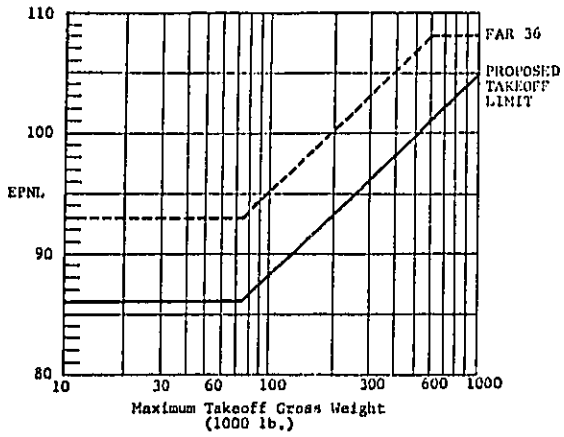
J. N. Krebs

attach.

CERTIFICATION LEVELS FOR NEW AIRCRAFT IN THE LATE 1970's TIME PERIOD

TAKEOFF

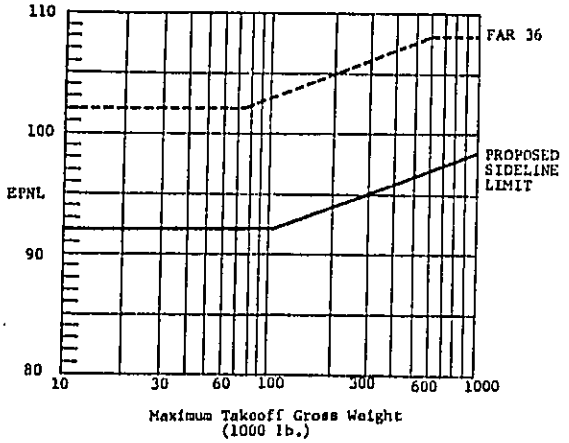
3.5 N. Mi. from Brake Release



SIDELINE

0.35 N. Mi. (4 Engine A/C)

0.25 N. Mi (Less than 4 Engines)

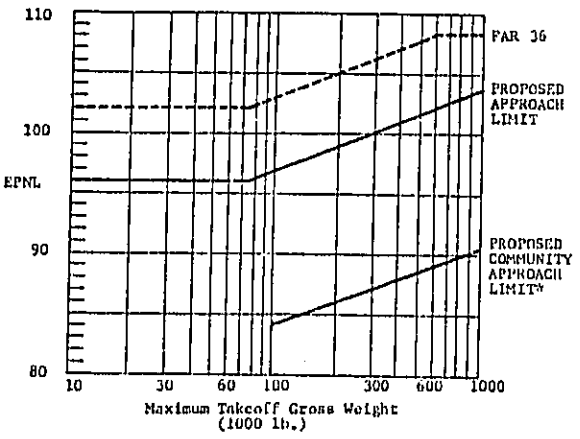


APPROACH

1.0 N. Mi. from Threshold

COMMUNITY APPROACH

3.5 N. Mi. from Threshold



*Based on 6°/3° Two-Segment Approach with 600 ft. Intercept

Telegrams: Britair Weybridge Telex Cablegrams: Britair Weybridge

British Aircraft Corporation Limited

COMMERCIAL AIRCRAFT DIVISION

BROOKLANDS ROAD WEYBRIDGE SURREY

Telephone Weybridge 45522

Telex: 27111

Tel. Extn.

Our Ref.

Your Ref.

Mr. William C. Sperry,
Chairman (Task Group 4 and 5),
Aircraft/Airport Noise Report Group,
Environmental Protection Agency

17th May 1973
Ref: MGW/css/127

Regulation of Concorde Noise

Dear Sir:

You informed the Concorde Manufacturers on May 16th 1973 that the Environmental Protection Agency would welcome the receipt of a statement relating to Concorde Noise for consideration by the Task Groups of which you are Chairman, and you further stated that such a statement would be referred to in the onward reporting by these Task Groups if received in due time.

In consequence, we enclose herewith a document entitled "Recommendation of the Manufacturers to the Environmental Protection Agency related to the Regulation of Concorde Noise" reference MGW/css/126, dated 17th May 1973, which is submitted on behalf of the four Concorde Manufacturers.

Yours faithfully,

M. G. Wilde
Concorde Project Director
British Aircraft Corporation (CAD)

Telegrams: Britair Weybridge Telex Cablegrams: Britair Weybridge

British Aircraft Corporation Limited

COMMERCIAL AIRCRAFT DIVISION

BROOKLANDS ROAD WEYBRIDGE SURREY

Telephone Weybridge 45522

Telex: 27111

Tel. Extn.

Our Ref. MGW/css/126

Your Ref.

May 17, 1973

Recommendation of the Concorde Manufacturers to the Environmental Protection Agency Related to the Regulation of Concorde Noise

The four companies who are jointly involved in the design and manufacturer of the Concorde supersonic aircraft (the British Aircraft Corporation, Rolls-Royce, Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation and Societe Nationale Industrielle Aerospatiale), supported by the British and French Governments, believe that this advanced form of transportation will be of great benefit to the whole community by enhancing worldwide communications, fostering international commerce and encouraging economic growth. In addition they believe it will give vital and new impetus to the future development of the air transport industry.

Whilst the challenge of providing such a revolution in air transportation was recognized as requiring extreme endeavours in the areas of airframe aerodynamics, powerplant design, structural efficiency and many others, the manufacturers and the Governments have been conscious of the acute need not to worsen the airport environment. In consequence, from the inception of the programme, noise control has been a key objective.

A series of detailed reports entitled "Concorde Airport Noise and Silencing Programme" have been submitted to the Environmental Protection Agency (Refs. 1, 2, 3 and 4) which cover the large amount of research and development which has been undertaken with the objective of achieving noise levels at entry into service directly comparable with the many long-range subsonic jets, which are expected to remain in service for many years to come.

Despite the inherent difficulties in this area, arising fundamentally from the need to employ high thrust engines using the straight jet engine cycle in combination with a small span, slender wing configuration, these objectives will

be achieved by the use of completely novel silencing means in the nozzle technology and in the engine aerodynamics and control systems. The development of these silencing means has required the deployment of a very significant proportion of the total project manpower and funds.

Whilst the manufacturers will have reduced the noise levels of Concorde at entry into service so as to achieve noise parity with the contemporary straight jet and low by-pass fan jet long-range subsonic aircraft, they cannot, using currently available technology, match the noise performance of the latest high by-pass engined subsonic aircraft. The requirements for supersonic flight are such that it is not technologically practical to utilise the large diameter high by-pass ratio fan engines which enable new subsonic aircraft to achieve the noise levels set by FAR Part 36 Annex C.

Since Concorde will be used predominantly on international routes and will represent only a very small proportion of such total operations, we recommend that Concorde be regulated to noise levels as low as are capable of being achieved by best effort available through technology or operational controls, in accordance with the recent I.C.A.O. Committee on Aircraft Noise (CAN 3) recommendation.

Mr. M. G. Wilde	Dr. P. H. Calder
for and on behalf of BRITISH AIRCRAFT CORPORATION LTD. and SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE	for and on behalf of ROLLS-ROYCE (1971) LIMITED and SOCIETE NATIONALE D'ETUDES ET DE CONSTRUCTION DE MOTEURS D'AVIATION

Ref. 1 - Concorde Airport Noise and Silencing Programme, (DO/JAH/LG/8904), October 1972.
Ref. 2 - Annex 1, Test Facilities, (DO/JAH/DW/8964), October, 1972.
Ref. 3 - Annex 2, Manufacturers Further Studies of Noise Reduction, (DO/JAH/LG/9198), 20th February 1973.
Ref. 4 - Annex 3, The Economic Aspects of Silencing Concorde, (DO/JAH/LG/9239), January 1973.

25 KNOB HILL ROAD, GLASTONBURY, CONNECTICUT 06033
203 - 633-2835
National Organization to Insure a Sound-controlled Environment

May 15, 1973

U. S. Environmental Protection Agency
Office of Noise Abatement and Control
Aircraft/Airport Noise Report Study
Task Group 4 and 5

William C. Sperry, Chairman

Dear Mr. Sperry:

We are pleased with the thoroughness and appropriateness of the draft reports on "Aircraft Noise Source Technology" and "Noise Regulatory actions by the Federal Aviation Administration" which you issued on 5 May 1973. Our compliments apply particularly in view of the short period of time available to collect the information from so many diverse sources. We are particularly pleased with your policy of relating technology application,Standards and Regulations to the local airport situation pictured in Figure 7 of the Task Group 5 Report.

As is usually the case we need not comment on the many sections of these reports with which we agree and comment only on the ones where we feel the text could be improved. On this basis the following suggestions for additions and/or changes are submitted.

1. With regard to minimum achievable noise levels some data on the Lockheed C 5 are being used to indicate that we can't go much lower in approach noise levels because of aircraft turbulance noise. This is a familiar tune which we have heard since the 1950's. It doesn't sound at all appropriate coming from a group working on technology.

During the test program at JFK prior to the Hempstead Case, a mass of data were obtained at about the FAR 36 approach measuring point which indicated about 90 PNdB as the throttle closed approach noise for 707's, DC 8's and 880's.

This is about 5 dB below the Figure 3 - 7 curve. This indicates that your full flaps curve is high. But the important point is that we are interested in the operating conditions before the flaps are fully extended and before the thrust level is increased again.

I am enclosing "Recommended changes to text of Report of Task Group 4" which could be used to eliminate some of the unnecessarily negative impact which the data on aircraft turbulance noise seems to have had.

2. The organization of the Task groups and the areas which they cover has left the use of Preferential Runways and some other means for noise abatement which are a function of technology without any task group or chapter in the report. Preferential runways are mentioned in the Task Group 2 draft but they should be discussed here from the standpoint of possible benefits with improved technology.

The FAA has no regulations on the use of preferential runways. The airlines and the airports have established local rules for preferential runway use and they are like most voluntary rules, not very strict. No one is pushing the state of the art, i.e., obtaining equipment and procedures which could make the large contributions to high noise exposure area reductions which are possible.

There are also other possible technological contributions to the reduction in areas of high noise exposure which are not included in the Task Group 4 list of current or future technology options. These include steeper climbout performance which has already been introduced in the new technology three engine transports and which could be improved upon in two engine 707 - DC 8 replacements. If requirements were imposed on medium and small hub airports to reduce the high noise exposure area this need would be quickly communicated to the manufacturers by the airlines and steep climb capability aircraft with short EPNdB footprints would be made available.

At some large hub airports where long range aircraft will operate and where operation over low noise sensitivity areas is not possible special provisions will be required to achieve land use compatibility. In this highly technological age the air transport industry should not be reluctant to do R & D on innovative systems for getting long range aircraft into the air without too much noise. Means are available for this purpose they need to be reduced to practice. A financial squeeze on those

airports which have no other alternative is needed to bring about these innovations.

The enclosure "Other Means for Noise Abatement is designed to provide additions to the report of Task Group 4 at each place in the report where additions are required to cover these other means for noise abatement.

We are particularly pleased with the manner in which you have handled proposed regulations in your Task Group 5 report. In your final section the three part regulatory plan involving the writing and enforcement of regulations by FAA, the proposal of regulations by EPA and the airport permits prescribed and enforced by EPA appear to be a practical arrangement for arriving at the result desired. We would like to recommend that responsibility for the development of safe practical and economically feasible aircraft designs and aircraft operating procedures be placed in the hands of NASA. This would make available to EPA and FAA considerable expertise which NASA has in this area. At the present time NASA does a considerable amount of important work on aircraft design and operations for noise abatement which gets lost because there is no channel through which this technical expertise is reduced to practice in airline operation.

We concur in your concept that decisions should be made at the local level regarding airport services to be provided to a particular area (size of NEF contours) and the disposition of the problems involving incompatible land use. We expect that with local decisions in these two areas and local provision for changes in land use (together with the financing of land use change) the ultimate solution to this problem which has so long plagued every airport community in our country is within reach.

We wish you well in your next step which will involve the development of recommendations along this line to be submitted to the FAA.

Sincerely,

John M. Tyler
Executive Director

Lloyd V. Hinton
Executive Director

Enclosures

Recommended Changes to text of Report of Task Group 4

Page 3 - 11 line 8 after the "approach conditions" add with flaps extended

line 14 after "etc" add especially the flap systems which produce large amounts of drag on approach. With the landing gear down and the wheel well doors closed the landing gear produces the next largest amount of drag, turbulance and therefore aerodynamic noise. The landing gear could of course be streamlined if this became necessary to lower the noise floor.

lines 15, 16 replace sentence with Airframe noise from current aircraft on approach as measured or predicted is presented in Figure 3 - 7.

line 19 replace the last paragraph with. The most controlling parameters in aerodynamic noise generation are flap angle and aircraft velocity. The turbulance and therefore aerodynamic noise varies with flap angle but depends to a large extent on the flap design. The landing velocity change results in a change in EPNdB proportional to velocity to the fourth power. This characteristic should be considered when appraising the effectiveness of alternative approach and landing procedures. For example, in a decelerating approach the aircraft would not only have low engine noise but would be clean, i.e., have low drag, and therefore low aerodynamic noise until its final deceleration close to touchdown. Just prior to touch down the aerodynamic noise would be the same as for a constant speed approach. However, during the final

deceleration phase the aircraft would have a high flap angle and higher than touchdown velocity and therefore higher than a constant speed approach aerodynamic noise.

Page 3 - 12 line 3 after "is reduced" add as would be the case with lower flap angles in steeper and/or decelerating approaches.

Page 5 - line 15 change to Further reductions in engine-generated noise on takeoff are achievable and should be required by revised FAR Part 36 requirements. Further noise reductions on approach are also achievable with the use of noise abatement approach procedures. These procedures will be facilitated by the use of improved guidance and control equipment. R & D work will be required on aircraft aerodynamic noise which will become a factor as engine noise is reduced below Part 36 - 10 dB levels.

Section I C Other Means for Noise Abatement

Preferential Runways

Other means for noise abatement which have been effective in the reduction of the impact of aircraft noise on the ground near takeoff and approach flight paths include the use of preferential runways. Preferential runways use is discussed in the chapter on aircraft operations but the contribution of technology to the possible extension of the use of preferential runways is discussed here.

The use of a runway which permits a take off or approach to be made over an ocean, a lake or other uninhabited areas instead of a residential area reduces the impact of aircraft noise on the airport environs. The FAA has recommended the use of preferential runways at all airports where there is a possible reduction of noise impact on people as a result of the use of one set of runways rather than others. The establishment of preferential runways is worked out at the local level among the airport operator, the FAA tower chief and the airlines using the airport.

The rules for the use of the preferential runways are also worked out at the local level. There are no FAA standards or regulations regarding crosswind components, tailwind components, gustiness, runway condition, etc. for the use of preferential runways. Aircraft are certified for takeoff and landing crosswind components but these are not used in practice. The acceptable tailwind component and gustiness acceptable for takeoffs and

are a function of runway length, aircraft weight, acceptable aircraft groundspeed and runway condition.

II Current Technology Options After 4th paragraph add:

"The expanded use of preferential runways provides an opportunity for reduction of the noise impact at airports where there are or could be runways directed toward uninhabited areas."

Section II E Other Means for Noise Abatement

Preferential Runways

Among the current technology options is the expanded use of preferential runways. This expanded use is available through:

(a) more routine use of the crosswind and tailwind capabilities of the aircraft and

(b) where desirable the incorporation of automatic aircraft control for use during gusty crosswind takeoff and landing operations.

The benefits to be derived from increased limits on crosswind and tailwind components on take off and landing are evident from the statistics on wind velocity at Washington National Airport. DCA is a near average U.S . airport in this respect.

% of time	Wind velocity below, mph
10	2.5
25	6.3
50	9.0
75	11.2
90	16.8
95	19.4

These figures are averages of monthly averages. For example for March and April the 50% value is 11 mph instead of 9 mph. However, it will be noted that if a crosswind component of 20 mph could be accepted instead of 10 mph the % of time value goes from 50% to 95%. Of course the wind is not always a crosswind. Therefore the % of time the preferential runway could be used would be higher than 95% at 20 mph.

Some crosswind component limits for some aircraft are set at 10 knots even though the aircraft is certified for a 30 knot crosswind.

More than half of the large hub airports have or could have runways which would receive aircraft approaches from and/or would direct aircraft take offs over areas which have low sensitivity to noise as compared with areas currently impacted with high aircraft noise exposure levels. Thus the use of preferential unways a greater portion of the time would have a major impact on the reduction of the area of incompatible land use.

Aircraft Power Loading

The difference in power loading between a two engine CTOL aircraft which must be capable of continuing a takeoff on half of its power in case of an engine failure, and a four engine CTOL aircraft, which must be capable of continuing take off on three quarters of its power, is quite marked. The two engine aircraft with high power loading for normal takeoffs can make a steep climb and can therefore produce a relatively short EPNdB contour or footprint as compared with that of the four engine aircraft. The two engine aircraft is toward the

STOL end of the CTOL design spectrum.

The four engine aircraft in the present fleet is longer range which would be impaired if it were required to make a steeper climbout on takeoff. This emphasizes the fact that airports having operations of long range aircraft must have the capability of handling the long range aircraft noise problem whereas the airports which do not have long range aircraft operations can require relatively steep climbouts to shorten the EPNdB contour.

In an air transport system designed to have long range operations from large hub airports only these large hub airports could be required to provide:

(a) the necessary areas of land use compatible with high aircraft noise levels, and/or

(b) facilities for using ground power (low noise power source) to accelerate the heavy long range aircraft to the point where their takeoffs could becomparable on a noise basis to that of the high power loading aircraft.

With a well designed air transport system in which large hub airports are designed for long range aircraft operations and other airports not so designed do not have long range operations a significant improvement in the distribution of high noise impacted areas is achieved. The noise impacted areas most remote from the boundaries of the non long range airports are shifted to airports where those areas may be over the ocean or may be non -existent because of special airport facilities.

Section III C Other Means for Noise Abatement

Preferential Runways

To obtain the maximum benefit from preferential runway use it will be necessary to:

(a) improve the aircraft design and control so that it will be possible to use preferential runways at all times except under emergency weather conditions

(b) relocate runways where practical so as to transfer operations to runways where the high noise exposure will be over uninhabited areas or areas where land use change cost will be a minimum.

Airport System Design

It will be possible to obtain short EPNdB footprints from aircraft which have good climb capability. Thus the high aircraft noise exposure contours will be relatively close to airports having operations of short and medium range aircraft only. Airports having long range aircraft operations,however, will pose a special problem. Airport operators trying to shrink their noise exposure contours to areas near the airport boundary will want to get rid of these operations. When airport operators find it necessary to exclude aircraft with large EPNdB footprints it will be profitable for airlines to pay extra for aircraft with steep climbout capability and then the aircraft manufacturers will make them available.

Special airports having long range operations will need to consider:

(a) whether they can attain an airport runway configuration which will locate operations over areas insensitive to aircraft noise, and if not (b) whether auxiliary airport facilities can be installed which will permit aircraft takeoffs in such a manner as to satisfactorily reduce the areas enclosed within the high noise exposure contours. This would permit a comparison of the cost of the auxiliary equipment against the cost of land use change.

Section V - Summary and Conclusions

B Page 5 - 3 after last paragraph, add

Other technological developments which do not involve noise source reductions but which contribute effectively to high noise exposure areas reductions are important. These developments include improvements in aircraft performance which facilitate higher percentage utilization of preferential runways and steeper climbs. Power for increased ground acceleration of heavy long range aircraft may also provide assistance at large airports impacted by large residential areas on all sides.

APPENDIX B

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