DOE/CS/50066-1
~~DOE/CS/50066.001-1~~

DR. 1120

Identification of Federal Aviation Administration Regulation and Procedures That Impact Fuel Consumption

MASTER

October 1979

Prepared For
U.S. Department of Energy
Assistant Secretary for
Conservation and Solar Energy

Under Contract No. DE-AP01-79CS50066.001

DISCLAIMER

Available from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price: Printed copy: ~~$7.25~~ 10.00
Microfiche: $3.~~00~~ 50

DOE/CS/50066-1
~~DOE/CS/50066.001-1~~

Identification of Federal Aviation Administration Regulations and Procedures That Impact Fuel Consumption

October 1979

Prepared by
J.B. Mckinley
Under Contract No. DE-AP01-79CS50066.001

Prepared For
U.S. Department of Energy
Assistant Secretary for
Conservation and Solar Energy
Washington D.C. 20545

PREFACE

The Office of Transportation Programs, Conservation and Solar Energy, Department of Energy sponsored this technical program to identify fuel inefficient FAA regulations and procedures and to assess their impact on fuel conservation in the air transportation system. This work was performed by Systems Control, Inc. (Vt), Champlain Technology Industries, Division under contract number DE-AP01-79CS50066.001.

The DOE technical monitor for this study was Mr. Robert L. Bowles. The project manager providing technical assistance for this study was Mr. Richard J. Adams of CTI. The principle author of this document was Mr. John B. McKinley of CTI.

The scope of the tasks performed during this study included a comprehensive review of the Federal Aviation Regulations (FARs), an in-depth literature review of aviation fuel conservation documents published since 1973, and data collection activities which involved surveying the Federal Aviation Administration (FAA) and the Air Transport Association of America (ATA). This study's period of performance was limited to four calendar months. Due to this short period of performance, no new analytical data was produced. However, the results presented in this document represent the most current data available from the sources utilized.

An important contribution to this effort was provided by the FAA, Office of Environment and Energy, and by the ATA, Office of Air Navigation/Traffic Control. These offices provided pertinent and timely conservation information included in this document.

Finally, sincere thanks is extented to Ms. S.M. Fournier, who performed the arduous task of typing and retyping, and to Mr. B.W. Richards for his engineering graphic support and data presentation necessary to produce this document.

TABLE OF CONTENTS

Preface	i
Table of Contents	ii
List of Tables	iv
List of Figures	v

<u>Section</u>	<u>Page</u>
1.0 EXECUTIVE SUMMARY	1-1
1.1 Program Purpose and Objectives	1-1
1.2 Method of Approach	1-1
1.3 Summary of Results and Conclusions	1-5
1.4 Recommendations	1-9
2.0 INTRODUCTION	2-1
2.1 Purpose	2-1
2.2 Objectives	2-1
2.3 Background	2-1
2.4 Method of Approach	2-3
2.4.1 FARs and Literature Review	2-3
2.4.2 Data Collection Activity	2-6
2.4.3 Relationship of FARs, On-Going Program and Research Areas	2-9
2.5 Organization of Report	2-9
3.0 DISCUSSION OF RESULTS	3-1
3.1 FARs Impacting Fuel Consumption	3-1
3.1.1 Evaluation Criteria	3-1
3.1.2 Description of Potentially Negative Fuel Impact FARs	3-8
3.2 Relationship of FARs To Conservation Program and Research Areas	3-13
3.2.1 Fuel Conservation Program and Research Areas Identification	3-13
3.2.2 The FAA and ATA Data Response Summary	3-15
3.2.3 Identification of Negative Impact FARs	3-18
3.3 FAR Impact Program Descriptions and Status	3-22
3.3.1 Relaxed Noise Abatement Procedures Description	3-24

TABLE OF CONTENTS (Continued)

Section	Page
3.3.2 Reduce Fuel Reserves	3-26
3.3.3 Revise Current Overweight Landing Limitations	3-27
3.3.4 Minimize Fuel Dumping	3-27
3.3.5 Profile Descent Procedures	3-28
3.3.6 Removing the 250 Knot Speed Limit Below 10,000 Feet in Terminal Control Areas	3-29
3.3.7 Optimized Takeoff and Climb Procedures	3-29
3.3.8 Increased Utilization of Direct Area Navigation Routes	3-30
3.3.9 Intermittent Use of High Density Procedures	3-30
3.3.10 Increased Use of Flight Simulators	3-31
3.3.11 Summary	3-31
4.0 RESULTS AND CONCLUSIONS	4-1
5.0 RECOMMENDATIONS	5-1
REFERENCES	R-1
APPENDIX A Federal Aviation Administration Listing of Energy Conservation Program Status	A-1
APPENDIX B Air Transport Association of America Assessment of FAA Programs Related to Fuel Conservation	B-1
APPENDIX C Listing of Federal Aviation Regulations Impacting Fuel Conservation	C-1
APPENDIX D RNAV Policy Statement by John L. McLucas, FAA Administrator, Issued January 7, 1977	D-1

LIST OF TABLES

Table		Page
1.1	Elimination Criteria Applied to 116 Fuel Impact FARs	1-3
1.2	List of 89 Current Fuel Conservation Program and Research Areas	1-4
1.3	Negative Impact FARs	1-6
1.4	Assessment of Estimated Fuel Savings for the Proposed FAA Energy Conservation Program Areas	1-8
1.5	Present Study Estimate of Fuel Savings for the Ten Program and Research Areas Negatively Impacted by FARs	1-9
2.1	Post-Fuel Crisis DOE Studies	2-5
2.2	Post-Fuel Crisis DOT/FAA and Related Studies	2-6
2.3	The Proposed FAA Energy Conservation Program Areas [3]	2-7
2.4	List of 89 Current Fuel Conservation Program and Research Areas	2-8
2.5	Elimination Criteria Applied To 116 Fuel Impact FARs	2-9
3.1	FARs Which Impact Fuel Consumption	3-3
3.2	Elimination Criteria Applied to FARs Related to Flight Test Programs	3-4
3.3	Elimination Criteria Applied to FARs Related to Environmental Controls	3-5
3.4	Elimination Criteria Applied to FARs Related to Aircraft Fuel Supply	3-5
3.5	Elimination Criteria Applied to FARs Regarding Aircraft Speed and Flight Altitude	3-6
3.6	Elimination Criteria Applied to FARs Regarding Airspace and ATC	3-6
3.7	Elimination Criteria Applied to FARs Regarding Aircraft Equipment	3-7
3.8	Elimination Criteria Applied to FARs Regarding Crew Member Qualification	3-8
3.9	Fuel Conservation Program and Research Areas With Status Level	3-14
3.10	Summary of the FAA and ATA Viewpoints of the FAA's Proposed Energy Conservation Program Areas	3-16
3.11	Potential FAA/Airline Actions to Maximize Fuel Conservation in the Air Traffic Control System	3-17
3.12	Fuel Conservation Program and Research Areas Impacted by the Potentially Negative Fuel Impact FARs	3-20
3.13	Negative Impact FARs	3-21
3.14	1978/1979 Assessment of Estimated Fuel Savings for the Proposed FAA Energy Conservation Program Areas	3-23
3.15	Assessment of Fuel Savings for the Ten Negatively Impacted Program and Research Areas by FARs	3-25
4.1	Present Study Estimate of Fuel Savings for the Ten Program and Research Areas Negatively Impacted by FARs	4-2

LIST OF FIGURES

Figure		Page
1.1	Relationship Between Data Sources, Method of Approach and Conclusions	1-2
1.2	Sequential Flow Diagram Accounting for the FARs and the Program and Research Areas Eliminated and Remaining	1-5
2.1	Relationship Between Data Sources, Method of Approach and Conclusions	2-4
3.1	Flow Diagram of Method of Approach Identifying Major Steps and Results for Each Step	3-2
3.2	Sequential Flow Diagram Accounting for the FARs and the Program and Research Areas, Eliminated and Remaining	3-19

1.0 EXCUTIVE SUMMARY

This study carefully examined the impact of the Federal Aviation Regulations (FARs) on fuel conservation in the air transportation system. To date there exist over 89 identifiable fuel conservation program and research areas. This report, the product of a four month study, has attempted to identify operational constraints in the areas of FARs and Air Traffic Control (ATC), which hinder further fuel savings in any of the 89 program and research areas.

The nature of this investigation presents an update of analyses from previous Federal Aviation Administration, Department of Energy (DOE) and National Aeronautics and Space Administration publications from a DOE viewpoint. The short duration and cost constraints of this study did not allow an assessment of safety, social or any of the broader impacts of the regulations. However, this study was not intended to solve all of the regulatory problems. Rather, this was a cursory review of the FARs intended to pinpoint those fuel "inefficient" regulations which could be changed to improve the overall fuel conservation effort in the air transportaiton industry. The program and research areas identified as being negatively impacted by FARs were analyzed to quantify the fuel savings available through revision or removal of those constraints. A recommended list of new R&D initiatives are proposed in order to improve fuel efficiency of the FARs in the air transportation industry.

1.1 PROGRAM PURPOSE AND OBJECTIVES

The purpose of this report is to present a prioritized set of research tasks to enhance the fuel efficient regulatory environment in the air transportation system, through FAA evaluation and revision of appropriate fuel inefficient FARs and ATC procedures. More specifically, this purpose addresses the following objectives:

1) To identify those fuel inefficient FARs and ATC procedures,

2) To assess potential fuel savings through removing or revising appropriate FARs and/or procedures, and

3) To investigate current fuel conservation program and research areas impacted by FARs and ATC procedures, identifying current work performed and by whom.

1.2 METHOD OF APPROACH

The sequential steps describing the method of approach used for this study are presented as a flow diagram in Figure 1.1. The many program elements can be summarized in four major steps. The first step required a comprehensive review of the existing FARs to determine which regulations impacted fuel consumption. These FARs were then categorized into the following seven operational areas: (1) flight test programs, (2) environmental control, (3) aircraft fuel supply, (4) air-

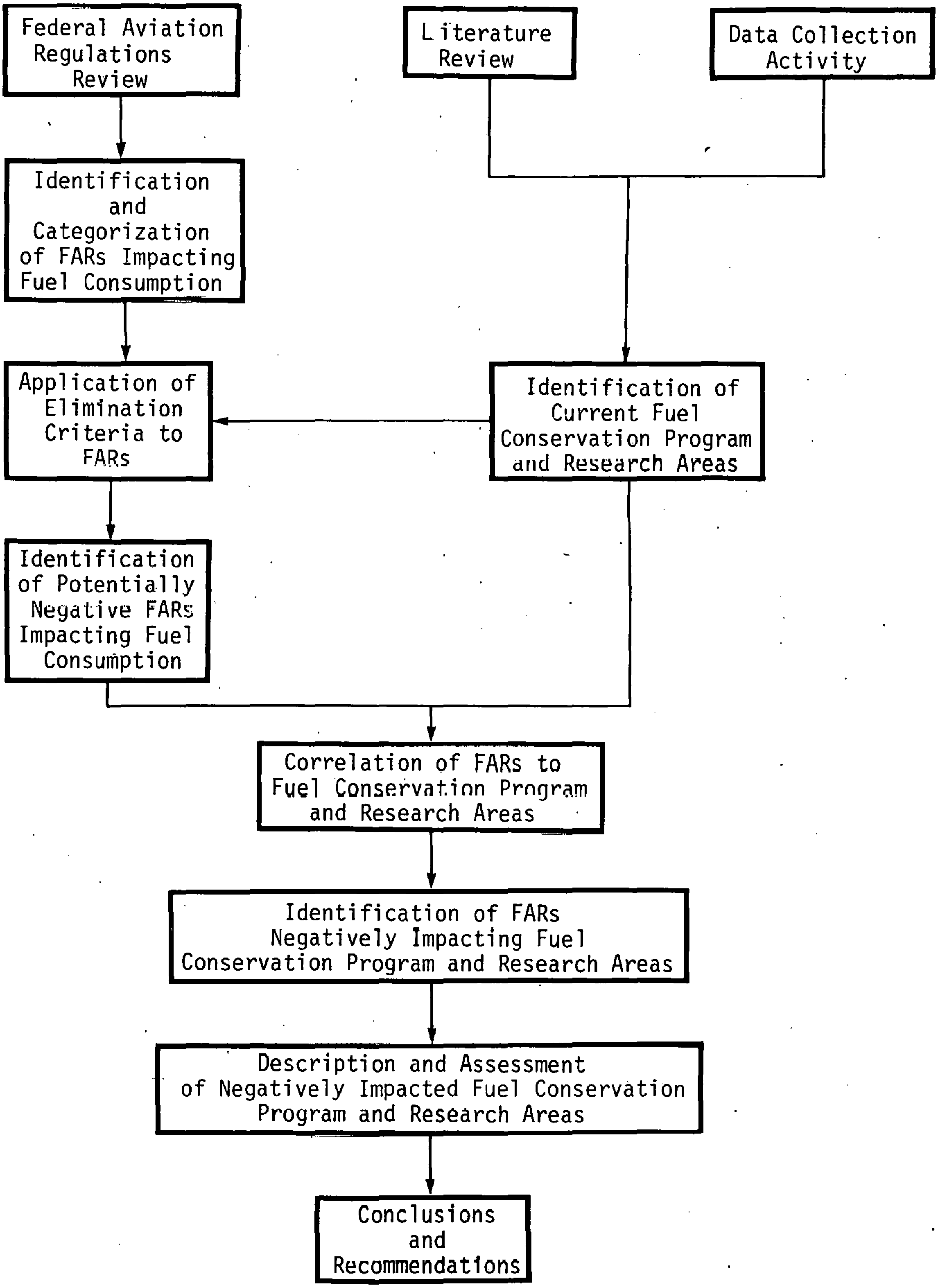

Figure 1.1 RELATIONSHIP BETWEEN DATA SOURCES, METHOD OF APPROACH AND CONCLUSIONS

craft speed and flight altitude, (5) airspace and air traffic control, (6) aircraft equipment and (7) crew member qualification. These seven categories are consistent with previous FAA efforts (see reference 4).

Following this categorization, the FARs were then evaluated against elimination criteria, shown in Table 1.1, developed to eliminate any FARs which did not significantly impact fuel consumption. The remaining FARs were considered to have a potential negative impact on fuel consumption and further analyzed in order to determine which FARs have a direct negative impact on fuel consumption or fuel conservation program and research areas.

Table 1.1 ELIMINATION CRITERIA APPLIED TO 116 FUEL IMPACT FARs

Elimination Criteria	Remarks
1. FARs of necessity which can not be changed for reasons of safety	Defines those FARs requiring necessary engine testing and airborne equipment for safety considerations even though extra fuel is burned.
2. Offers no significant additional savings	These FARs were generally in the areas of flight test program regulations, aircraft equipment certification, and crew member qualification criteria.
3. Do not constrain any fuel conservation program or research areas	Evaluated against the list of 89 fuel conservation program and research areas.

The second step involved an in-depth literature review of more than 60 documents published since 1973 and related to aircraft fuel savings potential. Special emphasis was placed on a review of 23 documents published since 1976, for the purpose of obtaining post-fuel crisis data on airline and agency fuel conservation programs. From the combined results of this literature review and the data collection activities (discussed subsequently), a list of 89 identifiable fuel conservation program and research areas,shown in Table 1.2,was formed.

The third step entailed collecting data through a survey of the FAA and the Air Transport Association of America (ATA). The purpose of this step was to obtain current (1978/1979) quantitative data on the FAA's purposed energy conservation program areas from both the user and the FAA viewpoints. This was necessary since the literature review was not able to fulfill this requirement. The results of this survey was useful in determining the status level and purview for each of the impacted program and research areas.

The fourth and final step was to identify and categorize those FARs and procedures which negatively impact fuel conservation program and research areas. This step involved correlating the FARs determined to have a potential negative impact with the 89 program and research areas. Through

Table 1.2 LIST OF 89 CURRENT FUEL CONSERVATION PROGRAM AND RESEARCH AREAS

1. Fuel Advisory Departure (FAD)/Gate Holding
2. Improve and Increase Utilization of Quota/Flow
3. Profile Descent Procedures
4. High Altitude and Optimum Speed Holding Procedures
5. Increase Usage of Enroute Linear Holding
6. Intermittent Use of High Density Procedures
7. Assigning Optimum Cruise Altitudes When Possible
8. Increased Utilization of Direct Area Navigation Routes (RNAV)
9. Revised Standard Instrument Departures (SIDs) and Standard Terminal Area Routes (STARs)
10. Reducing Vertical Separation Requirements Above Flight Level 290
11. Removing 250 Knot Speed Limit Below 10,000 Feet in Terminal Control Areas (TCA)
12. Passenger Weight Adjustment for Fuel Reserve Calculations
13. Revising Current Over Weight Landing Limitations
14. Relaxed Noise Abatement Procedures
15. Increased Application of Keep-Em-High Procedures
16. Curfew Relaxation
17. Reduced Separation for Instrument Flight Rules (IFR) Parallel Runways Within 4300 Feet
18. Wake VORTEX Class Sequencing
19. Wake VORTEX Avoidance System (WVAS)
20. Use of Short Temporary Runways During Airport Construction/Maintenance
21. Provide Additional Snow/Ice Removal Equipment
22. Construct Short General Aviation Runways at Large Hub Airports
23. Air Traffic Controller Training and Awareness of Fuel Conservation Procedures
24. Reduce Reserved Airspace
25. Increase the Number of Instrument Landing System (ILS) Installations
26. Increased Use of Flight Simulators
27. Capacity Restraint
28. Reseating Existing Aircraft
29. Reduce Fuel Tankering
30. Optimum Cruise Speed
31. Discrete Address Beacon System/Airport Traffic Advisory and Resolution Service (DABS/ATARS)
32. Upgraded Third Generation Air Traffic Control (UG3RD)
33. Microwave Landing System (MLS)
34. Delayed-Flap, High Speed Approach
35. International Air Transportation Association (IATA) High Speed Approach
36. Reduced Flap Approach
37. Reduced Fuel Reserves
38. Optimized Takeoff and Climb Procedures
39. Two-Segment Approaches
40. Reduce Airport Lighting
41. Efficiency on a Commercial Air Carrier Program
42. Expanded Terminal Control Area (TCA)
43. Local Flow Traffic Management (LFTM)
44. Simultaneous Landings on Intersecting Runways
45. Simultaneous Arrivals/Departures on Intersecting Runways
46. Airport Surface Traffic Control, Airport Surface Detection Equipment-3 (ASDE-3)
47. Airport Fog Dispersal System
48. Improve Airport Pavement
49. Optimum Descent Procedures
50. Joint-Use of Restricted Areas
51. Advanced Aircraft Technology
52. On-Board Performance Computers
53. Lighter-Than-Air (LTA) Vehicles
54. Minimize Circuitous Routings
55. Optimize Runway/Taxiway Usage
56. Minimize Fuel Dumping
57. Visual Confirmation System (VICON)
58. Color Runway Approach Lights
59. Vortex Alleviation Technology
60. Automated Terminal Service (ATS)
61. Terminal Information Processing Center (TIPS)
62. Automated Enroute ATC (AERA)
63. Cockpit Display of Traffic Information (CDTI)
64. Aviation Automated Weather Observation System (AV-AWOS)
65. Automated Low Cost Weather Observation System (ALWOS)
66. Cruise Speed Control (Monitoring within ±.01 Mach)
67. Cruise Thrust Setting (Monitoring Mach/Engine Pressure Ratio Mismatch)
68. Reduced Engine Bleed (Air Conditioning, Pressurization, Anti-Surge)
69. Frequent Trim Control Adjustment
70. Reduce Non-Revenue Flying
71. Reduce Aircraft Operating Empty Weight (Service Items, Portable Water, etc.)
72. Careful Monitoring of Fuel Used by Specific Aircraft Engines and Crews
73. Replacement/Retrofitting of Older Aircraft
74. Increase Pilot Training and Proficiency in Fuel Efficient Procedures
75. Removing or Reducing Aircraft Exterior Paint
76. Eliminate Unnecessary Auxiliary Power Unit (APU) Usage
77. Taxi on Fewer Engines
78. Load to Aft Center of Gravity
79. Improve Taxi Equipment/Facilities (Towing Aircraft)
80. Use of Mobile Lounges
81. Computer Flight Planning
82. In-Flight Reclearance
83. One Stop vs. Non Stop
84. Increased Number of Alternate Airports
85. Aerodynamic Cleanliness
86. Instrument Calibration
87. Engine Thrust Specific Fuel Consumption (TSFC) Recovery
88. Engine Idle Fuel Flow
89. More Frequent Maintenance and Cleaning

this correlation, those program areas and FARs which had negligible effects were eliminated from further review. This correlation process identified the negative impact FARs with the program areas they impacted. This led to the assessment of potential fuel savings attainable through the appropriate revision of FARs and ATC procedures.

1.3 SUMMARY OF RESULTS AND CONCLUSIONS

Through the steps and procedures described above and shown in Figure 1.2, 10 fuel conservation program and research areas were determined to be negatively impacted by 23 FARs. Figure 1.2 illustrates the numerical inventory of FARs and program areas retained for each step of the current program to arrive at the conclusions. Table 1.3 correlates the 23 FARs and the 10 program and research areas they negatively impact.

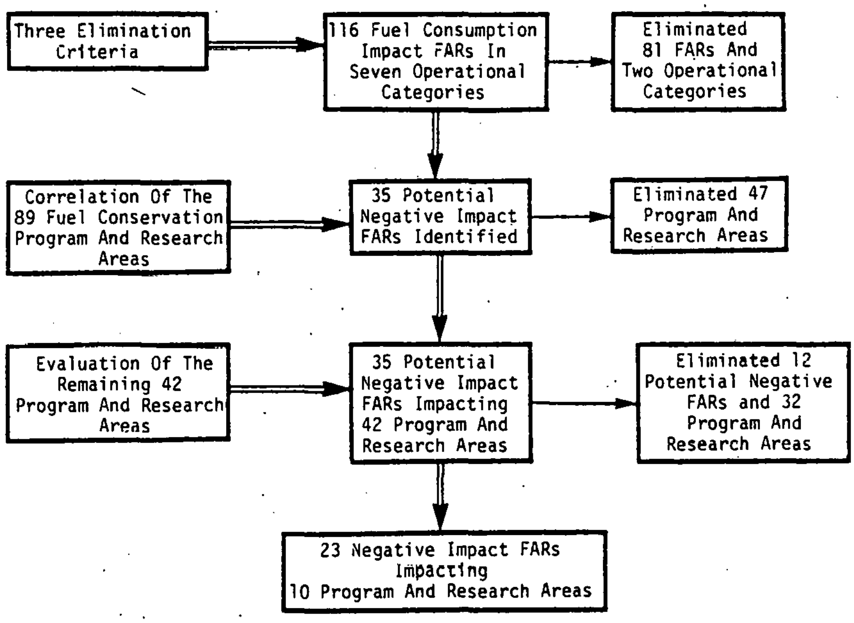

Figure 1.2 SEQUENTIAL FLOW DIAGRAM ACCOUNTING FOR THE FARs AND THE PROGRAM AND RESEARCH AREAS, ELIMINATED AND REMAINING

Table 1.3 NEGATIVE IMPACT FARs

FARs BY OPERATIONAL CATEGORY	PROGRAM AND RESEARCH AREAS IMPACTED	AREAS BY NUMBER (10 Total)
ENVIRONMENTAL CONTROL		
36 Appendix C	Relaxed Noise Abatement Procedures	1
91.87	Relaxed Noise Abatement Procedures	1
AIRCRAFT FUEL SUPPLY		
91.23	Reduce Fuel Reserves	2
91.207	Reduce Fuel Reserves	2
121.198	Revising Current Overweight Landing	3
121.198	Minimize Fuel Dumping Limitations	4
121.639	Reduce Fuel Reserves	2
121.641	Reduce Fuel Reserves	2
121.643	Reduce Fuel Reserves	2
121.645	Reduce Fuel Reserves	2
135.97	Reduce Fuel Reserves	2
AIRCRAFT SPEED AND FLIGHT ALTITUDE		
91.70	Profile Descent Procedures	5
91.70	Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	6
91.70	Optimized Takeoff and Climb Procedures	7
95.8001	Increase Utilization of Direct Area Navigation Routes	8
AIRSPACE AND ATC		
71.121	Increase Utilization of Direct Area Navigation Routes	8
91.90	Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	6
91.90	Optimize Takeoff and Climb Procedures	7
91.123	Increased Utilization of Direct Area Navigation Routes	8
93.123	Intermittent Use of High Density Procedures	9
121.93	Increased Utilization of Direct Area Navigation Routes	8
121.95	Increased Utilization of Direct Area Navigation Routes	8
121.103	Increased Utilization of Direct Area Navigation Routes	8
121.113	Increased Utilization of Direct Area Navigation Routes	8
121.115	Increased Utilization of Direct Area Navigation Routes	8
121.121	Increased Utilization of Direct Area Navigation Routes	8
CREW MEMBER QUALIFICATIONS		
121.442	Increased Use of Flight Simulators	10

The assessment of benefits through revision of appropriate FARs represents the most current data available. In gathering data for this report, it was discovered that very little data was available for fuel conservation program and research areas which have been implemented or demonstrated within the past three years. This is due to the fact that no comprehensive quantitative assessment has been made to determine actual (not estimated or potential) fuel saved to date on a system-wide basis for each fuel conservation program and research area. This is because the FAA's fuel conservation effort is comprised of a very large number of related or overlapping program and research areas which have not yet been fully implemented. Further complicating the fuel conservation assessment effort is the fact that fuel savings realized by individual airlines is dependent upon fleet mix, route structure and load factor considerations. Traditionally, data of this type is obtained from individual airlines for their particular routes and airports. Data of this nature is usually collected centrally by the ATA from the airlines on a voluntary basis. For these reasons it was not possible to combine this data for each user into a comprehensive system-wide assessment at this time.

Both the FAA and ATA were asked to provide recent quantitative data relative to the FAA's proposed energy conservation program areas under review. Their responses are reproduced in Appendices A and B. Using this recent FAA and ATA data in conjunction with the literature survey, Table 1.4 was compiled. It should be noted that all of the fuel savings data presented in Table 1.4 is based on projected or potential "estimates" by DOE, FAA or the National Aeronautics and Space Administration (NASA) as indicated. The DOE estimates in Table 1.4 are from reference 2. The FAA estimates are based on potential benefits projected for the years 1977 through 1990 in reference 3. The NASA estimates are from reference 13.

The potential improvement in fuel efficiency cumulatively by the year 1990, from the FAA's proposed energy conservation program, is estimated to be 32 percent or about 39 billion gallons of fuel [6].

As seen in Table 1.4, the estimated fuel benefits for each program area are specified for three agencies: the DOE, FAA and NASA. Data for each program area by each agency was not available. It is important to note that the "dashes" by program areas represent those which offer the largest fuel savings. The asterisks represent those program areas where current empirical data is available for validation and verification of the 1979 estimates, either from specific demonstrations by the FAA and/or individual airlines or from internal unpublished reports of dedicated FAA/NASA programs.

Together with the information provided in Table 1.4, and through further analysis of the 10 program and research areas, an assessment of the potential fuel benefits available through revision of appropriate FARs was determined. This assessment is shown in Table 1.5, and is representative of the most current data available. From this table it is apparent that the program area offerering the largest fuel savings is that of Increased Utilization of Direct Area Navigation Routes, followed by Profile Descent Procedures, Relaxed Noise Abatement Procedures and Increased Use of Flight Simulators. It is also important to note that the asterisks in Table 1.5, represent program and research areas which might yield a fuel savings based on previous studies, but the magnitude has not yet been determined. The estimates shown in the present study column of Table 1.5 are from references 2 and 3.

Table 1.4 ASSESSMENT OF ESTIMATED FUEL SAVINGS FOR THE PROPOSED FAA ENERGY CONSERVATION PROGRAM AREAS

	DOE ESTIMATE [2] TOTAL (%) AVAILABLE	FAA ESTIMATE [3] (%) '79	(%) '90	NASA[13] TOTAL (%) AVAILABLE
I. ATC PROGRAM AREA				
* Fuel Advisory Departure	0.0	1.70	1.70	—
* Flow Control Automation	1.7	0.33	1.65	—
* Wake Vortex Avoidance Systems	—	0.36	1.00	—
-* Area Navigation	3.5	0.80	1.60	—
Discrete Address Beacon System/ Automated Traffic Advisory and Resolution Service	—	0.0	0.10	—
Post-Upgraded Third Generation Air Traffic Control	—	0.0	0.30	—
Microwave Landing System	—	0.0	0.20	—
II. AIRPORTS PROGRAM AREA				
Airport Surface Traffic Control	—	0.0	0.10	—
Fog Dispersal Systems	—	0.02	0.10	—
Snow-Ice Removal Equipment	—	0.13	0.13	—
III. AIRCRAFT OPERATIONS AREA				
* Capacity Restraint	—	0.70	0.70	—
* Reseat Existing Aircraft	—	0.40	0.40	—
* Simulators	≈0.0	0.10	0.10	—
Load to Aft Center of Gravity	—	0.20	0.20	—
Reduce Fuel Tankering	0.2-0.4	0.30	0.30	—
* Taxi on Fewer Engines	0.4(1.0-3.0)	0.20	0.20	—
* Climb Procedures in Terminal Control Areas	0.5	0.16	0.16	—
-* Optimum Descent	2.5 3.0	0.60	2.40	—
-* Optimum Cruise Speed	2.0	0.70	0.70	—
* Optimum Altitude	Small	0.56	0.65	—
IV. AIRCRAFT TECHNOLOGY PROGRAM AREA				
New Near-Term Aircraft	—	0.0	11.40	15.0
Winglets	—	0.93	2.19	5.0
Active Controls	—	0.0	1.20	5.0
-* On-Board Performance Computers	3.0	0.51	2.14	—
Lighter Than Air Cargo Vehicles	—	0.10	0.57	—
Large Air Cargo Transports	—	0.0	0.30	—

/NOTE/ * Represents program areas where current (1979) data is available for further verification and validation.

- Represent program areas where large fuel savings are currently available

Table 1.5 PRESENT STUDY ESTIMATE OF FUEL SAVINGS FOR THE TEN PROGRAM AND RESEARCH AREAS NEGATIVELY IMPACTED BY FARs

PROGRAM AND RESEARCH AREAS	PRESENT STUDY ESTIMATE TOTAL (%) AVAILABLE	NEGATIVE IMPACT FARs
1. Relaxed Noise Abatement Procedures	1.0 to 3.0	36 Appendix C, 91.87
2. Reduce Fuel Reserves	0.2 to 0.4	91.23, 91.207, 121.639, 121.641, 121.643, 121.645, 135.99
3. Revise Current Overweight Landing Limitations	*	121.198
4. Minimize Fuel Dumpings	*	121.198
5. Profile Descent Procedures	2.0 to 2.5	91.70
6. Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	0.4	91.70, 91.90
7. Optimized Takeoff and Climb Procedures	0.5	91.70, 91.90
8. Increase Utilization of Direct Area Navigation Routes	3.5	71.121, 91.123, 95.8001, 121.93, 121.95, 121.103, 121.113, 121.115, 121.121
9. Intermittent Use of High Density Procedures	*	93.123
10. Increase Use of Flight Simulators	1.9 (1979)	121.442

/NOTE/ * These areas might yield a fuel savings based on previous studies but the magnitude has not yet been determined.

It is not possible to combine the potential savings numbers shown in Table 1.5 in a linear fashion due to the interdependency of many of these programs. In particular, certain options such as Optimized Takeoff and Climb Procedures (no. 7 in Table 1.5) are not achievable without also removing the 250 Knot Speed Limit below 10,000 feet (no. 6) and Relaxing Noise Abatement Procedures (no. 1). Due to these specific relationships and the interdependency of several of the other elements in Table 1.5, the total fuel savings attainable from the program and research areas of Table 1.5 was estimated to be 7-10 percent.

1.4 RECOMMENDATIONS

Two generic types of recommended actions are presented. First, a proposed series of broad/joint effort interagency programs is suggested in order to improve fuel efficiency in the air transportation industry.

These programs are necessary to attack fuel inefficiencies on a system-wide basis and to allow a free interchange of information between various regulatory groups. Second, a simple list of specific new R&D initiatives is provided. This list was developed from the detailed analysis of the impact of the current regulatory environment on the on-going research and on the aviation user's ability to save additional fuel.

General Interagency Conservation Actions

1. A comprehensive program to remove or relax current regulatory constraints to fuel efficient operations should be organized, formulated and coordinated with the FAA, the air carriers, and the DOE.

2. Discussions should be continued and increased and a coordination plan developed to insure the necessary free exchange of knowledge and motivation for fuel efficient operations between flight crews and air traffic control personnel.

3. A fuel usage/savings monitor program should be developed. This program should be structured to assess the annual or semi-annual fuel efficiency status of the air transportation industry and to maintain current coordination with on-going research as far as identifying areas of new potential savings are concerned.

Specific Actions To Improve Energy Conservation

1. Examine the safety and societal impact of redrafting the fuel inefficient FARs in a manner consistent with current air transportation fuel conservation efforts.

2. Analyze and develop integrated fuel efficient/low noise arrival and departure procedures.

3. Develop and implement a program to monitor and document the impact of extra add-on fuel reserves.

4. Investigate the impact and feasibility of liberalizing overweight landing limitations.

5. Develop and implement a program to monitor and quantify the amount of fuel dumped attributable to emergencies, extra add-on fuel reserves and meteorological conditions.

6. Develop technology guidelines and an implementation schedule to facilitate the revision of FARs to permit operations with 1000 foot vertical separation above Flight Level 290.

7. Evaluate improved profile descent procedures which integrate removal of the 250 knot speed limit and separation of general aviation aircraft where possible.

8. Support the adoption of the 300-350 knot speeds for those departing aircraft and airports where it is feasible and estimate total fuel savings impact.

9. Develop a program to assess the amount of fuel consumed at select high density traffic airports through vectoring and holding aircraft that are constrained by inefficient use of high density procedures.

10. Establish the maximum amount of additional fuel savings achievable with increased simulator usage for each aircraft type. Provide this data to the FAA with recommendations for implementing more simulator time where applicable.

11. Assess the actual savings demonstrated to date due to the partially implemented Area Navigation direct routing capability. Develop and coordinate an approach to Area Navigation implementation that might lead to a full realization of the 10.4 billion gallon cumulative savings available through this option by the year 2000.

2.0 INTRODUCTION

This report is the result of a four month concentrated study to formulate a comprehensive list of FARs and ATC procedures which impact aviation fuel consumption and conservation programs. A major effort of this program was to assess the air transportation industry's fuel conservation program status and purview. This type of information should serve to update knowledge of both on-going programs and programs currently under development which are impacted by the FARs.

2.1 PURPOSE

The purpose of this report is to present a prioritized set of research tasks aimed toward a more fuel efficient regulatory environment in the air transportation system, through the revision of appropriate fuel inefficient FARs and ATC procedures. More specifically, this purpose addresses the following three tasks: (1) to identify those fuel inefficient FARs and ATC procedures; (2) to assess potential fuel savings through removing or revising appropriate FARs and/or procedures; and (3) to investigate current fuel conservation program and research areas impacted by FARs and ATC procedures, identifying current work performed, the performing agency and any new or revised research efforts that are required.

2.2 OBJECTIVES

Accomplishment of the above purpose was achieved by satisfying the three specific program objectives below:

1) To document those FAA regulations and ATC procedures which impact fuel conservation,

2) To estimate a range of energy savings attainable by eliminating ATC constraints and/or revising appropriate regulations, and

3) To select and develop appropriate research tasks and programs which would make the regulatory environment in which the airline industry operates more fuel efficient.

2.3 BACKGROUND

The oil embargo and Federal fuel allocations of 1973 and 1974 prompted the development of many fuel conservation techniques by all aviation user and organizational groups. To date there exist over 89 identifiable fuel conservation program and research areas [1,2,3]. There also currently exist operational constraints which hinder further fuel savings in many of these program areas.

Congress entered into the energy conservation debate in 1975, enacting the Energy Policy and Conservation Act, Section 382(a)(2). This act required Federal regulatory agencies, including the FAA, to report to Congress the content and feasibility of proposed program and research areas which offered a minimum additional savings of 10 percent reduction in annual energy consumption from the amount of energy consumed in 1972.

Dwindling fuel supplies and rising fuel prices caused the airlines to adopt voluntary fuel efficiency procedures. These efficiency improvements were also achieved partly as a result of changes in airline policy and procedural changes implemented in the cockpit. Such measures as reductions in cruise speed, close management of fuel loads (reserves), avoidance of unnecessary fuel tankering, selective elimination of low load-factor routes, reduction of ground delays and more frequent maintenance were responsible for much of the demonstrated savings. Some airlines voluntarily initiated some of these measures even prior to the October 1973 oil embargo and the resulting fuel allocations imposed during the ensuing shortage in 1974.

The FAA enacted a fuel conservation program in parallel with these airline efforts. The program was implemented in 1973 with a projected fuel savings of some 20,000 barrels per day. This savings was to be achieved by significant improvements in ground and airborne aircraft handling procedures to be implemented by ATC. Such programs as Fuel Advisory Departures/Gates Holding, Air Traffic Flow-Control Procedures, Linear Enroute Holding and Terminal Holding at Higher Altitudes, Profile Descents and the Airport Quota System, were the primary elements of the FAA fuel conservation effort.

The April 1976 FAA Report to Congress, required by Section 382(a)(2) of the Energy Policy and Conservation Act, showed that implementation of changes in aircraft operational procedures could produce significant measurable savings in the amount of fuel consumed by the Nation's commercial air transportation industry. Between the years of 1972 and 1974, air carriers demonstrated an improvement of 4.5 percent in total fuel consumed. The FAA attributed this savings to improved airborne operating procedures enacted within the present ATC system constraints. However, a large portion of this improvement was due to the enactment of Federal fuel allocation policies which led to higher load factors and reductions in the operation of fuel inefficient aircraft. Lack of a monitoring program prevented any direct measurement of the specific impact of improved procedures.

Currently, problems exist with both the airline and the FAA conservation initiatives. In an August 1977 report to Congress by the General Accounting Office (GAO), both the airlines and the FAA were criticized for not doing more to conserve fuel. Although this criticism was timely and based on a current assessment by the GAO of the latest task force study on delays and load factors in current airline operations, it did not represent a detailed, comprehensive research study of what had actually been accomplished in the fuel conservation area by either the airlines or the FAA's programs.

A study performed by Systems Control, Inc. (Vt) for the Federal Energy Administration (now a part of the Department of Energy (DOE)) did, in fact, indicate that there are many diverse barriers to the achievement of further fuel conservation by the air carriers. These barriers consist primarily of operating limitations imposed by the FARs and the current ATC System. The results of this study showed that approximately three-fourths of the remaining fuel conservation measures in the area of flight operations were constrained by FAA regulations and ATC procedures. In the areas of ground operations and flight planning, approximately two-thirds of the remaining fuel conservation programs were similarly affected.

Because of the impact of these operational constraints and regulations on potential fuel savings, it was the opinion of a large number of airlines that no additional fuel savings could be demonstrated without substantial procedural changes in the current ATC System and/or selected changes in the FARs. This may or may not be true; however, it has been shown [1,2,5] that these constraints do negatively impact available conservation options.

2.4 METHOD OF APPROACH

As an overview this approach had four major steps. The first step required a comprehensive review of the existing FARs and ATC procedures to determine which regulations impacted fuel consumption. Secondly, an in-depth review of literature published since 1973 and related to aircraft fuel savings potential was conducted. Special emphasis was placed on a review of literature published since 1976, for the purpose of obtaining post-fuel crisis data on airline fuel conservation programs. The third step involved surveying the FAA and ATA with regard to the status of current FAA/ATC/airline fuel conservation program areas. The fourth and final step was to categorize those FARs and ATC procedures which negatively impact fuel conservation program and research areas. Once identified, ATC procedures and FAR revisions which might improve fuel conservation efforts were evaluated and considered for recommendation. Shown in Figure 2.1 is a flow diagram illustrating the method of approach for the research activities described above.

2.4.1 FARs And Literature Review

An in-depth review of the FARs was conducted at the beginning of the project. It was determined that 116 FARs impact fuel consumption. An FAR was defined as impacting fuel consumption if the regulation resulted in the use of fuel, whether for testing, training, safety or otherwise. These 116 FARs (similarily identified in Reference 4) were categorized into the following seven operational areas: (1) flight test programs, (2) environmental control, (3) aircraft fuel supply, (4) aircraft speed and flight altitude, (5) airspace and air traffic control, (6) aircraft equipment and (7) crew member qualification.

Following this categorization, the FARs were then evaluated against criteria developed to eliminate any FARs which do not significantly impact fuel consumption. These remaining FARs were considered to have a potential negative impact on fuel consumption and were analyzed in

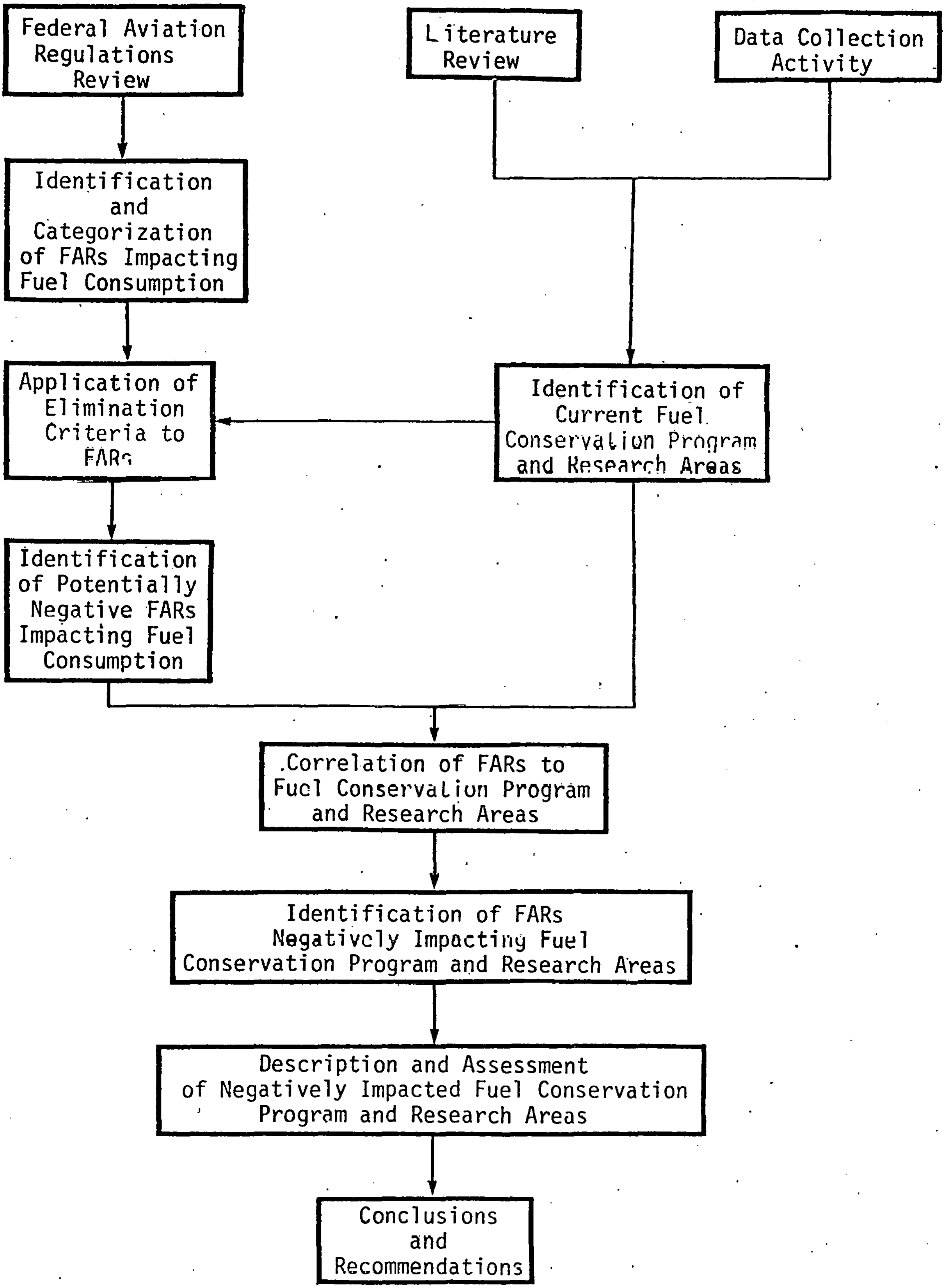

Figure 2.1 RELATIONSHIP BETWEEN DATA SOURCES, METHOD OF APPROACH AND CONCLUSIONS

order to determine which FARs have a direct negative impact on fuel consumption and fuel conservation program and research areas. Deliniation of the elimination criteria and the method of approach used to determine the FARs having a negative impact on fuel consumption is discussed in Section 2.4.3.

A thorough review of the more than 60 documents published between 1973 and 1976, led to an intensive study of 23 documents published between 1976 and 1979 (Tables 2.1 and 2.2). The large majority of these reports were cost/benefit forecast analyses or offer similar postulated data. The intent of the review was to gather current (1978/1979) qualitative and quantitative data, in addition to status, purview and constraints for the current fuel conservation program and research areas. Tables 2.1 and 2.2 present a detailed list of studies which were more heavily relied on and quoted frequently in the current DOE study. These lists show the most recent post-fuel crisis studies of both the DOE, DOT/FAA, and related studies. Reports which were particularly useful in compiling a comprehensive list of current fuel conservation program and research areas are so designated by an asterisk.

Table 2.1 POST-FUEL CRISIS DOE STUDIES

DATE	REFERENCE	AUTHOR	AFFILIATION
5/79	Potential of Noncapital Methods and Their Implementation to Reduce Congestion and Save Energy at Major U.S. Airports	Ellis, Dygert, et.al.	Peat, Marwick, Mitchell & Co.
10/78	Examination of Commercial Aviation Operational Energy Conservation Strategies *	Covey & Mascetti	The Aerospace Corporation
5/77	Implementation of the Energy Policy and Conservation Act	Bowles & Pont	Federal Energy Administration
3/77	Fuel Efficient Activities of Aircraft and Air Carriers *	Adams	Systems Control, Inc. (Vt)
1/77	Alternative Scenarios for Federal Transportation Policy	Friedlaender & Simpson	MIT
7/76	Baseline Energy Forecasts and Analysis of Alternative Strategies for Airline Fuel Conservation	Anon	Urban Systems Research and Engineering
6/76	Cost/Benefit Tradeoffs for Reducing the Energy Consumption of Commercial Air Transportation	Gobetz & LeShane	United Technology Research Center

*Reports which were particularly useful in compiling a list of current fuel conservation program and research areas.

Table 2.2 POST-FUEL CRISIS DOT/FAA AND RELATED STUDIES

DATE	REFERENCE	SOURCE
3/79	New Engineering and Development Initiatives-- Policy and Technology Choices (Vol I & II) *	For FAA by User/Aviation Industry Representatives
1/79	Federal Register, Vol. 44, No. 3, Proposed Rules for Terminal Airspace	FAA
11/78	A Proposed Aviation Energy Conservation Program for the National Aviation System (Vol. I-IV) *	FAA, Office of Aviation Policy
5/78	Aviation Energy Conservation *	FAA, Office of Aviation Policy
3/78	Consultative Planning Conference New E & D Initiatives -- Policy and Technology Choices	FAA
2/78	Dynamic Simulation of Fuel Conservation Procedures Using Denver Colorado's Stapleton Airport as the Test Geography	FAA/Nation Aviation Facilities Experimental Center (NAFEC)
1/78	Airport Surface Detection Equipment (ASDE-3), Project Plan	FAA System Research and Development Service
9/77	FAA Aviation Forecasts Fiscal Tasks 1978-1989	FAA Office of Aviation Policy
8/77	Effective Fuel Conservation Programs Could Save Millions of Gallons of Aviation Fuel	General Accounting Office
6/77	Benefit Analysis of the Automated Flow Control Function of the Air Traffic Control Systems Command Center	DOT Transportation Systems Center
1/77	Policy Analysis of the Upgraded Third Generation Air Traffic Control System	FAA Office of Aviation Policy
1/77	Draft Order 7110.72A, Local Flow Traffic Management	Air Traffic Service
11/76	Report to Congress by the Federal Energy Administration on the Energy Efficiency of Agency Regulations	FAA Office of Aviation Policy
9/76	Cost/Benefits and Implementation of the Wake Vortex Avoidance System (WVAS) and Vortex Advisory System (VAS)	FAA
6/76	Flow Control Procedures	FAA Air Traffic Service
4/76	Report to Congress by the Federal Aviation Administration on Proposed Programs for Aviation Energy Savings	FAA Interservice Energy Task Force II

*Reports which were particularly useful in compiling a list of current fuel conservation program and research areas.

2.4.2 Data Collection Activity

Since the literature review could not provide the current (1978/1979) quantitative data necessary to fulfill the requirements of this project, the FAA and the ATA were surveyed. Each organization was presented with a list of proposed energy conservation program areas which was obtained from the FAA's proposal for the National Airspace System [3]. Accompanying the list shown in Table 2.3, was a request for qualitative ~~and~~ quantitative data, project status and data reporting plans.

The results of the data collection task and the literature review were combined to form the list of 89 fuel conservation program and research areas shown in Table 2.4. This list was incorporated in the elimination criteria, and also used in determining the FARs that have a negative impact on fuel conservation program and research areas.

Table 2.3 The Proposed FAA Energy Conservation Program Areas [3]

I. FAA AIR TRAFFIC CONTROL SUBPROGRAM	
• Fuel Advisory Departure	• Discrete Address Beacon System/ Automated Traffic Advisory and Resolution Service
• Flow Control Automation	• Post-Upgraded Third Generation Air Traffic Control
• Wake Vortex Avoidance Systems • Area Navigation	• Microwave Landing System
II. AIRPORTS SUBPROGRAM	
• Airport Surface Traffic Control • Fog Dispersal Systems	• Snow-Ice Removal Equipment
III. AIRCRAFT OPERATORS AND MANAGEMENT SUBPROGRAM	
• Capacity Restraint • Reseat Existing Aircraft	• Taxi on Fewer Engines • Climb Procedures in Terminal Control Areas
• Simulators • Load to Aft Center of Gravity • Reduce Fuel Tankering	• Optimum Descent • Optimum Cruise Speed • Optimum Altitude
IV. AIRCRAFT TECHNOLOGY SUBPROGRAM	
• New Near Term Aircraft • Winglets • Active Controls	• On-Board Performance Computers • Lighter Than Air Cargo Vehicles • Large Air Cargo Transports

Table 2.4 LIST OF 89 CURRENT FUEL CONSERVATION PROGRAM AND RESEARCH AREAS

1. Fuel Advisory Departure (FAD)/Gate Holding
2. Improve and Increase Utilization of Quota/Flow
3. Profile Descent Procedures
4. High Altitude and Optimum Speed Holding Procedures
5. Increase Usage of Enroute Linear Holding
6. Intermittent Use of High Density Procedures
7. Assigning Optimum Cruise Altitudes When Possible
8. Increased Utilization of Direct Area Navigation Routes (RNAV)
9. Revised Standard Instrument Departures (SIDs) and Standard Terminal Area Routes (STARs)
10. Reducing Vertical Separation Requirements Above Flight Level 290
11. Removing 250 Knot Speed Limit Below 10,000 Feet in Terminal Control Areas (TCA)
12. Passenger Weight Adjustment for Fuel Reserve Calculations
13. Revising Current Over Weight Landing Limitations
14. Relaxed Noise Abatement Procedures
15. Increased Application of Keep-Em-High Procedures
16. Curfew Relaxation
17. Reduced Separation for Instrument Flight Rules (IFR) Parallel Runways Within 4300 Feet
18. Wake VORTEX Class Sequencing
19. Wake VORTEX Avoidance System (WVAS)
20. Use of Short Temporary Runways During Airport Construction/Maintenance
21. Provide Additional Snow/Ice Removal Equipment
22. Construct Short General Aviation Runways at Large Hub Airports
23. Air Traffic Controller Training and Awareness of Fuel Conservation Procedures
24. Reduce Reserved Airspace
25. Increase the Number of Instrument Landing System (ILS) Installations
26. Increased Use of Flight Simulators
27. Capacity Restraint
28. Reseating Existing Aircraft
29. Reduce Fuel Tankering
30. Optimum Cruise Speed
31. Discrete Address Beacon System/Airport Traffic Advisory and Resolution Service (DABS/ATARS)
32. Upgraded Third Generation Air Traffic Control (UG3RD)
33. Microwave Landing System (MLS)
34. Delayed-Flap, High Speed Approach
35. International Air Transportation Association (IATA) High Speed Approach
36. Reduced Flap Approach
37. Reduced Fuel Reserves
38. Optimized Takeoff and Climb Procedures
39. Two-Segment Approaches
40. Reduce Airport Lighting
41. Efficiency on a Commercial Air Carrier Program
42. Expanded Terminal Control Area (TCA)
43. Local Flow Traffic Management (LFTM)
44. Simultaneous Landings on Intersecting Runways
45. Simultaneous Arrivals/Departures on Intersecting Runways
46. Airport Surface Traffic Control, Airport Surface Detection Equipment-3 (ASDE-3)
47. Airport Fog Dispersal System
48. Improve Airport Pavement
49. Optimum Descent Procedures
50. Joint-Use of Restricted Areas
51. Advanced Aircraft Technology
52. On-Board Performance Computers
53. Lighter-Than-Air (LTA) Vehicles
54. Minimize Circuitous Routings
55. Optimize Runway/Taxiway Usage
56. Minimize Fuel Dumping
57. Visual Confirmation System (VICON)
58. Color Runway Approach Lights
59. Vortex Alleviation Technology
60. Automated Terminal Service (ATS)
61. Terminal Information Processing Center (TIPS)
62. Automated Enroute ATC (AERA)
63. Cockpit Display of Traffic Information (CDTI)
64. Aviation Automated Weather Observation System (AV-AWOS)
65. Automated Low Cost Weather Observation System (ALWOS)
66. Cruise Speed Control (Monitoring within :.01 Mach)
67. Cruise Thrust Setting (Monitoring Mach/Engine Pressure Ratio Mismatch)
68. Reduced Engine Bleed (Air Conditioning, Pressurization, Anti-Surge)
69. Frequent Trim Control Adjustment
70. Reduce Non-Revenue Flying
71. Reduce Aircraft Operating Empty Weight (Service Items, Portable Water, etc.)
72. Careful Monitoring of Fuel Used by Specific Aircraft Engines and Crews
73. Replacement/Retrofitting of Older Aircraft
74. Increase Pilot Training and Proficiency in Fuel Efficient Procedures
75. Removing or Reducing Aircraft Exterior Paint
76. Eliminate Unnecessary Auxiliary Power Unit (APU) Usage
77. Taxi on Fewer Engines
78. Load to Aft Center of Gravity
79. Improve Taxi Equipment/Facilities (Towing Aircraft)
80. Use of Mobile Lounges
81. Computer Flight Planning
82. In-Flight Reclearance
83. One Stop vs. Non Stop
84. Increased Number of Alternate Airports
85. Aerodynamic Cleanliness
86. Instrument Calibration
87. Engine Thrust Specific Fuel Consumption (TSFC) Recovery
88. Engine Idle Fuel Flow
89. More Frequent Maintenance and Cleaning

2.4.3 Relationship Of FARs, On-Going Program And Research Areas

As discussed in Section 2.4, 116 FARs were identified which impact fuel consumption. FARs were defined as impacting fuel consumption if the regulation or procedures used to comply with the regulation had a potential for increased fuel conservation. Not all of the 116 FARs impacted fuel consumption significantly; therefore, it was necessary to establish elimination criteria so as to exclude these FARs from further review. Table 2.5 below describes the elimination criteria which were applied to each of the 116 FARS.

Table 2.5 ELIMINATION CRITERIA APPLIED TO 116 FUEL-IMPACT FARs

ELIMINATION CRITERIA	REMARKS
1. FARs of necessity which can not be changed for reasons of safety	Defines those FARs requiring necessary engine testing and airborne equipment for safety considerations even though extra fuel is burned.
2. Offers no significant additional savings	These FARs were generally in the areas of flight test program regulations, aircraft equipment certification, and crew member qualification criteria.
3. Do not constrain any fuel conservation program or research areas.	Evaluated against the list of 89 fuel conservation program and research areas.

The remaining FARs not eliminated were found to have a potential negative fuel consumption impact. These were next evaluated relative to the 89 program and research areas. Each program area was aligned with the FAR(s) that it impacted. This step eliminated any program areas not impacted by the FARs. It was also necessary to determine the degree to which each program area was impacted, if at all, by the FARs. FARs found to have a significant impact on program and research areas were defined as negative fuel impact FARs. The remaining FARs were no longer considered in the study. Section 3.3 describes each one of the program and research areas negatively impacted by FARs and discusses the operational constraints present in each.

2.5 ORGANIZATION OF REPORT

Section 1.0 presents the executive summary identifying the program objectives and results. Section 2.0 presents a program overview of the purpose and objectives of this study and provides background material relating to the impact and improvement attributable to the Congress, the Airlines, and FAA fuel efficiency programs.

Section 2.0 also describes the method of approach used to arrived at the results and conclusions. Specific fuel inefficient FARs and ATC procedures are identified and discussed in Section 3.0. Also enumerated in Section 3.0 is a description of fuel conservation program and research areas presently constrained by FARs and ATC procedures. Section 4.0 provides a list of conclusions developed from the primary results determined in Section 3.0. Section 5.0 prioritizes a list of recommended potential FAA/DOE research and development programs for future consideration. Appendices A and B provide copies of the responses of the FAA and the Air Transport Association of America (ATA) obtained during the data collection task. A detailed list of the fuel impact FARs is provided in Appendix C. Appendix D privides a copy of the January 7, 1977, FAA RNAV Policy Statement.

3.0 DISCUSSION OF RESULTS

The purpose of this section is to present a detailed discussion of the analyses used to support the conclusions and recommendations in Section 4.0 and 5.0 Section 3.1 discusses those FARs impacting fuel consumption. Section 3.2 examines those FARs which impact fuel consumption in relation to the fuel conservation program and research areas. Section 3.3 provides a description of each FAR fuel impacted program and research area, including benefits and constraints encountered. Figure 3.1 identifies the major points of the subsequent discussions with a brief comment while diagraming the method of approach used for this study.

3.1 FARs IMPACTING FUEL CONSUMPTION

A comprehensive review of the FARs revealed that at least 116 FARs have a stated or implied impact on fuel consumption. A list of these FARs taken from the table of contents of the FARs, is provided in Appendix C. This listing permits a division of these FARs into seven fuel conservation operational categories. These operational categories were suggested in the November 1976, FAA report to Congress [4]. Shown in Table 3.1 are the seven FAA operational categories and the FARs by number. Each operational category represents an FAR category requiring activities which directly or indirectly result in increased fuel consumption.

3.1.1 Evaluation Criteria

There are many qualitative and quantitative reasons for the impact these FARs have on fuel consumption. However, for the purpose of this study it is necessary to isolate those FARs that have a potential negative impact on fuel consumption. The following criteria were developed to eliminate any of the 116 FARs that did not significantly impact fuel consumption or could not be changed due to safety considerations.

1) FARs of necessity which cannot be changed for reasons of safety -- defines those FARs regarding necessary engine and airframe certification. Also included are those FARs describing necessary equipment which must accompany an aircraft in flight. Such equipment falls into the categories of navigation instrumentation, communication equipment, and passenger/crew safety equipment. Both activities result in increased fuel consumption, but are considered necessary to ensure safety in flight.

2) Offers no significant additional savings -- defines those FARs which generally fall in the program categories of flight test program regulations, aircraft equipment, and crew member qualification. More specifically, this criteria applies to those FARs where fuel conservation program or research areas had previously demonstrated that further FAR revisions offered no additional significant fuel savings. An example is the size and weight of aircraft navigation

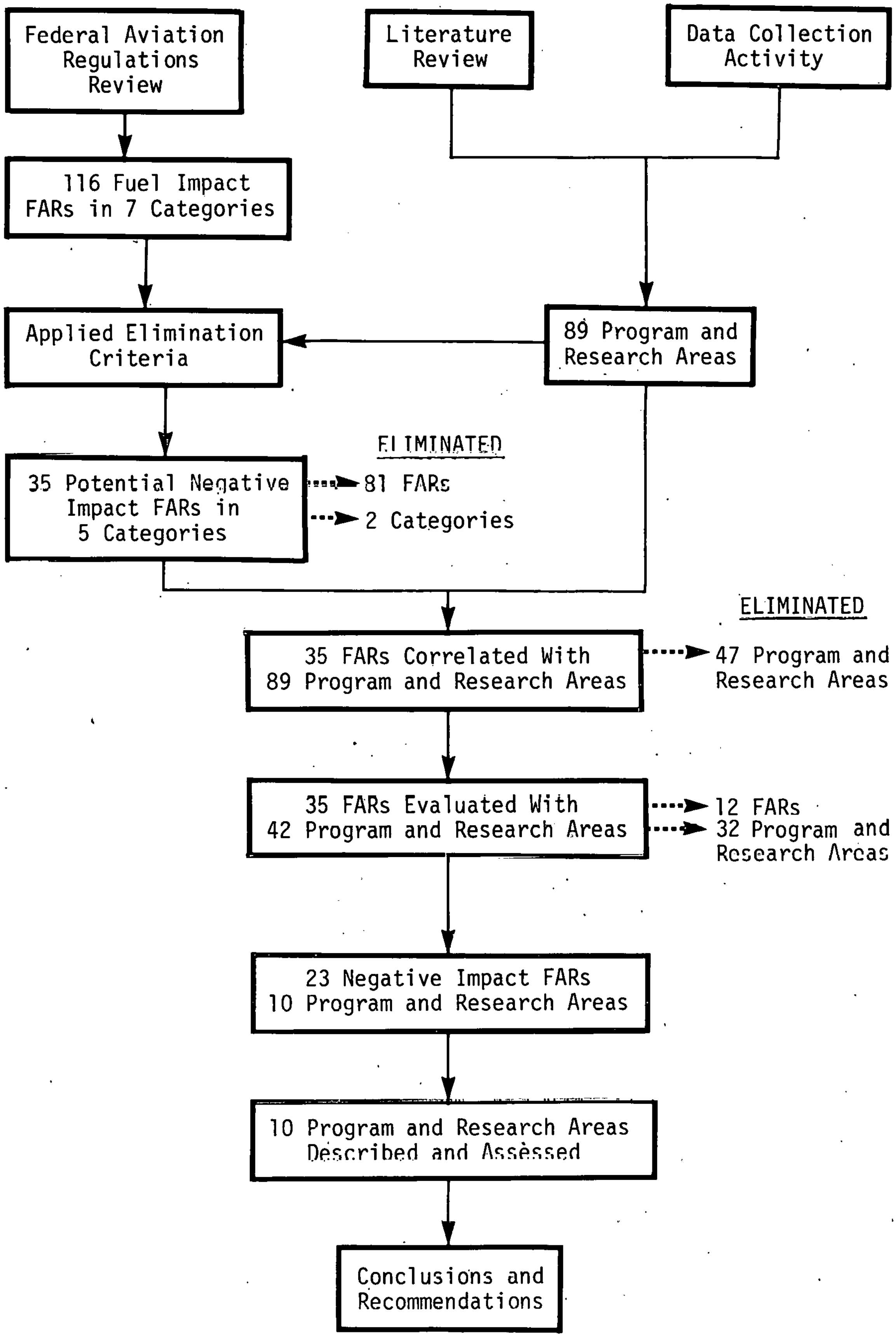

Figure 3.1 FLOW DIAGRAM OF METHOD OF APPROACH IDENTIFYING MAJOR STEPS AND RESULTS FOR EACH STEP

Table 3.1 FARs WHICH IMPACT FUEL CONSUMPTION

Operational Categories	FARs Examined	Number of FARS
1. Flight Test Programs	21.33, 21.35, 21.81, 21.83, 21.127, 21.128, 21.221, 21.223, 21.225, 91.93, 91 Appendix A, 121.163	12
2. Environmental Control	36.1, 36.203, 36 Appendix A, C, 91.55, 91.87, 91 Appendix B, SFAR No. 27 Sec. 15, 17, 19, 21, 25	12
3. Aircraft Fuel Supply	91.23, 91.207, 121.198, 121.639, 121.641, 121.643, 121.645, 135.97	8
4. Aircraft Speed and Flight Altitude	91.70, 91.116, 95.13, 95.15, 95.17, 95.8001,	6
5. Airspace and Air Traffic Control	71.121, 71.123, 71.151, 71.193, 91.89, 91.90, 91.95, 91.97, 91.123, 93.123, 121.93, 121.95, 121.103, 121.113, 121.115, 121.121, 121.125, 121.127	18
6. Aircraft Equipment	91.33, 91.35, 91.52, 91.90, 91.187, 91.189, 91.191, 91.193, 91 Appendix A, 121.305, 121.307, 121.309, 121.310, 121.318, 121.319, 121.321, 121.323, 121.325, 121.327, 121.329, 121.331, 121.333, 121.337, 121.339, 121.340, 121.341, 121.343, 121.345, 121.347, 121.349, 121.351, 121.353, 121.357, 121.359, 121.360, 121.581	36
7. Crew Member Qualification	61.55, 61.57, 61.58, 61.65, 61.67, 61.69, 61.109, 61.129, 61.131, 61.135, 61.155, 61.165, 121.425, 121.434, 121.439, 121.440, 121.441, 121.442, 121.443, 121.447, 135.121, 135.123, 135.125, 141 141.35	24

equipment. Early navigation equipment and computers were bulky and heavy. Significant reduction in weight and size has been achieved in addition to useful interface equipment (i.e., weather radar) entering the cockpit. It is believed that no significant additional savings can be attained through aircraft navigation equipment dimension reduction, at least in the near future [4]. Specified hours of training and experience have been established for crew member qualifications in order to meet the rigorous standards of safety. Reduction of these hours could not be significant enough to save additional fuel at the expense of safety. Simulator flight hours in lieu of actual aircraft time has become the common alternative and has been exploited to a large extent.

3) Do not constrain any fuel conservation program or research area -- defines those FARs that are not a constraint to fuel conservation when evaluated against the list of 89 program and research areas.

Application of the evaluation criteria results in the elimination of 81 of the 116 FARs. The thirty-five remaining FARs are considered to have a potential negative impact on fuel consumption. Tables 3.2 through 3.8 categorize the 116 FARs by the seven operational areas described previously. Each table provides a list of FARs by number, the elimination criteria applied when appropriate, and comments where necessary for clarity. Examination of the tables shows two FARs in the category of Environmental Control, eight in Aircraft Fuel Supply, six in Aircraft Speed and Flight Altitude, 18 in Airspace and ATC, and one in Crew Member Qualification have potential negative impact on fuel consumption. The direct negative impact of these FARs cannot be quantitatively determined with actual data, except in regard to the operational constraints they place on fuel conservation program and research areas. Another point is that the degree of impact by each FAR is likely to vary. This aspect will be explained thoroughly in Sections 3.2 and 3.3 It should also be noted that two operational categories, Flight Test Programs and Aircraft Equipment, were eliminated from further consideration since no significant potential negative impact on fuel consumption was determined.

Table 3.2 ELIMINATION CRITERIA APPLIED TO FARs RELATED TO FLIGHT TEST PROGRAMS

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
21.33		✓	✓	✓		Regards inspection and tests
21.35		✓	✓	✓		Flight test compliances
21.81		✓	✓	✓		Class I type certification
21.83		✓	✓	✓		Class II type certification
21.127		✓	✓	✓		Aircraft flight tests
21.128		✓	✓	✓		Aircraft engine tests
21.221		✓	✓	✓		Class I airworthiness certification
21.223		✓	✓	✓		Class II airworthiness certification
21.225		✓	✓	✓		Provisional airworthiness certification
91.93		✓	✓	✓		Flight test areas
91.Appendix A		✓	✓	✓		Category II instrument & equipment performance criteria
121.163		✓	✓	✓		Aircraft proving tests

Table 3.3 ELIMINATION CRITERIA APPLIED TO FARs RELATED TO ENVIRONMENTAL CONTROLS

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
36.1		✓	✓	✓		Applicability of noise standards
36.203		✓	✓	✓		Validity of noise measurement results
36 Appendix A		✓	✓	✓		Noise certification test & measurement conditions
36 Appendix C					✓	Noise levels for subsonic transport & turbojet aircraft
91.55		✓	✓	✓		Civil aircraft sonic boom
91.87					✓	Noise abatement runway system
91 Appendix B		✓	✓	✓		Authorization to exceed Mach 1
SFAR No.27, Sec. 15		✓	✓	✓		Fuel venting & exhaust emission type certification
Sec. 17		✓	✓	✓		Supplemental or amendment to Sec. 15
Sec. 19		✓	✓	✓		Airworthiness approval tags
Sec. 21		✓	✓	✓		Airworthiness approval certificates
Sec. 25		✓	✓	✓		Operation of approved engines

Table 3.4 ELIMINATION CRITERIA APPLIED TO FARs RELATED TO AIRCRAFT FUEL SUPPLY

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
91.23					✓	Fuel requirements for Instrument Flight Rules flight conditions
91.207					✓	Visual Flight Rules fuel requirements
121.198					✓	Increased zero fuel landing weights
121.639					✓	Domestic air carrier fuel requirements
121.641					✓	International Flag air carrier fuel requirements
121.643					✓	Supplemental air carrier fuel requirements
121.645					✓	Fuel supply for turbine air carriers
135.97*					✓	Visual Flight Rules fuel supply

Table 3.5 ELIMINATION CRITERIA APPLIED TO FARs REGARDING AIRCRAFT SPEED AND FLIGHT ALTITUDE

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
91.70					✓	Aircraft speed restrictions
91.116					✓	Instrument Flight Rules approach and departure minimums
95.13					✓	Designated eastern U.S. mountainous areas
95.15					✓	Designated western U.S. mountainous areas
95.17					✓	Designated Alaskan mountainous areas
95.8001					✓	Instrument Flight Rules route altitudes and intersections

Table 3.6 ELIMINATION CRITERIA APPLIED TO FARs REGARDING AIRSPACE AND ATC

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
71.121					✓	Designation of Very High Frequency Omnidirectional Range Federal Airways
71.123					✓	Domestic Very High Frequency Omnidirectional Range Federal Airways
71.151					✓	Restricted areas
71.193					✓	Positive control areas
91.89					✓	Operation at airports without control towers
91.90					✓	Terminal control areas
91.95					✓	Restricted and prohibited areas.
91.97					✓	Positive control airspace and route segments
91.123					✓	Course to be flown
93.123					✓	High density traffic airports
121.93					✓	Air carrier route approval
121.95					✓	Route width
121.103					✓	Enroute navigation facilities
121.113					✓	Air carrier area and route requirements
121.115					✓	Route width
121.121					✓	Enroute navigation facilities
121.125					✓	Flight following system
121.127					✓	Flight following system requirements

Table 3.7 ELIMINATION CRITERIA APPLIED TO FARs REGARDING AIRCRAFT EQUIPMENT

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
91.33	✓		✓	✓		Civil aircraft instrument & equipment requirements
91.35	✓		✓	✓		Flight & cockpit voice recorders
91.52	✓		✓	✓		Emergency locator transmitters
91.90	✓		✓	✓		Terminal Control Area aircraft operating equipment
91.187	✓		✓	✓		Night Visual Flight Rules equipment
91.189	✓		✓	✓		Overwater survival equipment
91.191	✓		✓	✓		Overwater radio equipment
91.193	✓		✓	✓		Emergency equipment
91 Appendix A	✓	✓	✓	✓		Category II instrument & equipment performance criteria
121.305	✓		✓	✓		Flight & navigational equipment
121.307	✓		✓	✓		Engine instruments
121.309	✓		✓	✓		Emergency equipment
121.310	✓		✓	✓		Additional emergency equipment
121.318	✓		✓	✓		Public address and interphone system
121.319	✓		✓	✓		Crew member interphone system
121.321	✓		✓	✓		Shoulder harness
121.323	✓		✓	✓		Instruments & equipment for night operations
121.325	✓		✓	✓		Instrument Flight Rules instruments & equipment
121.327	✓		✓	✓		Supplemental oxygen for reciprocating engine aircraft
121.329	✓		✓	✓		Supplemental oxygen for turbine engine aircraft
121.331	✓		✓	✓		Supplemental oxygen for pressurized reciprocating engine aircraft
121.333	✓		✓	✓		Supplemental oxygen for emergency descent
121.337	✓		✓	✓		Protective breathing equipment for flight crew
121.339	✓		✓	✓		Extended overwater operating equipment
121.340	✓		✓	✓		Emergency floatation equipment
121.341	✓		✓	✓		Equipment for operation in icing conditions
121.343	✓		✓	✓		Flight recorders
121.345	✓		✓	✓		Radio equipment
121.347	✓		✓	✓		Visual Flight Rules radio equipment for navigation by pilotage
121.349	✓		✓	✓		Visual Flight Rules or Instrument Flight Rules radio equipment for navigation not by pilotage
121.351	✓		✓	✓		Extended overwater radio equipment
121.353	✓		✓	✓		Air carrier equipment for operation over uninhabited terrain
121.357	✓		✓	✓		Airborne weather radar equipment requirements
121.359	✓		✓	✓		Cockpit voice recorders
121.360	✓		✓	✓		Ground proximity warning-glide slope deviation alerting system
121.581		✓	✓	✓		Air carriers forward observer's seat

Table 3.8 ELIMINATION CRITERIA APPLIED TO FARs REGARDING CREW MEMBER QUALIFICATION

FARs	ELIMINATION CRITERIA			ELIMINATED		COMMENTS
	1	2	3	yes	no	
61.55		✓	✓	✓		Second in command qualifications for large airplanes
61.57		✓	✓	✓		Recent flight experience for pilot in command
61.58		✓	✓	✓		Pilot in command proficiency check
61.65		✓	✓	✓		Instrument rating requirements
61.67		✓	✓	✓		Category II pilot authorization requirements
61.69		✓	✓	✓		Glider towing experience
61.109		✓	✓	✓		Airplane rating and aeronautical experience
61.129		✓	✓	✓		Airplane rating and aeronautical experience
61.131		✓	✓	✓		Rotorcraft rating and aeronautical experience
61.135		✓	✓	✓		Airship rating and aeronautical experience
61.155		✓	✓	✓		Airplane rating and aeronautical experience
61.165		✓	✓	✓		Additional category ratings
121.425		✓	✓	✓		Initial transition and upgrade flight training for pilots
121.434		✓	✓	✓		Operating experience
121.439		✓	✓	✓		Recent experience for pilot qualification
121.440		✓	✓	✓		Line checks
121.441		✓	✓	✓		Pilot proficiency checks
121.442					✓	Use of flight simulators
121.443		✓	✓	✓		Pilot in command qualifications for domestic air carriers
121.447		✓	✓	✓		Pilot route and airport qualifications for particular trips
135.121		✓	✓	✓		Pilot in command qualifications for night flight
135.123		✓	✓	✓		Pilot in command qualifications for carrying passengers under Visual Flight Rules over-the-top
135.125		✓	✓	✓		Pilot in command qualifications for Instrument Flight Rules flight
141.35		✓	✓	✓		Chief instructor qualifications

3.1.2 Description Of Potentially Negative Fuel Impact FARs

In order to gain a thorough understanding of the 35 FARs determined to have a potentially negative fuel impact on conservation program and research areas, a description of each FAR in the five remaining operational categories is presented. This will assist the reader during the discussion of the potential negative impact FARs' relationship to the 89 conservation program and research areas, as well as the determination of the direct negative fuel impact FARs presented in Section 3.2.

A. FARs RELATED TO ENVIRONMENTAL CONTROL

FAR Part	Subpart	Section	Description
36	Appendix C	5	Defines acceptable noise levels of Effective Preceived Noise (measured in decibels) per maximum aircraft weight categories. <u>Benefits available through relaxation of certification noise limits for transport category and turbojet powered airplanes and through relaxing the required number of flight test hours for newer more fuel efficient aircraft.</u>
91	B	87	Applies to the use of noise abatement runway system operation where a runway use program exists. ATC currently assigns a pilot the noise abatement runway if deemed necessary, which often requires circuitous routing and increased fuel consumption. <u>Benefits available from fewer circuitous routings for newer, quieter aircraft and possibly through a planned revision of the runway use program coordinated with local authority as fleet mix changes.</u>

B. FARs RELATED TO AIRCRAFT FUEL SUPPLY

FAR Part	Subpart	Section	Description
91	A	23	Delineates fuel requirements for flight in Instrument Meteorological Conditions. The flight must be able to complete its trip to the first intended airport, fly from that airport to its alternate, and fly thereafter for 45 minutes at normal cruise. <u>Benefits realized in more determinate planning of the alternate airport.</u>
91	D	207	Concerns Visual Flight Rules fuel requirements. Flight to the intended airport must have sufficient fuel, considering weather, to arrive at the intended airport and fly thereafter for 30 minutes. <u>Benefits achievable in improved timely weather briefings to aircraft.</u>
121	I	198	Describes increased zero fuel and landing weights for transport cargo service compliance. Permits certain aircraft to exceed by 5% their zero fuel weight with a corresponding increase in landing weight. <u>Benefits gained with relaxed requirements would be realized in less fuel dumpings</u>.
121	U	639	Describes fuel supply requirements for domestic air carriers. The aircraft must have sufficient fuel to arrive at the intended airport, to fly from that airport

FAR Part	Subpart	Section	Description
			to the most distant alternate airport, and thereafter, fly for 45 minutes. Benefits available in more discrete planning of the alternate airports.
121	U	641	Describes fuel supply requirements for international flag air carriers The aircraft must have sufficient fuel to fly to the intended airport, to fly to the most distant alternate airport, and thereafter, fly for 30 minutes plus 15% of the total flight time or 90 minutes at normal cruise, which ever is less. Benefits available through improved weather information and selective alternate airport planning.
121	U	643	Describes fuel requirements for nonturbine supplemental air carriers and commercial operators. Considering weather conditions, an aircraft must have sufficient fuel to fly to the intended airport, to fly from there to the most distant alternate airport, and thereafter, fly for 45 minutes at normal cruise. Benefits same as above.
121	U	645	Describes fuel requirements for turbine supplemental air carriers and commercial operators. Considering weather, the aircraft must have sufficient fuel to fly to the intended airport, and thereafter, fly for 10% of the total time required to return to the departure airport. Benefits same as above.
135	C	97	Visual Flight Rules fuel supply requirements state that an aircraft must have sufficient fuel to fly to the intended airport, and thereafter, to fly for 30 minutes during the day and one hour at night, at normal cruise. Benefits same as above.

C. FARs RELATED TO AIRCRAFT SPEED AND FLIGHT ALTITUDE

FAR Part	Subpart	Section	Description
91	B	70	Aircraft are restricted from operation below 10,000 feet Mean Sea Level at an indicated airspeed of more than 250 knots. Within an airport traffic area, no reciprocating engine aircraft may be operated more than 156 knots, no turbine-power aircraft more than 200 knots. Benefits are achieved through increasing the speed limit below 10,000 feet Mean Sea Level for arrival and departure traffic when appropriate.

FAR Part	Subpart	Section	Description
91	B	116	Describes takeoff and landing minimums under Instrument Flight Rules for civil and military airports, and the use of Runway Visual Range and Automatic Radio Direction Finding Equipment prodedures. Further reduction of minimums through the Microwave Landing System is under development, promising benefits.
95	B	13	Describes designated eastern U.S. mountainous areas for Instrument Flight Rules altitudes. Benefits achievable through the increased use of non-Very High Frequency Omnidirectional Range area navigation systems to avoid circuitous low altitude routing in mountainous areas.
95	B	15	Describes designated western U.S. mountainous areas. Benefits are the same as above.
95	B	17	Describes designated Alaska mountainous areas. Benefits are the same as above.
95	D	8001	This section describes Instrument Flight Rules altitudes and intersections. Benefits available through increased use of area navigation routes and equipment.

D. FARs RELATED TO AIRSPACE AND AIR TRAFFIC CONTROL

FAR Part	Subpart	Section	Description
71	C	121	Describes designation of Very High Frequency Omnidirectional Range Federal airways and Very High Frequency Omnidirectional Range Tactical Air Navigation facilities. Benefits achievable through the use of more approved area navigation routes.
71	C	123	Designates domestic Very High Frequency Omnidirectional Range Federal airways and Very High Frequency Omnidirectional Range Tactical Air Navigation facilities. Benefits same as above.
71	D	151	Delineates the restricted areas within the continental control area. Reduction of the number of restricted areas has already provided large benefits. A further reduction may be possible.
71	H	193	Designation of positive control areas. This FAR impacts direct area navigation while operating under Visual Flight Rules.

FAR Part	Subpart	Section	Description
91	B	89	This section describes operation at airports without control towers. This FAR is subject to major revision depending on outcome of the Automated Terminal Service program under development.
91	B	90	This section describes operation in Group I, II, and III terminal control areas. Benefits achievable through revision of this FAR to accommodate optimum approach and departure procedures.
91	B	95	Concerns operation in restricted and prohibited areas. Large benefits have already been achieved through significant reductions and revisions.
91	B	97	Defines operation of aircraft within positive control areas and route segments. This FAR impacts direct area navigation routing while operating under Visual Flight Rules.
91	B	123	This section concerns operation within controlled airspace under Instrument Flight Rules, along Federal airways or other routes. Benefits available through area navigation defined routes.
93	K	123	This section designates high density traffic airports and their limited hourly number of allocated Instrument Flight Rules operations. This FAR impacts many current program and research areas which could improve Instrument Flight Rules airport capacity.
121	E	93	Designates requirements for international flag and domestic air carriers seeking a route approval. Benefits achievable if more area navigation route designs would be encouraged.
121	E	95	Designated route width requirements for approval of routes. Also impacts area navigation.
121	E	103	Designates enroute navigational facility requirements for routes approved for domestic and international flag air carriers. Also impacts encouragement of area navigation designed routes.
121	F	113	Supplemental or commercial air carrier route and area approval requirements. Impacts are the same as other route approval requirements previously discribed.
121	F	115	Describes route width determination considerations. Benefits receivable through encouragement of area navigation route designs.

FAR Part	Subpart	Section	Description
121	F	121	Describes supplemental or commercial air carrier enroute navigational facility requirements for route approval. Benefits available through encouraged area navigation route design.
121	F	125	Designates requirements for route approval in accordance with flight following system (Air Traffic Control Radar) locations for supplemental or commercial air carriers. Benefits available through many research programs under development.
121	F	127	Defines requirements for supplemental or commercial operators using a flight following system (Air Traffic Control Radar). Benefits forecasted for improved and advanced flight following systems under development.
E. FARs RELATED TO CREW MEMBER QUALIFICATION			
121	O	442	Defines requirements for use of a flight simulator to acquire additional approved flight time. Flight simulators are presently used a significant amount. However, the FAA and Airline Transportation Association of America feel that additional benefits still remain in more extensive use of the simulators if this FAR is relaxed appropriately.

These descriptions indicate two things. First, it is observed that many FARs may impact the same conservation program or research area (i.e., area navigation, fuel reserves, etc.). And secondly, the degree of impact each FAR has on each program and research area is likely to vary in significance.

3.2 RELATIONSHIP OF FARs TO CONSERVATION PROGRAM AND RESEARCH AREAS

This section analyses the 89 identifiable fuel conservation program and research areas and establishes their relationship to the 35 FARs determined to have a potential negative impact on these program and research areas.

3.2.1 Fuel Conservation Program And Research Areas Identification

Shown in Table 3.9 is a list of the 89 fuel conservation program and research areas with an assigned status level. The status level column is subdivided into six other columns identified as Implemented, Under Development, Inactive, Unknown, Other and Purview. Also provided in the table is a legend of descriptors. The symbolic descriptors define an action or degree of action for the first five columns. The numberic descriptors define the source of responsibility for action in the purview columms.

Table 3.9 FUEL CONSERVATION PROGRAM AND RESEARCH AREAS WITH STATUS LEVEL

LEGEND:

✓ - IMPLIED	1 - FAA
* - PARTIALLY	2 - AIR TRAFFIC CONTROL
X - AUTOMATION TECHNIQUES UNDER DEVELOPMENT	3 - AIRLINE
† - NOT A PRESENT CONSIDERATION	4 - AIRPORT MANAGEMENT
	5 - ADVANCED TECHNOLOGY (NASA)

PROGRAM AND RESEARCH AREAS	STATUS LEVEL					
	IMPLEMENTED	UNDER DEVELOPMENT	INACTIVE	UNKNOWN	OTHER	PURVIEW
1. FUEL ADVISORY DEPARTURE (FAD)/GATE HOLDING	✓				X	1
2. IMPROVE AND INCREASE UTILIZATION OF QUOTA/FLOW		✓			X	1
3. PROFILE DESCENT PROCEDURES	✓				*	1,2,3
4. HIGH ALTITUDE AND OPTIMUM SPEED HOLDING PROCEDURES	✓				*	2
5. INCREASE USAGE OF ENROUTE LINEAR HOLDING	✓				*	1,2
6. INTERMITTENT USE OF HIGH DENSITY PROCEDURES	✓					2
7. ASSIGNING OPTIMUM CRUISE ALTITUDES WHEN POSSIBLE	✓					2,5
8. INCREASED UTILIZATION OF DIRECT AREA NAVIGATION (RNAV) ROUTES	✓				*	1,2,3
9. REVISED STANDARD INSTRUMENT DEPARTURES (SIDs) AND STANDARD TERMINAL AREA ROUTES (STARs)	✓				*	1
10. REDUCING VERTICAL SEPARATION REQUIREMENTS ABOVE FLIGHT LEVEL 290			✓			1,5
11. REMOVING 250 KNOT SPEED LIMIT BELOW 10,000 FEET IN TERMINAL CONTROL AREAS (TCAs)		✓				1,2
12. PASSENGER WEIGHT ADJUSTMENT FOR FUEL RESERVE CALCULATIONS			✓			1,3
13. REVISING CURRENT OVER WEIGHT LANDING LIMITATIONS	✓					1
14. RELAXED NOISE ABATEMENT PROCEDURES					†	1,4
15. INCREASED APPLICATION OF KEEP-EM-HIGH PROCEDURES	✓					2
16. CURFEW RELAXATION					†	1,4
17. REDUCE SEPARATION FOR INSTRUMENT FLIGHT RULES (IFR) PARALLEL RUNWAYS WITHIN 4300 FEET.		✓				1
18. WAKE VORTEX CLASS SEQUENCING		✓			X	1,5
19. WAKE VORTEX AVOIDANCE SYSTEMS (WVAS)		✓			X	1,5
20. USE OF SHORT TEMPORARY RUNWAYS DURING AIRPORT CONSTRUCTION/MAINTENANCE				✓		1,4
21. PROVIDE ADDITIONAL SNOW/ICE REMOVAL EQUIPMENT			✓			1,4
22. CONSTRUCT SHORT GENERAL AVIATION RUNWAYS AT LARGE HUB AIRPORTS				✓		1,4
23. AIR TRAFFIC CONTROLLER TRAINING AND AWARENESS OF FUEL CONSERVATION PROCEDURES	✓				*	1,2
24. REDUCE RESERVED AIRSPACE	✓				†	1,2
25. INCREASE THE NUMBER OF INSTRUMENT LANDING SYSTEM (ILS) INSTALLATIONS	✓				*	1,4
26. INCREASED USE OF FLIGHT SIMULATORS	✓					1,3
27. CAPACITY RESTRAINT	✓				*	1,3
28. RESEATING EXISTING AIRCRAFT	✓					3
29. REDUCE FUEL TANKERING	✓				*	3
30. OPTIMUM CRUISE SPEED	✓				*	1
31. DISCRETE ADDRESS BEACON SYSTEM/AIRPORT TRAFFIC ADVISORY AND RESOLUTION SERVICE (DABS/ATARS)		✓				1
32. UPGRADED THIRD GENERATION AIR TRAFFIC CONTROL (UG3RD ATC)		✓				1
33. MICROWAVE LANDING SYSTEM (MLS)		✓				1
34. DELAYED-FLAP, HIGH SPEED APPROACH	✓				*	1,3
35. INTERNATIONAL AIR TRANSPORTATION ASSOCIATION HIGH SPEED APPROACH	✓				*	1,3
36. REDUCED FLAP APPROACH	✓				*	1,3
37. REDUCED FUEL RESERVES				✓		1
38. OPTIMIZED TAKEOFF AND CLIMB PROCEDURES					†	1
39. TWO-SEGMENT APPROACHES					†	2,3
40. REDUCE AIRPORT LIGHTING	✓				*	4
41. EFFICIENCY ON A COMMERCIAL AIR CARRIER PROGRAM			✓			3
42. EXPANDED TERMINAL CONTROL AREA (TCA)		✓				1
43. LOCAL FLOW TRAFFIC MANAGEMENT (LFTM)	✓				*	1
44. SIMULTANEOUS LANDINGS ON INTERSECTING RUNWAYS	✓				*	1
45. SIMULTANEOUS ARRIVALS/DEPARTURES ON INTERSECTING RUNWAYS	✓				*	1
46. AIRPORT SURFACE TRAFFIC CONTROL, AIRPORT SURFACE DETECTION EQUIPMENT-3 (ASDE-3)		✓				1
47. AIRPORT FOG DISPERSAL SYSTEM			✓			1
48. IMPROVE AIRPORT PAVEMENT			✓			1
49. OPTIMUM DESCENT PROCEDURES	✓					1
50. JOINT-USE OF RESTRICTED AREAS	✓					1
51. ADVANCED AIRCRAFT TECHNOLOGY		✓				1,5
52. ON-BOARD PERFORMANCE COMPUTERS	✓				*	3
53. LIGHTER - THAN - AIR (LTA) VEHICLES		✓				1
54. MINIMIZE CIRCUITOUS ROUTINGS	✓				*	2
55. OPTIMIZE RUNWAY/TAXIWAY USAGE		✓				1,2
56. MINIMIZE FUEL DUMPING	✓				*	1
57. VISUAL CONFIRMATION SYSTEM (VICON)		✓				1
58. COLOR RUNWAY APPROACH LIGHTS		✓				1,4
59. VORTEX ALLEVIATION TECHNOLOGY		✓				5
60. AUTOMATED TERMINAL SERVICE (ATS)		✓				1
61. TERMINAL INFORMATION PROCESSING CENTER (TIPS)		✓				1
62. AUTOMATED ENROUTE ATC (AERA)		✓				1
63. COCKPIT DISPLAY OF TRAFFIC INFORMATION (CDTI)		✓				1,5
64. AVIATION AUTOMATED WEATHER OBSERVATION SYSTEM (AV-AWOS)		✓				1
65. AUTOMATED LOW COST WEATHER OBSERVATION SYSTEM (ALWOS)		✓				1
66. CRUISE SPEED CONTROL (MONITORING WITHIN ±.01 MACH)	✓				*	3
67. CRUISE THRUST SETTING (MONITORING MACH ENGINE PRESSURE RATIO MISMATCH)	✓					3
68. REDUCED ENGINE BLEED (AIR CONDITIONING, PRESSURIZATION, ANTI-SURGE)	✓					3
69. FREQUENT TRIM CONTROL ADJUSTMENT	✓					3
70. REDUCE NON-REVENUE FLYING	✓				*	3
71. REDUCE AIRCRAFT OPERATING EMPTY WEIGHT (SERVICE ITEMS, PORTABLE WATER, ETC.)	✓					3
72. CAREFUL MONITORING OF FUEL USED BY SPECIFIC AIRCRAFT ENGINES AND CREWS				✓		3
73. REPLACEMENT/RETROFITTING OF OLDER AIRCRAFT	✓					3
74. INCREASE PILOT TRAINING AND PROFICIENCY IN FUEL EFFICIENT PROCEDURES	✓					3
75. REMOVING OR REDUCING AIRCRAFT EXTERIOR PAINT	✓				*	3
76. ELIMINATE UNNECESSARY AUXILIARY POWER UNIT (APU)	✓					3
77. TAXI ON FEWER ENGINES	✓					3
78. LOAD TO AFT CENTER OF GRAVITY	✓				*	3
79. IMPROVE TAXI EQUIPMENT/FACILITIES (TOWING AIRCRAFT)		✓			†	4
80. USE OF MOBILE LOUNGES					†	4
81. COMPUTER FLIGHT PLANNING	✓				X	2,3
82. IN-FLIGHT RECLEARANCE	✓				*	2
83. ONE STOP VS NON-STOP					†	3
84. INCREASED NUMBER OF ALTERNATE AIRPORTS	✓				*	1,3
85. AERODYNAMIC CLEANLINESS	✓					3
86. INSTRUMENT CALIBRATION	✓					3
87. ENGINE THRUST SPECIFIC FUEL CONSUMPTION (TSFC) RECOVERY		✓				3,5
88. ENGINE IDLE FUEL FLOW	✓				*	3
89. MORE FREQUENT MAINTENANCE AND CLEANING	✓					3

As seen in the first column, 49 program and research areas have been implemented. Of these 49 areas, only 19 have been implemented to the fullest extent practical, 27 are only partially implemented, two have additional plans for automation, and one is no longer being considered a fuel conservation option.

Shown in the second column of Table 3.9, there are 24 areas under development. Of the remaining program and research areas, seven are inactive, four are undetermined and eight (including one area already implemented) are no longer being considered as fuel conservation options.

The purview column of Table 3.9, defines the source of responsibility or action for each of the 89 fuel conservation program and research areas. This column identifies five major sources: the FAA, Air Traffic Control, Airlines, Airport Management, and Advanced Techology of NASA. Much of this information was collected from the FAA and ATA during the data collection task of this study. Table 3.9 shows that 28 program and research areas are solely under the purview of the FAA, 10 solely for the Air Traffic Control, 22 solely for the Airlines, 3 solely for Airport Management and 1 solely for Advanced Technology under NASA. However, in many cases, the responsibility sources identified in the purview column are jointly shared, often including the FAA. Examining the table reveals that 29 program and research areas are jointly shared, of which 26 involve the FAA. An example is the area of Profile Descent Procedures, number three. In this case, the FAA is responsible for developing profile descent routes for appropriate airports and for training air traffic controllers on the use of these procedures; the Air Traffic Control system is responsible for the consistent and efficient use of these procedures; and the airlines are responsible for providing the necessary equipment in their aircraft and the training of their pilots in equipment use and route procedures, who in turn, are responsible for requesting these approach procedures.

3.2.2 The FAA and ATA Data Response Summary

This section provides a brief discussion and summary of the data collected from the FAA and ATA, presented in Appendices A and B, respectively. This data was requested from the FAA and ATA in order to gain current (1979) qualitative and quantitative data on the FAA's proposed energy conservation program areas for the National Airspace System [3], previously shown in Table 2.3. Although the information collected was useful and pertinent, neither response provided a comprehensive system-wide assessment of the current (1979) full conservation program impact.

Table 3.10 provides a summary of the FAA and ATA information gathered for each of the FAA's proposed conservation program areas, as well as any additional areas included in the responses. Under both of the response columns the first three subcolumns indicate the status level of the program areas, and the remaining two sub-columns indicate the source of responsibility for action (FAA or other).

Where information is available from both the FAA and ATA, there is no apparent disagreement. However, the detailed discussions provided in Appendices A and B show disagreement as to the degree of progress being made toward full system-wide implementation for program areas such as Fuel Advisory Departure, Wake Vortex Avoidance Systems, Area Navigation, Airport Surface Traffic Control, Climb Procedures in TCAs, Optimum Descent, and Optimum Altitude. Note that the FAA responded to all 31 of the program areas in some manner, and the ATA responded to 24 for which it had pertinent information. The ATA, in addition to the information in Table 3.10, provided other useful information regarding potential FAA and airline actions toward fuel efficiency in the Air Traffic Control system, shown in Appendix B. A summary listing of the potential FAA/airline actions are shown in Table 3.11, many of which are also included in Table 3.10.

Table 3.10 SUMMARY OF THE FAA AND ATA VIEWPOINTS OF THE FAA's PROPOSED ENERGY CONSERVATION PROGRAM AREAS

FAA PROPOSED ENERGY CONSERVATION PROGRAM AREAS AND OTHER PROGRAM AREAS	FAA RESPONSE					ATA RESPONSE				
	IMPLEMENTED	UNDER DEVELOPMENT	INACTIVE	FAA PURVIEW	OTHER PURVIEW	IMPLEMENTED	UNDER DEVELOPMENT	INACTIVE	FAA PURVIEW	OTHER PURVIEW
I. FAA AIR TRAFFIC CONTROL PROGRAM AREA										
Fuel Advisory Departure	✓			X		✓			X	X
Flow Control Automation		✓		X			✓		X	X
Wake Vortex Avoidance System		✓		X			✓		X	
Area Navigation	✓			X		✓			X	
Expanded Terminal Control Area		✓		X			✓		X	
Local Flow Traffic Management	✓			X						
Standard Instrument Departure/ Standard Terminal Arrival Routes	✓			X						
Discrete Address Beacon System/ Airport Traffic Advisory and Resolution Service		✓		X						
Microwave Landing System		✓		X						
Gate Hold Procedures	✓			X		✓			X	X
Simultaneous Landings on Intersecting Runways	✓			X						
Simultaneous Arrival and Departures on Intersecting Runways	✓			X						
II. AIRPORTS PROGRAM AREAS										
Airport Surface Traffic Control		✓		X			✓		X	
Fog Dispersal System			✓	X				✓	X	
Snow-Ice Removal Equipment			✓	X				✓	X	
Airport Pavements			✓	X						
III. AIRCRAFT OPERATORS PROGRAM AREAS										
Capacity Restraint					X					X
Reseating Existing Aircraft					X					X
Simulators	✓			X		✓			X	
Reduce Fuel Tankering					X					X
Taxi on Fewer Engines					X					X
Climb Procedures in Terminal Control Areas		✓		X					X	
Optimum Descent	✓			X		✓			X	
Optimum Cruise Speed	✓			X		✓			X	X
Optimum Altitude	✓			X					X	
IV. AIRCRAFT TECHOLOGY PROGRAM AREAS										
New Near Term Aircraft					X					X
Winglets					X		✓			X
Active Controls					X		✓			X
On-Board Performance Computers					X	✓				X
Lighter-Than-Air Cargo Vehicles					X					X
Large Air Cargo Transports					X					X
TOTAL (31 Program Areas)	11	7	3	21	10	7	6	2	14	14

NOTE: The FAA responded to 31 program areas.
The ATA responded to 24 program areas.

Table 3.11 POTENTIAL FAA/AIRLINE ACTIONS TO MAXIMIZE FUEL CONSERVATION IN THE AIR TRAFFIC CONTROL SYSTEM

1. Reemphasize to air traffic controllers the importance of fuel conservation.
2. Make maximum effort to clear flights at the altitudes requested.
3. Make maximum use of established fuel conservation descent procedures.
4. Assure use of existing gatehold procedures.
5. Minimize circuitous routings.
6. Apply high-density traffic procedures only when needed.
7. Minimize adverse effect of airspace reservations.
8. Better information on expected arrival delays.
9. Implement optimized runway/taxiway usage based on analytical and simulation results.
10. Implementation of additional facilities and improvement of availability of aids and services.
11. Implementation of the wake vortex detection system.
12. Local flow control procedures.
13. Improvement of Airport Surface Detection Equipment.
14. Expedite FAA action on the airlines request for 1,000 foot vertical separation above flight level 290.
15. Improvements in handling receipt and issuance of International Civil Aviation Organization (ICAO) teletype filed flight plans.
16. Revised routings and ATC flight plans.
17. Direct routes should be allowed to be planned and filed before departures.
18. Descent speeds are too high.
19. Eliminate 250 speed restriction to 1000 feet on climb-out.
20. Minimum fuel descent.
21. Careful spacing on approach so as to avoid go-arounds.
22. Reduce the required separation between parallel runways for independent approaches.
23. More use of simulators in lieu of training flight.
24. Minimize fuel dumping.

In summary of Table 3.10, of the 31 program areas that the FAA responded to, 11 are implemented, seven are under development, three are inactive and the remaining 10 had no status information. Twenty-one of the 31 program areas are under FAA purview and 10 are under other purview (i.e., airline, NASA). As for the ATA, 24 program areas were responded to, seven of which are implemented, six are under development, two are inactive and nine had no status level. Fourteen of the 24 program areas are identified as being under the FAA purview and 14 under other purview (four program areas are identified as having joint purview).

3.2.3 Identification of Negative Impact FARs

As an aid in following the subsequent discussion, Figure 3.2 illustrates a sequential diagram accounting for the FARs and the program and research areas eliminated and remaining.

Through a correlation of the 35 potential negative impact FARs with the 89 fuel conservation program and research areas, a list of program areas impacted by the 35 FARs was derived. This list is presented in Table 3.12, and structured to show the program and research areas that each of the 35 FARs impact. The program areas are referenced by number to Table 3.9 A total of 42 program and research areas are impacted by the 35 potential negative impact FARs. The remaining 47 program and research areas were eliminated form further review. Two points are readily seen in Table 3.12. One is that most of the FARs impact more than one program and research area, and secondly, many of the FARs impact some of the same program and research areas. This second point is illustrated by the 18 FARs which impact the program area of "Increased Utilization of Direct Area Navigation Routes" (number eight).

Further analysis of the information provided in Table 3.12, reveals that each of the 35 FARs does not have the same degree of impact on the associated program areas(s). FARs with a low degree of impact on its respective program areas(s) were those FARs that did not offer a significant fuel savings benefit if revised or removed. Examples are FAR Parts 95.13, 95.15 and 95.17. Each of these FARs, if revised or removed to accommodate increased utilization of direct area navigation routes, would not presently provide a significant fuel savings. This is primarily due to the fact that these FARs designate U.S. and Alaskan mountainous areas for Instrument Flight Rules altitudes, which at the present time do not affect a significant number of traffic. Through this type of analysis, 12 FARs and 32 program and research areas were eliminated from further review, as shown by the boxes in Table 3.12. Additionally, it was determined that many of the research areas, if implemented, would require only a routine FAR change. An example is the research area of Microwave Landing Systems (number 33). If implemented, such FAR Parts as 121.95, would simply be revised to allow smaller route spacing in order to achieve the full fuel savings benefits of Microwave Landing Systems. As a result, those research areas requiring only minor FAR changes if implemented, were excluded from further review. Through this analysis, 23 FARs were determined to have a significant negative impact on 10 program and research areas. The list of negative impact FARs and the program and research areas they impact are shown in Table 3.13 and discussed in Section 3.3.

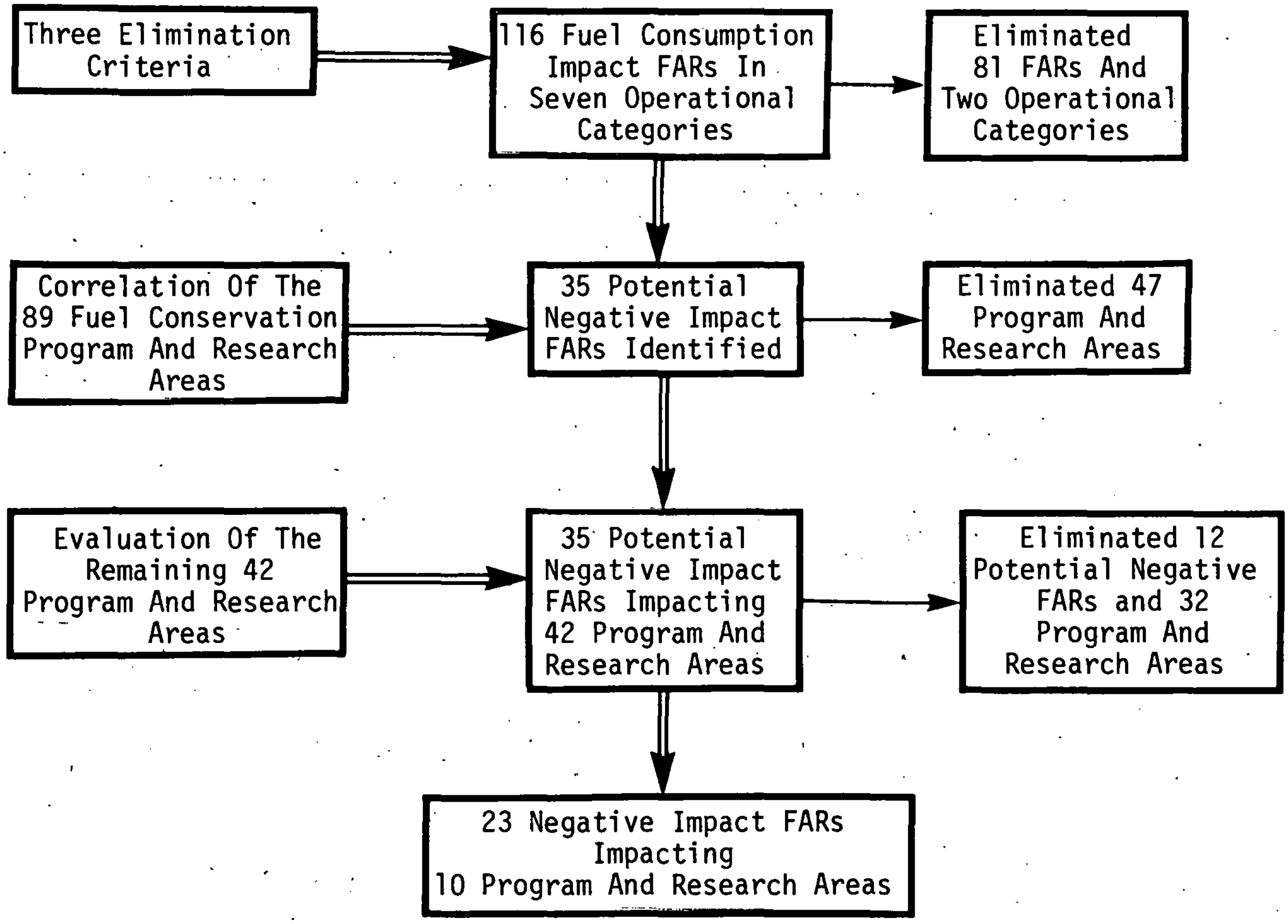

Figure 3.2 SEQUENTIAL FLOW DIAGRAM ACCOUNTING FOR THE FARs AND THE PROGRAM AND RESEARCH AREAS, ELIMINATED AND REMAINING

Table 3.12 FUEL CONSERVATION PROGRAM AND RESEARCH AREAS IMPACTED BY THE POTENTIALLY NEGATIVE FUEL IMPACT FARs

FARs by Operational Category	Program and Research Area Impacted (Reference by Number, Table 5.9)
ENVIRONMENTAL CONTROL	
36 Appendix C	14
91.87	3,11,14,16,34,35,36,38,43,49,55
AIRCRAFT FUEL SUPPLY	
91.23	37,84
91.207	37,84
121.198	13,56
121.639	37,51,84
121.641	37,84
121.643	37,84
121.645	37,84
135.97	37,84
AIRCRAFT SPEED AND FLIGHT ALTITUDE	
91.70	3,11,34,35,36,38,42,43,49
91.116	31,32,33
95.13	8
95.15	8
95.17	8
95.8001	8,9
AIRSPACE AND ATC	
71.121	8,54,62
71.123	8,54,62
71.151	8,50
71.193	3,11,34,35,36,38,42,54
91.89	60
91.90	3,11,22,34,35,36,42,49,38
91.95	8,50
91.97	8
91.123	8
93.123	1,2,6,11,17,18,19,21,22,31,32,33,34,35,36 38,42,43,44,45,46,47,48,49,55,61,62,63,84
121.93	8,9
121.95	8,9,33
121.103	8
121.113	8,9
121.115	8,9,33
121.121	8
121.125	1,2,8,62
121.127	1,2,8,62
CREW MEMBER QUALIFICATION	
121.442	26

/NOTE/ The boxed FARs and Program and Research Areas represent those which were excluded form further review due to their low level impact if either the FAR was revised or the program area implemented.

Table 3.13 NEGATIVE IMPACT FARs

FARs BY OPERATIONAL CATEGORY	PROGRAM AND RESEARCH AREAS IMPACTED	AREAS BY NUMBER (10 Total)
ENVIRONMENTAL CONTROL		
36 Appendix C	Relaxed Noise Abatement Procedures	1
91.87	Relaxed Noise Abatement Procedures	1
AIRCRAFT FUEL SUPPLY		
91.23	Reduce Fuel Reserves	2
91.207	Reduce Fuel Reserves	2
121.198	Revising Current Overweight Landing	3
121.198	Minimize Fuel Dumping Limitations	4
121.639	Reduce Fuel Reserves	2
121.641	Reduce Fuel Reserves	2
121.643	Reduce Fuel Reserves	2
121.645	Reduce Fuel Reserves	2
135.97	Reduce Fuel Reserves	2
AIRCRAFT SPEED AND FLIGHT ALTITUDE		
91.70	Profile Descent Procedures	5
91.70	Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	6
91.70	Optimized Takeoff and Climb Procedures	7
95.8001	Increase Utilization of Direct Area Navigation Routes	8
AIRSPACE AND ATC		
71.121	Increase Utilization of Direct Area Navigation Routes	8
91.90	Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	6
91.90	Optimize Takeoff and Climb Procedures	7
91.123	Increased Utilization of Direct Area Navigation Routes	8
93.123	Intermittent Use of High Density Procedures	9
121.93	Increased Utilization of Direct Area Navigation Routes	8
121.95	Increased Utilization of Direct Area Navigation Routes	8
121.103	Increased Utilization of Direct Area Navigation Routes	8
121.113	Increased Utilization of Direct Area Navigation Routes	8
121.115	Increased Utilization of Direct Area Navigation Routes	8
121.121	Increased Utilization of Direct Area Navigation Routes	8
CREW MEMBER QUALIFICATIONS		
121.442	Increased Use of Flight Simulators	10

3.3 FAR IMPACT PROGRAM DESCRIPTIONS AND STATUS

This section provides descriptions of the 10 program and research areas which are negatively impacted by 23 FARs. The assessment of benefits through revision of appropriate FARs represents the most current data available. In gathering data for this report, it was discovered that very little data is available for fuel conservation program and research areas which have been implemented or demonstrated within the past three years.

This is due to the fact that no comprehensive quantitative assessment has been made to determine actual (not estimated or potential) fuel saved to date on a system-wide basis for each fuel conservation program and research area. This is because the FAA's fuel conservation effort is comprised of a very large number or related or overlapping program and research areas which have not yet been fully implemented. Further complicating the fuel conservation assessment effort is the fact that fuel savings realized by individual airlines is dependent upon fleet mix, route structure and load factor considerations. Traditionally, data of this type is obtained from individual airlines for their particular routes and airports. Data of this nature is usually collected centrally by the ATA from the airlines on a voluntary basis. For these reasons, it was not possible to combine this data for each user into a comprehensive system-wide assessment at this time.

Both the FAA and the ATA were asked to provide recent quantitative data relative to the FAA's proposed energy conservation program areas under review. Their responses are reproduced in Appendices A and B. Using this recent FAA and ATA data in conjunction with the literature survey, Table 3.14 was compiled. It should be noted that all of the fuel savings data presented in Table 3.14 is based on projected or potential "estimates" by DOE, FAA or NASA, as indicated. The DOE estimates are from reference 2. The FAA estimates are based on potential benefits projected for the years 1977 through 1990 in reference 3. The NASA estimates are from reference 13.

As seen in Table 3.14, the estimated fuel benefits for each program area are specified for three agencies: the DOE, FAA and NASA. Data for each program area by each agency was not available. It is important to note that the "dashes" by program areas represent those which offer the largest fuel savings. The asterisks represent those program areas where current data is available for validation and verification of the 1979 estimates, either from specific demonstration activities or program areas partially implemented. For example, the program area of optimum descent in category III is estimated to be offering a total available fuel savings of 2.5% to 3.0% by the DOE, and an achievable fuel savings of 0.6% for 1979, by the FAA. In addition to fuel savings, a benefit in relaxed noise abatement procedures could be realized because of a lowered perceived noise level inherent to this program area. Optimum descent procedures have been implemented at Denver and Atlanta, and repeatedly demonstrated at airports such as Chicago/O'Hare, Kansas City, Dallas/Ft. Worth, Houston and others. Therefore, the asterisk next to this program area, indicates that current (1979) data should be available in order to properly assess recent fuel savings.

Table 3.14 1978/1979 ASSESSMENT OF ESTIMATED FUEL SAVINGS FOR THE PROPOSED FAA ENERGY CONSERVATION PROGRAM AREAS

	DOE ESTIMATE [2] TOTAL (%) AVAILABLE	FAA ESTIMATE [3] (%) '79	(%) '90	NASA[13] TOTAL (%) AVAILABLE
I. ATC PROGRAM AREA				
* Fuel Advisory Departure	0.0	1.70	1.70	—
* Flow Control Automation	1.7	0.33	1.65	—
* Wake Vortex Avoidance Systems	—	0.36	1.00	—
-* Area Navigation	3.5	0.80	1.60	—
Discrete Address Beacon System/ Automated Traffic Advisory and Resolution Service	—	0.0	0.10	—
Post-Upgraded Third Generation Air Traffic Control	—	0.0	0.30	
Microwave Landing System	—	0.0	0.20	—
II. AIRPORTS PROGRAM AREA				
Airport Surface Traffic Control	—	0.0	0.10	—
Fog Dispersal Systems	—	0.02	0.10	—
Snow-Ice Removal Equipment	—	0.13	0.13	—
III. AIRCRAFT OPERATIONS AREA				
* Capacity Restraint	—	0.70	0.70	—
* Reseat Existing Aircraft	—	0.40	0.40	—
* Simulators	≈0.0	0.10	0.10	—
Load to Aft Center of Gravity	—	0.20	0.20	—
Reduce Fuel Tankering	0.2-0.4	0.30	0.30	—
* Taxi on Fewer Engines	0.4(1.0-3.0)	0.20	0.20	—
* Climb Procedures in Terminal Control Areas	0.5	0.16	0.16	—
-* Optimum Descent	2.5-3.0	0.60	2.40	—
-* Optimum Cruise Speed	2.0	0.70	0.70	—
* Optimum Altitude	Small	0.56	0.65	—
IV. AIRCRAFT TECHNOLOGY PROGRAM AREA				
New Near-Term Aircraft	—	0.0	11.40	15.0
Winglets	—	0.93	2.19	5.0
Active Controls	—	0.0	1.20	5.0
-* On-Board Performance Computers	3.0	0.51	2.14	—
Lighter Than Air Cargo Vehicles	—	0.10	0.57	—
Large Air Cargo Transports	—	0.0	0.30	—

/NOTE/ * Represents program areas where current (1979) data is available for further verification and validation.

\- Represent program areas where large fuel savings are available.

It is also significant to note in Table 3.14, category IV, that NASA's total (%) available estimates are not as conservative as the FAA's (%) estimates for 1990. This is due to the fact that NASA's estimates go beyond the year 1990. The largest of these estimates is for the program area of "New Near-Term Aircraft". This program area includes the sum total of fuel benefits available through the fuel conservation program areas of advanced turbofan engines, winglets, supercritical airfoils, active controls and composite materials, amounting to 11.40% by 1990, for the FAA, and 15.0% total for NASA.

An assessment of fuel savings for the 10 program and research areas negatively impacted by the 23 FARs is shown in Table 3.15. The Total (%) Available column represents estimates from DOE and FAA studies, as well as those documented in this report (Present Study Estimate column). The program areas with "dashes" define areas where large fuel savings are available, such as profile descent procedures. Program areas with asterisks define areas where current (1979) data should be available in order to determine more accurately the fuel savings benefit achieved and the total amount available. It should be noted that when the Present Study Estimate agrees with the DOE Estimate, the DOE offered a more recent updated forecast than the FAA. Where no estimate is presented in the table, no estimate has been determined on a fully implemented basis for that program area, nor was it possible to determine a valid estimate with the limited data sample available.

A discussion of the areas of purview and status, documented or potential benefits and operational constraints are included in the subsequent descriptions of the programs negatively impacted by FARs.

3.3.1 Relaxed Noise Abatement Procedures Description

To date relaxed noise abatement procedures have not been considered as a fuel conservation option. The FAA has recommended standardized noise abatement procedures for turbojet-powered airplanes with a maximum certified takeoff weight over 75,000 pounds [6]. These procedures when compared to pre-noise abatement procedures have been shown to be fuel conservative and are very similar to the ATA's recommended noise abatement takeoff procedures. The ATA's procedures demonstrated by American Airlines documented a 0.8% savings of total fuel burned for their DC-10 fleet per year, using reduced thrust and flap retraction schedules. Through similar procedures, Northwest Airlines saved 0.8% of total fuel consumption per year for their DC-10 fleet [2].

Noise abatement procedures involving noise abatement routings, runway use programs and curfews have been fuel inefficient and deterrent to any benefits incurred through takeoff procedures. Noise abatement routings, runway use programs and curfews are imposed at the discretion of the airport operator subject to FAA approval, except for Washington National and Dulles International where they are directly imposed by the FAA. It would be expected that curfews should reduce the number of flights and increase passenger load factors. Both of these result in fuel efficiency benefits. Unfortunately, these benefits are outweighed by the undersirable effect curfews have by decreasing airport usage and

Table 3.15 Assessment Of Fuel Savings For The Ten Negatively Impacted Program And Research Areas By FARs

PROGRAM AND RESEARCH AREAS	DOE ESTIMATE [2] TOTAL (%) AVAILABLE	FAA ESTIMATE [3] TOTAL (%) AVAILABLE	PRESENT STUDY ESTIMATE TOTAL (%) AVAILABLE
- 1. Relaxed Noise Abatement Procedures	0.8 (for isolated cases)†	——	1.0 to 3.0 ††
2. Reduce Fuel Reserves	0.2 to 0.4	0.3	0.2 to 0.4
3. Revise Current Overweight Landing Limitations	——	——	——
4. Minimize Fuel Dumpings	——	——	——
-* 5. Profile Descent Procedures	2.0 to 2.5	2.4	2.0 to 2.5
6. Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	0.4	——	0.4
* 7. Optimized Takeoff and Climb Procedures	0.5	0.16	0.5
-* 8. Increase Utilization of Direct Area Navigation Routes	3.5	1.60	3.5
9. Intermittent Use of High Density Procedures	——	——	——
-* 10. Increase Use of Flight Simulators	0.0	0.10	1.9 (1979)

NOTE: †Based on individual airline demonstrations.

††Includes integrated benefits from quieter more fuel efficient aircraft, probable changes in fleet mix and some of the benefits derived from areas 5 and 7.

-Represents program areas where large fuel savings are available.

*Represents program areas where current (1979) data is available for further verification and validation.

capacity. Where night curfews exist prohibiting all operations, it would not be uncommon for a pilot to increase his airspeed to a fuel ineffient high cruise Mach in order to arrive on time. When a night curfew limits operations to a noise abatement runway, excessive holding of arrival aircraft often results, causing a fuel penalty. Current, special aircraft noise abatement routing procedures at Los Angeles International Airport between midnight and 6:30 a.m. result in approximately 60 percent of arrival aircraft holding in the terminal area prior to landing to accommodate the safe expedition of departing aircraft [2].

Potential benefits have been projected for Los Angeles International and Seattle-Tacoma Airport through relaxed noise abatement routing procedures. For these two airports, projected annual savings amounts to 0.8% of their total fuel consumed or 7.6 and 3.3 million gallons of fuel, respectively [2]. Since no consistent noise abatement procedures, runway use programs or curfews have been implemented system-wide, the total impact of relaxed noise abatement procedures is difficult to estimate. Consequently, there is no current estimate of the total conservation benefits available through revised abatement takeoff procedures, routings, runway use programs and curfews.

The largest operational constraint is the public's desire for reduced noise level at airports. This constraint has had a deterrent effect on airport capacity, particularly when curfews are involved [5]. To increase airport capacity to the optimal level, as is the desire of the FAA and airport management, will also increase airport noise level. Moving airports further from cities and other airport expansion solutions have been suggested to make increased noise and increased airport capacity compatible. However, this is difficult to implement in view of rising land cost, increased demand for land utilization and environmental constraints. Due to the complexity and multifaceted aspect of this problem, solution attempts to date have not considered the fuel conservation aspects. With the advent of newer, quieter aircraft, today's noise levels may be maintained while relaxing current noise abatement takeoff, routing and curfew procedures to take advantage of these quieter aircraft (and for changing aircraft mix), thereby saving additional fuel. It would therefore be advantageous for the FAA and airport operators to initiate a coordinated review of the runway use program and review the fuel impact of FAR Part 91.87 as the newer, quieter aircraft increase in operation.

3.3.2 Reduce Fuel Reserves

FARs 91.23, 121.639, 121.641, 121.643, 121.645 and 135.97, all pertaining to required fuel reserves, impact the area of reduced fuel reserves. The FAA has established guidelines for determining fuel load requirements depending on operating conditions (air carrier, weather conditions, etc.). FAA fuel reserve requirements fall into five categories [1].

1) Enroute reserves (international flights only)
2) Alternate fuel requirements
3) Reserve requirements at alternate airport

4) Extra add-on reserves (non-FAA)

   a) by company requirements
   b) by dispatcher
   c) by pilot-in-command

5) Approach fuel (for destination and alternate if required)

Adding on these reserves without a considerable amount of discretion leads to hauling thousands of pounds of unnecessary fuel.

Benefits achievable through reduced fuel reserves are dependent on the magnitude of reserve reduction. According to Alaska Airlines, who has investigated reduced reserves, they have documented a 6 to 35 percent penalty per flight for carrying excess fuel [2]. Although the system-wide fuel savings potential for reducing fuel reserves has not been determined, it is believed to be similar to the related program area of Reduce Fuel Tankering, offering about 0.2 to 0.4 percent fuel savings through 1990.

A study performed by the Airline Pilots Association [2] evidenced an attitude of reluctance by aircraft captains toward reducing fuel reserves Pilot reluctance is determined to be the primary constraint toward reduced fuel reserves, even with pilot education and computer programming of flight schedules. In addition, the FARs associated with fuel reserves are not explicit in regulations concerning "extra add-on fuel reserve" limitations.

3.3.3 Revise Current Overweight Landing Limitations

FAR Part 121.198 provides for those occurrences or events that result from in-flight problems or failures, that would require an aircraft to land prior to the intended destination or alternate. In such an event, unburned fuel may be required to be dumped to comply with FAA regulations and manufacturer specified maximum landing weight. This FAR allows for certain aircraft to exceed their certified zero fuel weight by about five percent, thereby increasing allowable landing weight.

There are no current published reports documenting fuel savings through overweight landings. However, several airlines have developed procedures for checking the landing charts for the maximum allowable landing weight and compliance with FAA regulations. Revising current overweight landing limitations allowing aircraft to land heavier could, in some instances, mean the difference between one-stop and non-stop flights, where one-stop flights offer additional fuel savings.

3.3.4 Minimize Fuel Dumping

Fuel dumping results when an aircraft arrives and cannot land at its destination because it is overweight with excessive fuel. Other than having to land immediately after departure, arriving at an airport overweight usually results from either carrying excessive fuel reserves or from having very favorable winds. It should be noted that fuel dumping is not done on a routine basis. However, minimizing fuel dumping is directly related to aircraft overweight landing limitations, and thus, impacted by FAR Part 121.198.

Although there are no current published reports documenting fuel savings through minimizing dumping, the Air Transport Association of America has determined that in 1972, 10 airlines dumped over 1.4 million gallons of jet fuel. Recent sampling of some ATA member airlines discloses that fuel dumping has been greatly reduced. It is not known the extent to which emergency conditions, excessive fuel reserves or favorable winds have in causing these aircraft to be overweight for landing. However, much fuel may be saved through revising FAR Part 121.198 without compromising safety to allow aircraft to land overweight.

3.3.5 Profile Descent Procedures

Profile descent procedures as certified by the FAA are designed to optimize an aircraft's descent from flight altitude. A typical profile descent consists of a power off descent at 3,000 to 4,000 feet per minute to 10,000 feet. At this point the aircraft is slowed to cross a waypoint 30 miles from the runway at 250 knots. From here, further speed and altitude reductions are imposed to accommodate radar vectoring and glide slope interception.

Benefits achieved through profile descent procedures have been thoroughly demonstrated and documented at Denver, Chicago/O'Hare, Dallas/Ft. Worth, Kansas City, and other airports. The National Aviation Facilities Experimental Center/FAA simulation performed for the Denver Stapleton Airport demonstrated a 13.6 percent reduction in the amount of fuel consumed, compared to standard Very High Frequency Omnidirectional Range (VOR) route structures and Air Traffic Control (ATC) radar vectors for a B727. When high speed fuel efficient descents of 250 knots below 10,000 feet were tested, a fuel saving of 18.2 percent over standard VOR and ATC procedures was demonstrated [7]. Another study has shown that three dimensional profile descents could improve fuel economy by 11.6 to 13.1 percent over conventional descent procedures [5]. However, the potential fuel savings on a fully implemented system wide basis is estimated to be 2.0 to 2.5 percent through 1990 [2].

There are no FARs which deal specifically with profile descents. However, current ATC procedures (vectoring, holding, etc.) and the lack of system-wide implementation of profile descent procedures cause a large negative potential impact on airline fuel conservation efforts. One regulatory constraint to profile descent procedures is the 250 knot speed limit below 10,000 feet, as designated in FAR Part 91.70. This is discussed in the following paragraph.

3.3.6 Removing the 250 Knot Speed Limit Below 10,000 Feet in Terminal Control Areas

Restricting aircraft below 10,000 feet in Terminal Control Areas to a maximum speed of 250 knots and in uncontrolled airspace to a maximum speed of 200 knots, constrains aircraft from operating at optimum speeds during flight phases of approach and departure. The largest potential benefit is probably during the departure flight phase. Optimum speed departures have been shown to offer fewer conflict and often decrease congestion and controller workload. It has been noted that high speed approach procedures such as profile descent, in some cases, result in terminal arrival airspace congestion, requiring additional vectoring and holding procedures. However, this congestion and vectoring may be alleviated with implementation of automated metering and spacing ATC software, 4D area navigation or other advanced ATC techniques. The potential total fuel savings for removing the 250 knot speed limit in Terminal Control Areas was determined to be about 0.4% [2].

This program area has been constrained by FAR Parts 91.70 and 91.90. However, the recent FAA Notice of Proposed Rule Making (NPRM) concerning expanded Terminal Control Area proposes eliminating the 250 knot speed limit and adopting a 300 to 350 knot speed limit for certain departing aircraft. This would enhance the fuel efficiency of terminal area operations considerably.

3.3.7 Optimized Takeoff and Climb Procedures

There are fuel benefits attributable to reduced thrust takeoff procedures in increased engine life and Thrust Specific Fuel Consumption (TSFC) related benefits. These procedures, however, are inefficient for climb. Fuel used for takeoff and climb varies with weight, temperature and wind conditions. Fuel differences between typical low and high speed schedules, depending on aircraft type and takeoff gross weight, could result in a 100 to 500 pound fuel savings [1]. Optimal does not always mean high speed. For example, the B727 high speed schedule of 340/0.80 (Knots Indicated Air Speed/Mach) is more fuel efficient for takeoff weights above 280,000 pounds, and less fuel efficient for lesser weights under International Standard Atmosphere (ISA) conditions. On the B727, the low speed schedule of 280/0.70 is more fuel efficient than the high speed schedule [2].

Fuel savings available through optimized takeoff and climb procedures was estimated to be 0.5% [2].

In the case of high speed efficient climb schedule aircraft, FAR Parts 91.70 and 91.90 have contrained aircraft to a maximum of 250 knots in Terminal Control Areas and 200 knots in uncontrolled airspace as discussed in paragraph 3.3.6. To date no comprehensive analysis of integrated fuel efficient takeoff and climb procedures has been documented.

3.3.8 Increased Utilization of Direct Area Navigation Routes

Area navigation routes generally define a straight line or great circle path between two airports or points of intersection. A recent FAA report projects the impact of Area Navigation on the total aviation conservation programs' Revenue Ton Miles per Gallon to be 1.45 percent in 1980 [3]. The potential fuel conservation due to implementing area navigation on a system wide basis exceeds 10.4 billion gallons of fuel cumulatively by the year 2000 [9] or about 3.5 percent by 1984 [2].

FAR constraints which impact Area Navigation include Parts 71.121; 91.123; 95.8001; 121.93; 121.95; 121.103; 121.113; 121.115 and 121.121; all of which pertain to airway route requirements and route approval. The airlines have been reluctant to install Area Navigation equipment in all aircraft because the FAA has done little to promote a system-wide Area Navigation implementation program since 1977. The FAA issued the RNAV Policy Statement in January 1977 (see Appendix D). This policy statement delineated steps to "facilitate RNAV use within the existing air traffic control environment" (Appendix D). One of these steps was to "undertake a long-range effort to develop a master enroute and terminal RNAV route design and transition plan." There is nothing in FAR Part 91.123 that prohibits the filing of direct Area Navigation routes nor prevents ATC from assigning such routes daily. But neither is there an FAA approved RNAV route structure or transition plan to facilitate the utilization of direct routes ensuring that the large potential for fuel conservation (10.4 billion gallons of fuel by the year 2000) can be achieved.

3.3.9 Intermittent Use of High Density Procedures

The Air Traffic Control facilities implemented fuel efficient procedures before the full impact of fuel shortages was realized [2]. The benefits derived from these rules and procedures (FAR 93.123) are undeniable. These procedures included optimum holding, priority clearance, linear holding, flow control and gate holding. However, the last three procedures mentioned could provide further fuel savings through ATC automation techniques not presently available at most airports.

High density procedures are used most frequently at high density traffic airports with large peak hourly operations, such as Atlanta, Chicago/O'Hare, John F. Kennedy, Denver and others. These procedures allow controllers to utilize the fuel conservative techniques mentioned above in order to descrease excessive vectoring and holding situations in high density terminal areas associated with peak hourly queues, or adverse airport conditions. Nevertheless, if high density procedures are used continually through non peak-hour periods, the fuel benefit is lost due to controllers allowing IFR aircraft to remain enroute longer than necessary and restricting VFR aircraft to special routing procedures necessary only during peak conditions. The FARs do not adequately specify how to turn the use of high density procedures on or off. The fuel benefits available through more efficient use of high density procedures should be determined.

3.3.10 Increased Use of Flight Simulators

A recent survey revealed that more than 70 modern flight simulators were owned and operated by 18 U.S. airlines [11]. American Airlines estimates that the U.S. scheduled airlines will save more than 204 million gallons of fuel through the use of flight simulators for training requirements during 1979 [11]. This will account for about 1.9 percent of total fuel consumed during 1979.

United Airlines and NASA Ames have just recently completed experiments justifying total landing maneuver transition training through flight simulators for both 727 and DC-10 aircraft. FAA approval has been received and crew members are being trained [12].

The airlines have also expressed interest in total pilot training through flight simulators. This will no doubt save millions of gallons of fuel and the impact on FAR Part 121.442 is clear, requiring much change. Before further FAR revision is submitted, careful investigation and scrutiny of test data and conditions should be performed.

3.3.11 Summary

This current study was a limited four month effort aimed at investigating the FARs solely from a fuel conservation viewpoint. Obviously, changes to these broad regulations cannot be done without considering safety, environmental and the air transportation industry impact. For this reason, the current results and recommendations are formulated to provide a first step in directing and developing more efficient and fuel conservative procedures in each area found to be fuel inefficient. The motivation for performing this cursory review was the fact that although there is ongoing Research and Development (R&D) in many of the important fuel conservation areas, this R&D has not produced any major system-wide implementation programs in the area of fuel conservation since the initial fuel embargo. For example, area navigation research was underway since 1971, with only isolated routes certified. The advantages of profile descents have been studied and demonstrated since 1974 at several terminal areas. From a fuel conservation viewpoint, the already elapsed time and lack of system-wide implementation in these and other areas is undeniably wasteful. By reviewing the FARs and identifying areas of inefficiency, an alternative means to continued R&D has been identified in several areas which would provide additional fuel conservation in the air transportation industry.

4.0 RESULTS AND CONCLUSIONS

This study has carefully examined the impact of the Federal Aviation Regulations on fuel conservation in the air transportation system. One hundred sixteen FARs were examined of which 35 FARs were categorized into five regulatory areas which could be correlated with on-going fuel conservation research program areas. Subsequent to this categorization, 89 research program areas were identified and analyzed for status and purview. When the 35 FARs were correlated with the 89 fuel conservation areas, 42 program and research areas were identified as being impacted. Once again, an assessment was made of the FARs needing further research and which research and program areas would be affected. This analysis provided a list of 10 proposed or ongoing research and program areas which could not be fully implemented without further analysis and revision of 23 FARs. These 10 program and research areas were described in detail and recommendations for a future course of action to facilitate the maximum savings of fuel were formulated. These recommendations are summarized in Section 5.0

The results and conclusions described above explicitly satisfy objectives 1 and 3 of this study. It was not possible to obtain the type of recent empirical data necessary to estimate a range of energy savings still available by reducing Air Traffic Control constraints or revising appropriate regulations. There were two reasons for this. First, the response provided by the FAA and the Air Transport Association of America (Appendices A and B), although very timely and comprehensive, did not contain specific <u>empirical</u> data for the many programs currently underway. Second, the extremely short period of performance (4 months) of this study did not allow for an independent research and data collection effort in the large number of programs. It is still felt that current (1979) data exists and could ultimately be obtained for many of the programs. However, this would be a much larger and more time consuming research effort than originally estimated. The energy savings data presented in this report is representative of the most recent data available in published reports.

Presented in Table 4.1 is a list of the 10 program and research areas and the fuel savings estimate for each. This additional savings is available through revision of the FARs by which they are impacted. These estimates were determined based on the information provided in Table 3.14 and through further analysis of the 10 program and research areas. From this table it is apparent that the program area offering the largest fuel savings is that of Increased Utilization of Direct Area Navigation Routes, followed by Profile Descent Procedures, Relaxed Noise Abatement Procedures and Increased Use of Flight Simulators. It is also important to note that the asterisks in Table 4.1 represent program and research areas which might yield a fuel savings based on previous studies, but the magnitude has not yet been determined. The estimates shown in the present study column of Table 4.1 are from references 2 and 3.

It is not possible to combine the potential savings numbers shown in Table 4.1 in a linear fashion due to the interdependency of many of these programs. In particular, certain options such as Optimized Takeoff and Climb Procedures (no. 7 in Table 4.1) are not achievable without also removing the 250 Knot Speed Limit below 10,000 feet (no. 6) and Relaxing Noise Abatement Procedures (no. 1). Due to these specific relationships and the interdependency of several of the other elements in Table 4.1, the total fuel savings attainable from the program and research areas of Table 4.1 was estimated to be 7 to 10 percent.

Table 4.1 PRESENT STUDY ESTIMATE OF FUEL SAVINGS FOR THE TEN PROGRAM AND RESEARCH AREAS NEGATIVELY IMPACTED BY FARs

PROGRAM AND RESEARCH AREAS	PRESENT STUDY ESTIMATE TOTAL (%) AVAILABLE	NEGATIVE IMPACT FARs
1. Relaxed Noise Abatement Procedures	1.0 to 3.0	36 Appendix C, 91.87
2. Reduce Fuel Reserves	0.2 to 0.4	91.23, 91.207, 121.639, 121.641, 121.643, 121.645, 135.99
3. Revise Current Overweight Landing Limitations	*	121.198
4. Minimize Fuel Dumpings	*	121.198
5. Profile Descent Procedures	2.0 to 2.5	91.70
6. Removing 250 knot Speed Limit Below 10,000 feet in Terminal Control Areas	0.4	91.70, 91.90
7. Optimized Takeoff and Climb Procedures	0.5	91.70, 91.90
8. Increase Utilization of Direct Area Navigation Routes	3.5	71.121, 91.123, 95.8001, 121.93, 121.95, 121.103, 121.113, 121.115, 121.121
9. Intermittent Use of High Density Procedures	*	93.123
10. Increase Use of Flight Simulators	1.9 (1979)	121.442

/NOTE/ * These areas might yield a fuel savings based on previous studies but the magnitude has not yet been determined.

5.0 RECOMMENDATIONS

This section summarizes two generic types of recommended actions. First, a proposed series of broad/joint effort interagency programs is suggested in order to improve fuel efficiency in the air transportation industry. These programs are necessary to attack fuel inefficiencies on a system-wide basis and to allow a free interchange of information between various regulatory groups. Second, a simple list of specific new R&D initiatives is provided. This list was developed from the detailed analysis of the impact of the current regulatory environment on the ongoing research and on the aviation user's ability to save additional fuel.

General Interagency Conservation Actions

1. A comprehensive program to remove or relax current regulatory constraints to fuel efficient operations should be organized, formulated and coordinated with the FAA, the air carriers, and the DOE. The purpose of this program would be to prepare a ranked list of the fuel impact of the energy inefficient regulations identified in this study. Based on the potential fuel savings impact, an outline would be prepared discussing appropriate courses of action for eliminating or reducing each regulation's impact and providing the necessary time table and manpower to achieve the desired goal. Programs of this type are already underway within the FAA. What is needed is a renewed emphasis based on the national goal of energy conservation and a reduced implementation time frame including the proper follow-up by responsible individuals in all agencies and industry.

2. Discussions should be continued and increased and a coordination plan developed to insure the necessary free exchange of knowledge and motivation for fuel efficient operations between flight crews and air traffic control personnel. The air carriers, the Air Transport Association of American, the FAA and the DOE should examine the necessary priorities and existing working channels to improve the program in this area, since it is the underlying foundation upon which further improvements must be based.

3. A fuel usage/savings monitor program should be developed. This program should be structured to assess the annual or semi-annual fuel efficiency status of the air transportation industry and to maintain current coordination with on-going research as far as identifying areas of new potential savings are concerned. This program, ideally, would be a cooperative FAA/DOE effort. In lieu of a cooperative effort, the DOE should establish an independent monitoring capability in order to maintain current knowledge of the status of the real world fuel consumption picture.

Specific Actions To Improve Energy Conservation

The specific action items described below were determined to offer significant near term fuel savings. The sum of the fuel conservation benefits available from these actions, if fully implemented, is estimated to be seven to 10 percent of total fuel consumed through the year 1990. It is recommended that the DOE and FAA consider the fuel conservation potential of the actions recommended. Performance of these tasks would, of course, be determined and delegated by the FAA. However, cooperation is necessary from the airlines, air traffic control, the Air Transport Association of America, the DOE and the FAA, in order for the fuel savings to be experienced in an expeditious manner.

1. Examine the safety and societal impact of redrafting the fuel inefficient FARs in a manner consistent with current air transportation fuel conservation efforts.

2. Analyze and develop integrated fuel efficient/low noise arrival and departure procedures.

3. Develop and implement a program to monitor and document the impact of extra add-on fuel reserves.

4. Investigate the impact and feasibility of liberalizing overweight landing limitations.

5. Develop and implement a program to monitor and quantify the amount of fuel dumped attributable to emergencies, extra add-on fuel reserves and favorable wind conditions.

6. Develop technology guidelines and an implementation schedule to facilitate the revision of FARs to permit operations with 1000 foot vertical separation above flight level 290.

7. Evaluate improved profile descent procedures which integrate removal of the 250 knot speed limit and separation of general aviation aircraft where possible.

8. Support the adoption of the 300-350 knot speeds for those departing aircraft and airports where it is feasible and estimate total fuel savings impact.

9. Develop a program to assess the amount of fuel consumed through vectoring and holding aircraft that are constrained by inefficient use of high density procedures.

10. Establish the maximum amount of additional fuel savings achievable with increased simulator usage for each aircraft type. Provide this data to the FAA with recommendations for implementing more simulator time where applicable.

11. Assess the actual savings demonstrated to date due to the partially implemented RNAV direct routing capability. Develop and coordinate an approach to RNAV implementation that might lead to a full realization of the 10.4 billion gallon cumulative savings available through this option by the year 2000.

REFERENCES

1. "Fuel Efficient Activities of Aircraft and Air Carrier", Adams, R.J., Systems Control, Inc.(Vt.), Champlain Technology Industries Division, for the Federal Energy Administration under contract Number CR-04-60934-00, March 1977 (Draft).

2. "Examination of Commerical Aviation Operational Energy Conservation Strategies", Covey, R.R., et al., The Aerospace Corporation for the U.S. Department of Energy under contract Number EM-78-C-03-2184, October 1978.

3. "A Proposed Aviation Energy Conservation Program for the National Aviation System", Vol. I, II, III, DOT, FAA, FAA-AVP-78-12, November 1978.

4. "Report to Congress by the Federal Aviation Administration on the Energy Efficiency of Agency Regulations", DOT, FAA, AD-A034 611, November 1976.

5. "New Engineering and Development Initiatives -- Policy and Technology Choices", Vol. I, II, Economics and Science Planning, Inc. for the DOT, FAA, under contract Number DOT-FA77WA-4001, March 1, 1979.

6. "Noise Abatement Departure Profile", DOT, FAA, Advisory Circular, AC 91-53, October 17, 1978.

7. "Dynamic Simulation of Fuel Conservation Procedures Using Denver Colorado's Stapleton Airport as the Test Geography", O'Brien, P.J. and Tobias, L., FAA, NAFEC, NA-78-9-LR, February 1978.

8. "Proposed Rules, Terminal Airspace:, Federal Register, Vol. 44, No. 3, January 4, 1979.

9. "Systems Integration: RNAV and the Upgraded Third Generation System", Bolz, E.H., et al., Systems Control, Inc.(Vt.), Champlain Technology Industries Division, FAA-RD-77-22, December 1976 (Draft).

10. "Navaids to the Year 2000", Aarons, R.N., Business and Commercial Aviation, March 1979.

11. "Flight Simulators Impact on U.S. Airlines", Killian, D.C., Aviation, January 1979.

12. "Simulation Improvements for Reduced Transition Training Time", Aviation, January 1979.

13. "Aircraft Fuel Conservation Technology", NASA, OAST, NASA-TM-X-74295, September 10, 1975.

14. "An Assessment of the Benefits of the Use of NASA Developed Fuel Conservation Technology in the U.S. Commercial Aircraft Fleet", ECON, Inc., for NASA, NASA-CR-148148, August 29, 1975.

15. "Potential of Noncapital Methods and their Implementation to Reduce Congestion and Save Energy at Major U.S. Airports", Ellis, R.H., Dygert, P., et al., Peat, Marwick, Mitchell & Co., DOT-OS-60061-2, May 1979.

16. "Aviation Energy Conservation" Zook, C.T., FAA, OAP, May 5, 1978.

APPENDIX A

FEDERAL AVIATION ADMINISTRATION LISTING OF ENERGY CONSERVATION PROGRAM STATUS

I. FAA ATC SUBPROGRAM

FAD - Implemented

Fuel Advisory Departure (FAD) procedures are designed primarily as a fuel savings effort during extended periods of arrival delays in excess of one hour into the O'Hare Airport. It is a current and on-going program that was used on more than 15 separate occasions during the past winter. Some optional changes and enhancements to the program are planned. Additionally, as soon as possible and after coordination with industry, the procedures will be expanded to include several other delay prone airports within the National Airspace System.

Flow Control Automation - Under Development

See report # FAA-RD-76-204, Benefit Analysis of the Automated Flow Control Function of the Air Traffic Control Systems Command Center, June 1977, enclosed.

The Central Flow Control software development effort was started in April of 1977. The primary purpose of this effort is to convert the automated flow control function from a lease time-share computer to an FAA owned IBM 9020A computer located in Jacksonville, Florida. Additional benefits include an increased accuracy in simulation and estimation resulting from the addition of real-time inputs to the static Official Airline Guide (OAG) data base. The improved flow control function is undergoing shakedown tests, and is scheduled for commissioning in September 1979.

Wake Vortex Advisory System - Under Development

See report # SS-223-U9-20, Evaluation of the Costs and Benefits of Installing the Vortex Advisory System at Selected U.S. Airports, July 1977, by Louis A. Fusates, TSC.

See report entitled Cost/Benefits and Implementation of the Wake Vortex Avoidance System (WVAS) and Vortex Advisory System (VAS), September 1976, enclosed.

RNAV - Implemented

See RNAV Policy Statement as published in the Federal Register, Volume 42, No. 9 - Thursday, January 13, 1977, enclosed.

See report # FAA-RD-77-22, Systems Integration: RNAV and the Upgraded Third Generation System, December 1976, enclosed.

See report # FAA-RD-76-196, Implementation of Area Navigation in the NAS: An Assessment of RNAV Task Force Concepts and Payoffs, December 1976.

For information contact: Paul Rich, ARD-730, 426-8605.

Expanded Terminal Control Area (TCA) Program - Under Development

This option was not a part of the proposed program as outlined in the FAA's report; the fuel impact is not clear at this time. Nevertheless, see the enclosed relevant pages (1326-1333) of NPRM 78-19 for a description of this program, Federal Register, Vol. 44, No. 3, Thursday, January 4, 1979.

Local Flow Traffic Management (LFTM) - Implemented

See the enclosed description of the program and the draft order simplifying procedures which have been circulated to FAA facilities and the industry for comment.

Standard Instrument Departure/Standard Terminal Arrival (SID/STAR) - Implemented

It is the policy of the FAA's Air Traffic Service to permit pilots to climb or descend in the most fuel efficient manner whenever operational circumstances permit. To facilitate development of optimum departure and arrival procedures when unrestricted climb-outs or descents are not possible, FAA Orders 7100.8 and 7100.9 set forth specific criteria for the development of SID and STAR procedures to reduce the need for pilot/controller communication and circuitous routing in busy terminal areas. The SID and STAR programs are interrelated with the FAA's Local Flow Traffic Management Program and help to structure the flow of air traffic for the benefit of all air traffic system users.

DABS/ATARS - Under Development

See report # FAA-AVP-77-3, Policy Analysis of the Upgraded Third Generation Air Traffic Control System, enclosed.

MLS - Under Development

Report # FAA-EM-76-13, Analysis of the Requirements for, and the Benefits and Cost of the National MLS, not available for public release at this time.

For information contact: Paul Rich, ARD-730, 426-8605.

Gate Hold Procedures - Implemented

Gate Hold procedures for departing aircraft are used whenever ground delays are expected to exceed five minutes. The objective of this program is to achieve five minutes or less of departure delay after engine start and taxiing time. Procedurely, prior to starting engines, pilots contact ground control/clearance delivery to receive an engine start time based on anticipated departure delays, thereby minimizing engine run time.

Simultaneous Landings on Intersecting Runways - Implemented

FAA Order 7110.65A describes procedures for simultaneous landings on intersecting runways to reduce arrival delay factors for inbound aircraft and save fuel. By segregating arrivals based on aircraft group and runway distance criteria, required aircraft spacing is decreased minimizing arrival delay.

Simultaneous Arrival/Departures on Intersecting Runways - Implemented

Simultaneous arrival/departures on intersecting runways, outlined in FAA Order 7110.75A, are also based on aircraft group and runway distance criteria. Effective use of this procedure at many major terminals saves fuel by minimizing delay to departing aircraft which would otherwise have to wait for an arrival to land.

II. AIRPORTS SUBPROGRAM

ASTC - Under Development

The ASDE-3 portion of the Airport Surface Traffic Control program will undergo a demonstration at NAFEC from 10/79 thru 2/80. See report # FAA-RD-78-12, ASDE-3 Project Plan, January 1978, enclosed.

For information contact: Don Saunders, ARD-122, 426-9342.

Fog Dispersal System - Inactive

This option provides only minimal results thus far and requires a very large expenditure by airport operators. To date, airport operators are reluctant to pursue this program.

Snow-Ice Removal Equipment - Inactive

See report # FAA-RD-75-139, Heating Systems for Airport Pavement, 1975 - available from Herman Daulerio, ARD-420, 426-3687.

Although the study has shown that this option is cost beneficial over a 20-year time period, airport operators are reluctant to make the necessary large investment to implement this program.

Airport Pavements

See report # FAA-RD-73-205-I, Non-destructive Vibratory Testing of Airport Pavements, September 1975.

See report # FAA-RD-76-83, Non-destructive Evaluation of Civil Airport Pavement - Frequency Sweep Method, September 1976.

See report # FAA-RD-78-58, Recycling of Asphaltic Concrete Air Field Pavement - a Laboratory Study, May 1979.

For information contact: Carl Schulten, ARD-430, 426-9396.

III. AIRCRAFT OPERATORS SUBPROGRAM

Capacity Restraint and Reseat Existing Aircraft

These fall within the purview of airline management. In all probability, the Airline Deregulation Act of 1978 will result in greater efficiency of aircraft utilization and substitution in the long run.

Simulators - Implemented

Current FARs allow simulator training to replace actual training flights to a large extent. The FAA is considering issuing a Notice of Proposed Rule Making to permit expanded training, checking and certification of flight crew members in advanced training simulators. With higher percentages of training being accomplished in simulators instead of the aircraft, in-flight training could be reduced. The reduction of training flights are estimated to achieve significant fuel savings while providing higher levels of flight safety. An information poll of U.S. air carriers has shown that 32,000,000 gallons of fuel could be saved annually during the near-term if the proposed rules are implemented. Total industry savings of over 65,000,000 gallons per year may result as the goal of total simulation is achieved.

Reduce Fuel Tankering and Taxi on Fewer Engines

These options fall within the purview of the aircraft operators, however, trade journals indicate that educational programs emphasize the fuel savings inherent in adopting these procedures.

Climb Procedures in TCAs - Under Development

NPRM 78-19 proposes an increase in the climb speed limit within TCAs, see enclosed page 1332.

Optimum Descent - Implemented

The fuel-efficient descent is a part of the Local Flow Traffic Management Program which is already implemented. There are, however, constraints to using the optimum descent in some areas because of the highly complex and congested nature of the terminal area.

Optimum Cruise Speed - Implemented

It is the policy of the FAA's Air Traffic Service to permit the pilot to select the speed of the aircraft whenever operational circumstances permit. This operational philosophy is readily apparent in all of the applicable instructions and guidance it provides for air traffic control specialists.

Air traffic control normally uses speed control to space aircraft as an alternative to vectors around traffic, or spacing obtained through delays produced by flow control restrictions or the use of holding patterns. As a general rule, ATC speed control is used sparingly in the departure environment, rarely in the en route environment, and mostly in the arrival environment.

Optimum Altitude - Implemented

It is the policy of the FAA's Air Traffic Service to permit departure aircraft to climb restriction-free to the requested en route altitude, then, in the arrival phase, to permit a restriction-free descent for landing. It must be remembered, however, that the successful implementation of this operational philosophy is subject to the constraints of other air traffic.

At major hub locations, such as New York or Chicago, traffic "bridging" and "tunneling" are the norm and this frequently requires "step climbs" for departures and "step descents" for arrivals during all but the least busy periods. As a general rule, however, the great majority of flights are assigned the requested en route altitude.

IV. AIRCRAFT TECHNOLOGY SUBPROGRAM

All of the options in this subprogram are outside the purview of the FAA; however, the FAA has an Inter-Agency Agreement with NASA to evaluate active controls.

For information contact: J.B. McCollough, ARD-530, 426-3290.

JUN 1 1 1979

SUBJECT: Proposed Revision of Order 7110.72, Local Flow Traffic Management

I. BACKGROUND.

The enclosed DRAFT Order 7110.72A, is a proposed revision to Order 7110.72, Local Flow Traffic Management. A revision to this order is necessary because of the obsolescense of the existing order as it relates to the implementation schedule of Local Flow procedures. The temporary moratorium levied on further implementation of these procedures in early 1978 resulted in misunderstandings and generated a dampening effect on the program. This proposed order does not contain a timetable as before but directs air traffic facilities to implement the procedure for all airports where high performance turbine-powered aircraft operate. In other words, it is more positive in direction. It is also important to understand that the main thrust of this procedure is that the air traffic control system is developing a means which will provide pilots the opportunity to operate their aircraft in a fuel efficient manner.

The purpose of this proposed revision then, is to provide guidance to air traffic facilities for establishing a procedure to enhance safety, conserve aviation fuel, and reduce the impact of aircraft noise on local communities. Conservation of aviation fuel has been of concern for some time but is now one of the highest in priority. This order contains three equally important ingredients to achieve a substantial reduction in fuel burn from cruise altitude to the ground. They are: (1) locally designed procedures permitting an uninterrupted descent from the highest possible altitude over the shortest possible flight path to the runway, (2) proper application of the procedures by the controller, and (3) the pilot taking advantage of this environment created to save fuel.

Accomplishment of these goals is not an easy task. Some of the factors are: conflicting traffic flows, metering techniques, pilot/controller education, and negotiations between facilities. In spite of these and other problems, from what has been learned so far, compromise, hard work, and dedication in this program can overcome most of the obstacles. The resultant dividends in aviation fuel savings will be significant.

Whether one believes the energy crunch is real or not, there is one thing that you have to believe and that is the rapidly increasing cost of fuel. The FAA is in the business to foster aviation and to provide a service to the users of the National Airspace System. The Local Flow Traffic Management program is an excellent tool to provide this service as well as conserve energy. Controller and pilot education and dedication are paramount to the success of this effort. This can only be accomplished through the diligent and sustained support and efforts of the FAA Regional Offices, facility managers, and user organizations.

II. PROPOSAL.

(See enclosed.)

This order is intended to support national interest as a means to reduce energy consumption. We would appreciate your constructive comments by July 13, 1979. If you have any questions, please contact Gene A. Barlow, AAT-320.3, telephone 202/426-8532.

DAVID E. HODGE
Acting Chief, Terminal Operations
and Procedures Branch, AAT-320
ATC Operations and Procedures Division
Air Traffic Service

Enclosure

Enclosure

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

7110.72A

DRAFT

SUBJ: LOCAL FLOW TRAFFIC MANAGEMENT

1. PURPOSE. This Order provides guidance for establishing a procedure which enhances safety, conserves aviation fuel, and reduces the impact of aircraft noise on local communities.

2. DISTRIBUTION. This Order is distributed to selected offices in Washington and Regional Headquarters, Area Offices, National Aviation Facilities Experimental Center, the Aeronautical Center, all Air Traffic Field Offices and Facilities, General Aviation and Air Carrier District Offices, all Regional Flight Inspection and Procedures Staffs, Flight Inspection National Field Offices, Flight Inspection Field Offices, and interested aviation public.

3. CANCELLATION. Order 7110.72 dated 11/15/76, Order 7110.73 dated 2/28/77.

4. BACKGROUND. Fuel conservation procedures have been employed by ATC facilities even before fuel resources became a national issue of critical concern. As the fuel situation grew more severe, the Air Traffic Service took a systems approach to developing additional measures to further reduce airborne fuel consumption. This approach employed techniques and experiences acquired in several facilities through revised ATC procedures designed to accommodate a more fuel effective operation of aircraft during the arrival phase of flight. This concept was subsequently named the Local Flow Traffic Management Program to emphasize the necessity of managing the traffic flow with full consideration given to all related responsibilities. This program, established in late 1976, has proven to be an effective tool for significantly reducing aircraft fuel consumption. Additional benefits are derived in the area of noise relief by minimizing low altitude maneuvering of arrival aircraft. This also permits departure aircraft to climb to higher altitudes sooner as arrivals are operating at higher altitudes at the crossover point. This in turn enhances safety by reducing exposure time between controlled aircraft and uncontrolled aircraft at the lower altitudes in and around the terminal environment. Distribution of arrival delays are more equitable as a result of the metering techniques associated with this program.

Distribution: Initiated By:

The success of the Local Flow Traffic Management Program lies in the metering of traffic into the terminal environment at a optimum airport acceptance rate along with the maximum application of fuel efficient descent and approach procedures from cruising altitude/flight level to the approach gate. The procedure is designed to absorb any necessary delays at or beyond the metering fixes using altitudes at Flight Level 200 and above. These delays may be absorbed by vectoring, speed adjustments, or holding.

The efficiency of a specific location's procedures and handling of the traffic is directly related to the efforts expended by the facility and can be measured by the elapsed time from the beginning of the optimum descent to the runway. For example, at a sea level airport, an indicator of a good Local Flow Traffic Management performance would be an elapsed time of 17 minutes from FL 240 to the runway with about 8.5 minutes of that time from 10,000 feet to the runway. A further necessary measurement is the comparison of airport acceptance before and after implementation. Traditionally, it has been determined that, after a brief period of experience and the achievement of a high level of proficiency, the acceptance rate is unchanged after implementation.

It should be emphasized that this effort requires a system's approach to air traffic management; i.e., the total involvement of every facility whose airspace is involved. The design and effectiveness of this program should not be limited by such constraints as airspace (sector/facility) boundaries. If the goals and benefits envisioned in this order are to be achieved, a positive attitude and, in some instances, a willingness to change our thinking regarding old methods, including interfacility cooperation, is essential.

In summation, the Local Flow Traffic Management Program has proven to be one of the most beneficial as it relates to fuel conservation and further implementation will result in a meaningful savings of aviation fuel for years to come. The degree of success attained at each location is directly related to the commitment by the responsible air traffic personnel.

5. <u>ACTION.</u>

a. Air route traffic control centers and air traffic terminal facilities shall develop Local Flow Traffic Management procedures for all airports where high-performance turbine-powered aircraft operate. These procedures shall be developed to provide for maximum use of fuel efficient descents from cruising altitude/flight level to the approach gate and, as a minimum, substantially reduce flying time at altitudes below 10,000 feet above airport elevation (AAE). While total implementation systemwide is the goal, it is recognized that one or more particular arrival routes at some locations may require a major effort. Facilities are encouraged to move ahead and establish procedures for the remaining routes and implement in phases as necessary. In other words, our efforts are to conserve as much fuel as soon as we can.

b. Development of the control procedure to accommodate fuel efficient descents is based on an altitude loss from 250 to 350 feet per nautical mile from cruising altitude/flight level. To the extent possible, authorize descent at pilot's discretion in accordance with 7110.65-233.d. The procedure terminates at that point when level flight is necessary for the pilot to stabilize his final approach. This will normally be accomplished just prior to interception of the glide slope from beneath, reaching the approach gate, or to a minimum altitude specified for the initial or intermediate approach segment of a nonprecision instrument approach. (See Appendix I.)

c. Control procedures from 10,000 AAE shall be developed to:

(1) Provide the shortest practical route from the metering fix to the runway, based on the altitude loss prescribed in 5.b.

(2) Eliminate holding and excessive vectoring.

(3) Minimize the assignment of speeds below 210 knots.

(4) Avoid routine level flight except as required for:

(a) Speed adjustments.

(b) Stabilization for glide slope or final approach course interception.

(c) Simultaneous "turn-ons" to parallel approaches.

d. Departure control procedures shall be developed to allow for unrestricted climbs to the extent possible while ensuring maximum compatibility with the fuel efficient descent procedures.

e. The following exceptions to the Local Flow Traffic Management Program may be initiated as appropriate:

(1) The minimum altitude for profile descents specified in 5.a does not apply to aircraft that file or request to operate below 10,000 AAE; i.e., "short haul" or tower en route flights. However, control procedures shall be implemented which will provide these aircraft level flight to a point where descent can be affected in accordance with the altitude loss specified in 5.b. Additionally, these aircraft shall be included in all metering efforts to the maximum extent possible.

(2) The provisions of this order are not applicable to military air traffic facilities unless they are notified by their respective headquarters. However, letters of agreement with military organizations that provide approach control services to civil aircraft may include a clause to reflect the appropriate requirements of paragraph 5 of this order.

f. Facilities shall establish an analysis and metering program as follows:

(1) Analysis - Prior to implementing metering, each facility shall compile aircraft movement data to facilitate a comprehensive analysis involving the accurate measurement of aircraft flying time from point-to-point along the arrival route from the center boundary or outer holding fix, over the metering fix to the landing runway. These data shall be carefully studied to establish optimum times between these points. Of critical importance is the determination of the optimum time/distance track from the metering fix to the runway for each approach configuration during moderate to heavy traffic conditions. Considerations must also be given to the impact of satellite airport operations with respect to the primary airport. This analysis will require a cooperative effort on the part of the centers and the affected terminal facilities.

(2) Metering - Procedures shall be developed to monitor the arrival flow to determine when the volume of aircraft approaches airport capacity. Traffic shall then be metered so as not to exceed this capacity. When delays are imposed, the priority of landing shall be based on the calculated time of arrival (CTA) for each aircraft. CTAs shall be calculated based on the estimated time of arrival at the metering fix plus the estimated flying time to the runway. These times shall then be adjusted to resolve simultaneous demands at the airport and to establish the time that an arrival aircraft will be required to cross the metering fix.

(a) Each facility shall, as required, establish operating positions which will be responsible for monitoring and metering the flow of traffic to and from affected airports. Establishment of these positions shall be subject to regional review and approval.

(b) Procedures shall ensure that the metering position be supplied with information on all conditions which affect the terminal acceptance rate. This information is not limited to changes in runway, airport conditions, or weather but also includes, among other things, demands placed on the IFR runways by VFR, tower en route and internally generated IFR traffic landing at the impacted or a satellite airport. Metering techniques, therefore, shall ensure that all aircraft operating within the system received equitable distribution of delays.

(c) Delay absorbing techniques (holding, speed control, and vectoring) shall be used to provide intervals between succeeding arrival aircraft which will allow for only the most expeditious routes to be flown from the metering fix to the runway at optimum system speeds. Holding should be accomplished at or above FL 200, and whenever possible, prior to the metering fix. In any case, holding shall be above 10,000 feet AAE except for aircraft that file for lower altitudes as noted in 5. e(1).

g. Facility chiefs shall provide appropriate training for personnel so that they fully understand the intent and procedural application of the Local Flow Traffic Management Program. They shall also expend every effort to inform users of the program intent and application. This effort should be directed at a pilot education program.

h. Suitable notices and charts shall be published depicting areas of concentrated high-performance aircraft flow (except in TCAs) for the information and use of VFR pilots. (See Appendix 2.) This information shall be disseminated locally with the widest possible publicity. (See Appendixes 2 and 3.)

i. New or revised procedures shall be coordinated as follows:

(1) Flight Inspection Field Offices (FIFOs). Coordination shall be accomplished with the responsible FIFO to ensure that new or revised procedures meet flight inspection requirements and are compatible with instrument approach procedures.

(2) Aviation user groups and other interested parties. Coordination shall be completed sufficiently in advance of implementation (at least 45 days) to permit adequate time for input and familiarization.

(3) Adjacent facilities and regions to ensure operational compatibility. In some cases, it may not be feasible to establish metering or holding fixes within the arrival center's airspace. Problems that arise because of a facility's boundaries that impact adjacent facilities and/or regions shall be reconciled at the regional level.

(4) Terminal and en route facilities shall establish a monitoring and evaluation program to ensure continuing improvement in Local Flow Traffic Management procedures.

j. The procedure contained in Order 7110.22B, "Arrival and Departure Handling of High-Performance Aircraft" although superseded by this order shall remain in effect until the provisions of this order are implemented at that terminal.

k. Regions shall submit a report to AAT-300 semiannually listing alphabetically all airports at which the procedures in this order have been implemented along with an assessment of their effectiveness and any recommended changes to the national directive. These reports are due in January and July of each year.

6. DEFINITIONS.

a. Fuel Efficient Descent. A reduced power descent from cruising altitude/level to interception of a glide slope or to a minimum altitude specified for the initial or intermediate approach segment of a nonprecision instrument approach. The procedural development for this descent is based on an altitude loss of from 250 to 300 feet per nautical mile, and normally terminates at the approach gate or where the glide slope of other appropriate minimum altitude is intercepted. (See Appendix 1.)

b. Metering. A method of regulating, as necessary, the IFR arrival traffic flow into a terminal area at a rate commensurate with, but not in excess of, a predetermined terminal acceptance rate.

c. Metering Fix. A fix along an established arrival route from over which aircraft will be metered prior to entering terminal airspace. Normally, this fix would be located in the center arrival sector adjacent to terminal airspace.

d. High-Performance Turbine-Powered Aircraft. All turbojet aircraft and any turboprop weighing more than 12,500 pounds.

RICHARD L. FAILOR
Director, Air Traffic Service

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
(NAME OF FACILITY)
(CITY, STATE)

ISSUED: (DATE) EFFECTIVE: (DATE)

(NAME OF FACILITY) LETTER TO AIRMEN NUMBER ( ).

SUBJECT: (SUBJECT OF LETTER)

CANCELLATION: (DATE - NOT TO EXCEED 24 MONTHS)

A (revised)/(new) procedure will be started at (place name) on (date). A cooperative effort on the part of all pilots will help to improve the degree of safety in the terminal environment. Furthermore, this program is designed to provide noise relief to our airport neighbors and conserve fuel.

Near midair collision studies have indicated that the most hazardous mix of of controlled and uncontrolled aircraft occurs in the terminal areas. The (revised)/(new) procedure is intended to reduce, as much as possible, the exposure of high-performance airplanes to uncontrolled aircraft. To the extent possible, inbound IFR aircraft will be kept above (altitude MSL) until a normal rate of descent can be started which terminates in a landing. This will normally involve maintaining (altitude MSL) (procedural description of fuel efficient descent).

The procedure has been established for instrument approaches, but should work equally well for aircraft operating VFR. Normally, the high-performance airplanes will follow these prescribed flight paths, and if the uncontrolled aircraft avoid these areas as much as possible, exposure will be reduced. Reduction of exposure should improve safety, which is the primary concern of all of us. We solicit your cooperation in making these procedures work so that total effectiveness may be realized.

(NOTE: Facility chiefs should attach a map of their local areas depicting normal IFR arrival routes where high-performance aircraft will be making profile descents to the final approach course.)

(SIGNATURE)
(NAME OF FACILITY CHIEF)
CHIEF, (NAME OF FACILITY)

LOCAL-FLOW TRAFFIC MANAGEMENT

The Federal Aviation Administration (FAA) has worked both at the national and local levels to redesign certain air traffic procedures and practices in an effort to conserve aviation fuel. Though our methods are procedurally effective, some were not fuel efficient. This situation was very evident in the busier terminal areas where prolonged low-altitude holding and maneuvering of turbine-powered aircraft occurred.

With the assistance of representatives from pilot and industry groups, a program was introduced which was intended to minimize arrival fuel burn. This program is called Local-Flow Traffic Management (LFTM). The LFTM program employed techniques and experiences acquired in several facilities through procedural application of fuel efficient descents and metering concepts. Since implementation, it has proven to be an effective tool for significantly reducing aircraft fuel consumption based on some reports from users. For example, one major airline conducted an analysis of their arrival operations at O'Hare Airport to determine the impact of this program on fuel burn. They saved an impressive 25.7 percent in fuel burn over a 3-month period. They commented that the rate of fuel burn was reduced by a more efficient use of throttles during this period which could be attributed to a continuing understanding and education in the techniques of optimum descent profile for pilot and controllers.

The success of the LFTM program lies in the metering of traffic into the terminal environment at a specific airport acceptance rate commensurate with capacity with the maximum application of fuel efficient descents and approach procedures from cruising altitude/flight level to the approach gate. The procedure is designed to absorb any necessary delays at or beyond the metering fixes using altitudes at flight level 200 and above rather than at low altitudes. These delays may be absorbed by vectoring, speed adjustments, or holding. Distribution of delays are more equitable as a result of these techniques.

Additional benefits are derived in the area of noise relief by minimizing low altitude maneuvering of arrival aircraft. This also permits departure aircraft to initially climb to higher altitudes at the crossover point. This in turn enhances safety by reducing exposure time between controlled aircraft and uncontrolled aircraft at the lower altitudes in and around the terminal environment.

The first LFTM programs were implemented at the Atlanta and Denver Airport on February 24, 1977. These two locations along with five others published charted procedures to supplement the LFTM program. From the beginning, these charted procedures were controversial, consequently, further proliferation of them were discouraged. Subsequently, several of the original seven locations have or are in the process of cancelling the charted procedures. Cancellation of the remaining charts have been encouraged.

Today, there are approximately 230 airports throughout the nation where the environment for fuel efficient descents are available and used. Our goal is to implement the LFTM program to the maximum extent possible at all airports that serve high-performance turbine-powered aircraft.

TERMINAL AIRSPACE

Concurrent with the issuance of this notice concerning enroute airspace, the FAA is developing additional proposals to reduce the probability of hazardous traffic conflicts involving the mix of controlled and uncontrolled aircraft in the terminal environment. These supplementary proposals will build on the controlled visual flight concepts proposed herein, and would raise the ceilings of the existing terminal control areas to 12,500 feet (and, in the two heavy air traffic areas mentioned above, 10,000 feet).

This would be a logical extension of many years of pilot participation in terminal radar separation programs. In 1962, such a program was initiated at Atlanta to solve communications workload problems and assist in aircraft sequencing. This was followed by a similar program at Merced Air Force Base, California, in 1965. This service was gradually extended until 1970, when the National Terminal Radar Program initiated a major expansion of ATC separation service following the 1968 Near Midair Collision Report (discussed below). Beginning with the TRSA at Nashville, a total of 86 TRSAs covering 105 airports were established under that program, the last being the Peoria TRSA in 1978. The 1970 National Radar Program also initiated the TCA concept involving mandatory ATC control of VFR (and IFR) aircraft. Beginning with the Atlanta TCA in 1970 and ending with the Kansas City TCA in 1975, 21 TCAs covering 23 airports have been implemented by regulation. In addition, the ceiling of the Atlanta TCA was raised to 12,500 feet in 1975 to provide additional protection for arriving and departing aircraft.

The controlled visual flight program carries this history forward by expanding the terminal airspace protected by ATC separation. New Group II Terminal Control Area proposals are being developed for the following 44 airports:

Albany, N.Y.	Dayton
Albuquerque	Des Moines
Anchorage	Dulles
Baltimore	El Paso
Birmingham	Port Lauderdale
Buffalo	Hartford-Windsor Locks
Charlotte	Honolulu
Cincinnati	Indianapolis
Columbus, Ohio	
Jacksonville	Reno
Kahului	Rochester, N.Y.
Lihue	Sacramento
Louisville	Salt Lake City
Memphis	San Antonio
Milwaukee	San Diego
Nashville	San Juan
Norfolk	Spokane
Oklahoma City	Syracuse
Omaha	Tampa
Orlando	Tucson
Phoenix	Tulsa
Portland, Oregon	West Palm Beach
Raleigh-Durham	

GROUP III TCAs NOT NEEDED

Because of the expanded use of Group II TCAs and TRSAs, it is believed that the Group III TCAs as a class would not be needed. While there are no Group III TCAs in existence, the current rules provide for their issuance if they are needed. A proposal to delete all references to Group III TCAs was circulated in 1976 (see Notice 76-20, 41 FR 46875, October 26, 1976). However, to obtain a more current and detailed public response on this question as a part of the extensive increase in the number of Group II Terminal Control Areas, the matter of deleting all references to "Group III" TCAs is proposed again in this notice. The reason for the proposed elimination of the Group III TCA concept is that, as originally issued in 1970, the Group III TCA rules permit aircraft to either be in two-way radio communication with ATC or be equipped with a transponder and altitude encoder. This would authorize properly equipped aircraft to transit the TCA without communication with ATC. In view of the increase in aircraft operations to date in terminal airspace, and those expected in the future, the FAA believes that adequate ATC control of the "mix" of controlled and uncontrolled aircraft requires, as a minimum, that each aircraft in the TCA receive and comply with ATC instructions. This capability would be assured in the 44 new Group II TCAs that are proposed. If those new TCAs are established, it appears that additional TCAs in which a pilot may elect not to communicate, if altitude reporting equipment is used, (e.g. the Group III concept), would serve no useful purpose.

THE TERMINAL AIRSPACE COLLISION POTENTIAL

In addition to the experience in enroute airspace, the FAA experience since the establishment of mandatory TCAs and voluntary Terminal Radar Service Areas (TRSAs) indicates that, in terminal airspace as well, the absence of ATC control of VFR aircraft interferes with the ability of the ATC system to assure separation for all airspace users. A comparison of periods before and after the establishment of terminal control areas and terminal radar service areas is instructive. In 1968, the FAA conducted an extensive study of the near midair collision hazard in U.S. airspace. The results of this study were published in the "Near Midair Collision Report of 1968," July, 1968. A major portion of the report was devoted to the collision potential in terminal airspace. For the year 1968 (which preceded the establishment of terminal control areas), the report concluded that, for the airports now served by terminal control areas, there were 271 incidents reported as "hazardous" to flight. In response to that study, since 1970, 21 terminal control areas were established. For the fiscal years 1975, 1976, and 1977, there were a total of 64 reported near midair collisions in these terminal control areas. For comparison purposes, this translates into an average of approximately 20 reported incidents per year, under the TCA requirements, in contrast with 271 incidents for the year 1968. Here again, it should be noted that these figures are not conclusive indicators of the absolute numbers of incidents, but are viewed as pointing toward the critical relationship between the absence of positive control of all aircraft and the likelihood of hazardous traffic conflicts in terminal airspace.

REGULATORY CONCLUSION

Where the mass transport of passengers by air carriers is involved, and considered in relation to the "highest possible" safety level intended for air carriers, the FAA believes that the presence of controlled and uncontrolled aircraft, in the same airspace, must be limited by regulation at the 44 additional airport locations referred to above, and in the airspace between the ceilings of existing TCAs and the lowered floor of the continental positive control area. The detailed, localized impacts and scope of each new TCA, and of the raising of the current TCA ceilings, will be addressed in later rule-making actions involving each location. However, based on the experience concerning the existing TCAs, the FAA concludes that extension of positive control to the additional locations would provide an effective means of further reducing the risk of midair collision.

SUMMARY OF SAFETY BENEFITS

For several years the FAA has been considering means of extending ATC services to VFR pilots without unduly limiting VFR operation. During this period, the factors involved in near midair collisions have received intensive review. The conclusions of this review all point in one direction: an orderly, equitable, and extensive expansion of positive controlled airspace is necessary to achieve a significant reduction of the midair collision potential in the enroute and terminal environments and to assure that ATC services grow with the projected growth of air commerce. Implementation of CVF as proposed in this notice would significantly expand the benefits of the collision avoidance capability that already exists in ground based and airborne equipment, and would provide a much broader basis for incorporating improved collision avoidance equipment at a later date.

AIR CARRIER PASSENGER BENEFITS

Scheduled air carrier passenger enplanements reached the 280 million mark in 1978. The establishment of Terminal Control Areas at the 44 additional airports listed above would raise, to 87%, the percentage of all enplaned scheduled air carrier passengers, in the United States, that receive the full benefits of mandatory positive control in terminal airspace. This is in contrast with the current figure, for the 21 existing TCAs, which is 62%. The FAA also plans to supplement this action with the establishment of 80 new terminal radar service areas (TRSAs). A TRSA is a designated area, around an airport, in which participating VFR aircraft are, if they request, provided separation from IFR aircraft and other participating VFR aircraft. Some of the existing TRSAs would be converted to TCAs. At the conclusion of this expansion of TCA and TRSA airspace, the total percentage of enplaned air carrier passengers receiving either mandatory (TCA) or voluntary (TRSA) separation protection will be approximately 97% as compared with 98% (which includes 62% in TCAs and 27% in TRSAs) in the current ATC system.

These figures mark a major shift in emphasis toward TCAs (up from 62% to 87% of enplaned scheduled air carrier passengers) and away from TRSAs (down from 27% to 10% of enplaned passengers). This should further increase the overall safety furnished by the CVF program. Considering the statutory mandate to seek the "highest degree of safety" for passengers in public air transportation, this expansion of terminal and enroute airspace would be an important factor in assuring that the ATC system continues to keep pace with the projected growth in air carrier passenger enplanements. For the years 1977-1989, these enplanements are forecast to increase by 80% (from 232.1 to 418.4 million) (The source of the forecasts in this notice is a study entitled *FAA Aviation Forecasts: Fiscal Years 1978-1989*, September, 1977. This study is in the rules docket).

COMMUTER AIRLINE PASSENGER BENEFITS

In addition to the substantial increase in terminal airspace protection for air carrier passengers that would be afforded by the planned TCAs and TRSAs, major safety benefits would also result for commuter airline passengers. Using 1977 figures (which is the last set of complete commuter traffic data), the addition of the 44 new TCAs and 80 new TRSAs (and the conversion of some of the existing TRSAs to TCAs) would raise the number of enplaned commuter passengers protected by ATC separation capability from 3,619,550 (in the existing TCAs and TRSAs) to 4,332,637 (after the proposed TCAs and TRSAs come into effect). Within this total increase of 19.7%, the number of enplaned commuter airline passengers protected by the mandatory TCA requirements would be increased from 2,667,992 to 3,446,147. This means that, based only on 1977 commuter data, the planned TCA actions would result in a 29.2% increase in the number of enplaned commuter airline passengers protected by TCA separation procedures. In relation to the total number of enplaned commuter airline passengers in the contiguous 48 States (6,937,649), this achieves an increase, in protected passengers, from 38.5% to 49.7%. When combined with the new TRSA actions, this figure rises to 62.5% of all commuter enplanements. It should be noted that these figures appear to be quite conservative for two reasons. First, they are based on 1977 data, whereas the projected growth of commuter airline operation is expected to place many more passengers in the protected airspace. (The September, 1977, FAA Forecast, discussed above, indicates that, between 1970 and 1977, commuter passenger enplanements increased from 4 million to 7 million, which is an average of more than 8% each year. Commuter enplanements are expected to reach 14.5 million by 1989, which is an increase of 123% from 1977.) In addition, the cited figures are generally for the primary airports only, and do not show enplanements at certain airports, included in TCAs and TRSAs, that are not the primary airport around which the TCA or TRSA is designed. The proposals in this notice could, in summary, be instrumental in increasing the volume of commuter airline passengers that receive the full benefits of the ATC system in terminal airspace.

GENERAL AVIATION BENEFITS

The proposed terminal and enroute proposals in this notice would benefit the general aviation passenger in a manner closely paralleling the benefits accruing to air carrier and commuter passengers. It is impossible to precisely predict the airport use pattern of business, private, and sport aircraft because they are not tied to any schedule and have as a primary value great flexibility of operation. However, many general aviation aircraft use the airports that are used by air carriers and commuters. These aircraft often serve as an important link between the airlines and their ultimate market. The FAA supports this "bridge" function of general aviation within the total public air transportation system and has also considered, in these proposals, the large and vital role of general aviation outside of public air transportation.

General aviation aircraft comprise 98.7% of the total number of aircraft in the U.S. civil aircraft fleet. During 1977, approximately 185,000 active aircraft (out of a total general aviation fleet of 212,735 aircraft) operated approximately 35.8 million hours of flight time. This constituted a 5.6% increase over the total flight hours for 1976 (33.9 million). The 1977 FAA Forecast indicates a growth rate of 5.6% per year through 1982, with a slower growth maintained through 1989. This is expected to result in a 63% increase in numbers of general aviation aircraft from 1977 to 1989 (up to 294,000 aircraft). The hours flown by this expanding general aviation aircraft fleet are forecast to grow 64% between 1977 and 1989. The composition of this fleet is expected to shift toward more fully well equipped single engine airplanes, multiengine airplanes, and turbine powered aircraft as the sophistication of general aviation increases. For example, by 1989, multiengine aircraft—which are already generally well equipped with avionics—are expected to comprise 18.5% of the general aviation fleet compared with 14.4% in 1977. These aircraft will be able to benefit directly from the expanded ATC service contemplated under the CVF concept. In the 44 additional TCAs, 80 additional TRSAs, and lowered positive control area, the proposals in this notice would substantially increase the ability of the ATC system to offer full separation protection to an expanding general aviation community that is already investing heavily in airborne avionics in order to tap into this system.

REGULATORY CONCLUSION

In summary, the raising of TCA ceilings to a lowered PCA floor of 12,500 feet (10,000 feet in the Western Step and Eastern Step) will assure that se aration protection is available, to millions of passengers, in the terminal and enroute phases of flight. This benefit will be significant for air carrier, commuter airline, and general aviation operations. The FAA concludes that this constitutes a needed and substantial increase in the ability of ATC and aircraft operators, working together, to further reduce the remaining risk of midair collision. However, the FAA intends to achieve this benefit in a manner that is responsive to, and accounts for, the potential costs and related impacts of the CVF program on the aviation community. The general aviation segment of that community—particularly the class of personally owned light aircraft—is the most cost sensitive user group. This is discussed below.

COSTS AND OTHER IMPACTS: REQUEST FOR PUBLIC COMMENTS

While the FAA is committed to the improvement of the ATC system wherver possible, it is also concerned with the impacts of it regulations on all airspace users, and will assess the need for expanded air traffic control against the regulatory impacts of "shrinking" the airspace in which aircraft that are not subject to air traffic control may operate freely in a "mix" with aircraft that are subject to air traffic control. Full public participation in the development of FAA regulations concerning this "mix" of controlled and uncontrolled air traffic is essential to solutions that are both effective and equitable. With respect to the enroute CVF proposals in this notice, public comment is requested herein. With respect to the forthcoming TCA proposals, as already noted, comments concerning the impacts of those actions will be invited for each location.

Some questions have been received from the public concerning whether the vigorous pursuit of safety objectives might result in the exclusion of aircraft from certain airspace merely because the aircraft are "small" or classified by purpose of use, such as "general aviation." Such exclusionary classification has no part in the controlled visual flight concept proposed here. While the safety objectives discussed above reflect an FAA commitment and Congressional mandate, the intent is to minimize the costs on all users, wherever possible, consistent with the safety objectives. All segments of aviation are viewed as integral and mutually supporting elements of a healthy and growing national aviation system. The imposition of a cost is intended to be related solely to the need to continue to assure the mandated levels of safety. It is not related to any intent to exclude or burden a particular aircraft class because of its mission. In particular, in dealing with a fleet comprised of 98.7% general aviation aircraft and 1.3% air carrier aircraft, much attention has been directed to the impacts of the CVF concept on the general aviation fleet.

The FAA recognizes the impacts of these proposals, particularly in the new terminal control areas. For example, a May, 1976, study entitled "*Analysis of the Impact of Terminal Control Area (TCA) implementation on General Aviation Activity,*" which investigated the probable effect of selected TCA development on general aviation operations, concludes that—

> The presence of a TCA at a large hub airport is accompanied by a marked shift in the type of general aviation aircraft using the primary TCA airport. This shift is towards the more sophisticated, more expensive, primarily business oriented aircraft.

On the other hand, that study also contained conclusions suggesting that certain other categories of impact may be held to a low level. It states that the establishment of a TCA "does not appear to dramatically affect the total number of airport operations attributable to general aviation aircraft," and that "expanding a TCA either upward or horizontally would have little effect on general aviation if reasonable VFR alternatives are retained." This study is in the docket for public review.

AN EVOLUTIONARY PROCESS

In order to ensure that the 44 proposed new TCAs, and the raised ceilings of the existing TCAs, are accomplished in a manner responsive to the problems raised at each location, the public will be invited to participate in the development of each of the new TCA actions. The configuration of a TCA can have impacts on the airports, other than the primary TCA airport, that may underlie the TCA or be included in it. Therefore, the concerns of airport operators, as well as those of aircraft operators, will be fully considered in each TCA action. It is believed that, with the same close participation of the aviation community that characterized the development of the existing TCAs following the 1968 Near Midair Collision Report, the projected addition of the new TCAs, some of which would be outgrowths of existing TRSAs, can be accomplished as a logical, equitable evolution of the earlier program.

PILOT PARTICIPATION

It is encouraging to note that, in the 80 existing TRSAs, which are completely voluntary, approximately 92% of all VFR arrivals and approximately 84% of all VFR departures elected to participate, that is, stay in communication with the appropriate ATC facility and use "Stage III" radar service. (Stage III radar service involves radar sequencing and separation service, to provide separation between participating VFR aircraft and all IFR aircraft operating in the TRSA.) This high participation rate reinforces FAA's broader experience indicating that a high professional concern exists, within all segments of the aviation community, that available safety aids be used whenever possible. The expansion of TCA and TRSA airspace under the CVF program is expected to involve a high degree of pilot support similar to that indicated by the large percentage of VFR pilots who now voluntarily participate in Stage III radar service.

In addition to the question of pilot acceptance, the FAA requests public comment on the economic impacts of the overall CVF concept in terms of equipment required. The lowered floor of the continental positive control area would, as discussed above, require the same equipment as a Group I TCA for all operations at and above 12,500 feet (10,000 feet in the areas described as the "Eastern Step" and "Western Step"). This requires an operable VOR or TACAN receiver, two-way radio capable of communicating on the TCA frequencies, a 4096 Code Transponder, and Mode C altitude reporting equipment. These equipment requirements would be applicable, except for the Mode C capability and (in the limited case specified in § 91.90(b)(2)(iii)) transponder, in the new Group II TCAs.

With respect to aircraft that are now operating above 12,500 feet, the CVF concept should not have additional equipment cost impacts, since § 91.24 already requires those aircraft to have transponders and Mode C altitude reporting equipment, and aircraft having that relatively sophisticated equipment may be expected to have the less sophisticated equipment (VOR/TACAN and two-way radio) proposed under the CVF concept.

With respect to aircraft operations in the band between 10,000 feet and 12,500 feet, probable equipment cost impacts are more difficult to assess, primarily because the FAA, to minimize unnecessary rule making, is reluctant to require VFR pilots or aircraft owners to periodically submit reports on aircraft usage or installed equipment.

However, in 1977, under an extensive but voluntary reporting program, a substantial number of reports were submitted. Because of the limitations of any sampling process, the results must be considered to be approximate. The study is, nevertheless, conservative on the low side and is useful in that it does not underestimate the portion of the general aviation fleet that remains to be equipped with full avionics (and that could, therefore, be most heavily impacted by the CVF concept). The report indicated that, for the least sophisticated aircraft, that is, single engine airplanes with fewer than 4 seats, 39.5% (29,403 airplanes) had no communications capability whatsoever. Of the airplanes having some communications equipment, 55.2% (41,126) had 360 channel communications capability, and 39.8% (29,650) had at least 100 channel VOR capability (the least sophisticated VOR equipment surveyed). Transponders and encoders were far more scarce, however, with approximately 10.6% of the airplanes (2,877) having transponders and 1.0% having encoders. In this class, therefore, only 1% of the airplanes, out of those sampled would be able to operate above the 10,000-foot portion of the lowered PCA floor, if the CVF concept is adopted as proposed, and 10.6% could operate in the new Group II TCAs. For this least expensive class of aircraft, it appears that an extensive fleet wide investment in avionics may be needed for these airplanes to participate in the new TCAs. It is less clear how the 10,000-foot PCA floor, defining the Eastern Step and Western Step, would affect these aircraft. The critical factor is the importance of operations above 10,000 feet to the operators of these aircraft. The FAA requests public input concerning the extent to which this class of aircraft uses the airspace above 10,000 feet. While nearly all of these aircraft have the theoretical performance capability of doing so, it may be that the long climb periods involved for these relatively low performance aircraft, as compared with the fuel range of these aircraft, and their usage (such as flight instruction, agricultural operation, etc.), effectively keep the aircraft out of the higher altitudes in any case.

The next increment in aircraft cost and complexity (i.e. the jump to the single engine airplane with 4 or more seats) appears, from this 1977 voluntary data, to also involve a major leap in avionics investment. Nearly 70% of the aircraft in this group (67,719 aircraft) were reported as having 360 channel communications equipment, 47.45% (46,565) has at least 100 channel VOR capability, and 70.2% (68,976) were transponder equipped. This class was also much more widely equipped with encoders, with 20.5% (20,128) being so equipped. As aircraft complexity and expense increased beyond this point into the multiengine piston, turboprop, and turbojet classes, the incidence of sophisticated avionics rose markedly, according to the study. For example, 98.3% of the twin engine turboprop airplanes with 12 seats or less (2,255 airplanes) were equipped with both transponder and encoder. For these more sophisticated aircraft classes, the additional equipment costs of the proposals in this notice should be minimal.

Manufacturing Trends

It also appears that normal aircraft production and marketing patterns will gradually reduce the proportion of the general aviation fleet that is most sensitive to avionics costs. For example, in 1977, single engine piston aircraft accounted for 81% of the general aviation fleet. By 1989, this percentage is forecast to drop to 77.5%, while multiengine aircraft are forecast to represent 14% of the fleet in 1989, compared with 11.9% in 1977. The 1977 figures for general aviation shipments (discussed above) confirm that, while total shipments increased from 13,749 in 1968 to 16,824 in 1977, the shipments of single engine airplanes with less than 4 seats declined from 4,507 (1968) to 3,379 (1977). During this period, the shipment of larger single engine airplanes increased from 6,972 to 10,478 and multiengine airplane shipments increased from 2,270 to 2,767. These figures suggest that time is on the side of a relatively problem-free transition to CVF by the expanding general aviation fleet.

However, the FAA recognizes that these overall fleet figures do not answer the concern of the private aircraft owner who has not invested in avionics, and for whom the costs of personal aircraft ownership are already a substantial burden. With regard to the forthcoming terminal airspace proposals, comments from this owner/operator group will be invited. With respect to the en route proposals in this notice, these operators are requested to submit, to the rules docket, their responses to the following questions:

1. If the aircraft is operated above 10,000 feet, what is the aircraft type, how much time is spent above 10,000 feet, and what is the purpose of this high altitude operation?

2. What is the general geographic area of the operation above 10,000 feet? Specific comment on the effect of the boundaries of the Eastern and Western 10,000-foot Steps is requested.

Environmental Considerations

With respect to the lowering of the floor of the continental positive control area to 12,500 feet generally, and 10,000 feet in the Eastern Step and Western Step, and the raising of the existing TCA ceilings to meet this lowered PCA floor, the FAA has determined that the noise, aircraft emissions, and fuel consumption effects would not involve a significant impact on the quality of the human environment. This is true since none of these proposed rule changes would significantly alter the flight paths or operational characteristics of aircraft at the lower altitude at which noise could be a factor (such as the 2,500 "buffer" between the PCA floor high, mountainous terrain), and no change is contemplated that would affect, in any significant way, the emissions characteristics or the total emissions generated by, aircraft operating in the en route or terminal airspace. While the total flight time of certain nonparticipating aircraft may be increased by circumnavigating the TCAs, this factor can be kept to a minimum through the use of minimum-distance bypass airways and VFR routes, and ATC accommodation of aircraft, in the TCA, workload permits. This is also true of the flight rules proposed in § 91.111 since the are not intended to materially affect the basis operation characteristics or flight paths of aircraft. The proposed relaxation of the speed restriction in § 91.70 would permit departing turbojet aircraft, under certain conditions, to leave a noise sensitive airport environment more quickly, in compliance with noise abatement procedures, and at airspeeds that are more efficient from a fuel conservation standpoint. Certain fuel consumption increases may be expected to result from the joining of the TCA ceilings with the lowered floor of the continental positive control area. These impacts and related costs would occur because nonparticipating VFR aircraft would be required to circumnavigate the TCA and could no longer overfly it. However, as was stated above regarding emissions impacts, the FAA has determined that these increases can be kept to a nonsignificant level through the use of fuel-efficient bypass airways, VFR routes permitting the shortest possible distance around the TCA, and ATC accommodation of aircraft where workload permits and where authorized by § 91.24. The individual environmental impacts of the 44 new TCAs that are planned will be addressed in the rule-making process for each of the affected airport areas.

Outline of Proposals

The extensive expansion of positive controlled airspace, as discussed in detail below, is proposed in order to ensure all airspace users the utmost in safe, uneventful air transportation. In order to assist commenters in responding to the request for views, data, and arguments on the application of the controlled visual flight concept, the following outline of the proposed rules is furnished. However, a full understanding of thes proposals requires a close reading of the draft regulatory language furnished below. Unless otherwise stated, all altitude reference Mean Sea Level (MSL).

DEFINITIONS—FAR PART 1

To ensure consistency between the basic regulatory definitions in Part 1 and the concept of controlled visual flight, and to correct deficiencies in that part, the following amendments are proposed (see §1.1):

1. The definition of "controlled airspace" would be broadened to specifically include "positive control areas." This corrects a long standing omission in this definition.

2. A new definition, describing "Controlled Visual Flight" would be added. This states that CVF is the operation of an aircraft under VFR "in designated positive control airspace." Note that CVR is not a third kind of flight other than VFR or IFR. It is not a hybrid. Rather, it would be defined as VFR in designated airspace having all aircraft separated by ATC. Therefore, all of the VFR provisions of the Federal Aviation Regulations would apply, in addition to any special rules applicable in the designated airspace.

3. Also correcting an omission, a definition of "positive controlled airspace" would be added making it clear that all airspace in which "positive control" (as now defined in § 1.1) is exercised by ATC is "positive controlled airspace." Together with the new definition of "controlled visual flight" (see above), this makes it clear that ATC separation of each aircraft from all other aircraft, VFR and IFR, is inherent in the CVF concept. This is in addition to the pilot's duty to see and avoid other aircraft specified in § 91.67, and the pilot's primary responsibility for flight safety stated in § 91.3(a).

AIRSPACE PROPOSALS—PART 71

As stated above, "controlled visual flight" would be defined as VFR operations in "designated positive controlled airspace." The proposed amendments to Part 71 would define the areas of positive controlled airspace within which compliance with the CVF rules would be required. Related amendments would also be made to preserve a consistent airspace structure. These proposals are as follows:

1. The major changes would be the amendment of § 71.193 to lower the continental positive control area (PCA) floor from 18,000 feet to 12,500 feet (10,000 feet in the Eastern Step and Western Step), and the amendment of Subpart K raising TCA airspace to meet the lowered PCA floor. This revision of Subpart K would, as in the past, be accomplished by additional airspace actions tailoring the raised airspace of each TCA to the conditions at each location. As stated above, public comment will be sought to minimize the adverse impacts on participating and nonparticipating aircraft. Section 71.12 would also be amended to reflect this revision of Subpart K. In addition, 44 new TCAs, at locations listed above, would be added following notice and public procedure involving Subpart K. With this action, there would be no need for "Group III TCAs," and that category would be removed from § 71.12. These changes, when combined with the lowering of the PCA floor, would provide for a continuous protective envelope of airspace, free of unknown VFR traffic, for climbing, cruising, and descending high performance aircraft. When combined with the operating rule proposals in Part 91 (discussed below), these airspace changes would assure the availability of positive control for all traffic, VFR and IFR, from takeoff to landing between locations served by TCAs. The lowering of the PCA floor, as proposed, would not apply to the Alaskan postive control area. The factors affecting aircraft operations in Alaska are not addressed in this notice.

2. Under the current rules, the continental control area extends upward indefinitely from 14,500 feet and the positive control areas terminate at 60,000 feet. There is no need for the airspace of the continental control area to be superimposed on the airspace of the continental positive control area. To eliminate this redundancy in the interest of a simpler airspace structure, § 71.9 would be amended (except in Alaska) to raise the floor of the continental control area to coincide with the ceiling of the continental positive control area, which is 60,000 feet (flight level 600).

3. Control zones, under § 71.11, now extend upward to the base of the continental control area. However, as stated above, the base of the continental control area would be moved up from 14,500 feet to flight level 600 (see above). There is no need to extend control zones up through the PCA airspace. For this reason, and to further simplify the airspace structure, § 71.11 would be amended to provide that control zones terminate at 10,000 feet MSL (or 3,000 feet above the elevation of the airport, whichever is higher).

OPERATING AND EQUIPMENT RULES—PART 91

The purpose of the operating and equipment proposals in this notice is to provide the conditions under which the "Controlled Visual Flight" concept can be effectively and jointly implemented by ATC and by pilots. These proposals are as follows:

The major equipment and operating rules implementing the CVF concept would be contained in a new § 91.111. These rules, which would apply in addition to all other VFR provisions, have one goal in common: The effective and continuous furnishing of ATC services to FVR operations at and above the floor of the continental positive control area. These proposals, which are believed to be the minimum needed to fully realize the benefits of an ATC controlled environment for VFR-trained pilots, are relaxed versions of the rules applicable to IFR operations in the positive control area. They have been designed with the responsibilities of VFR pilots in mind, and include the following:

(1) Either a VFR or IFR flight plan would be required before entering the positive controlled airspace (that is, before climbing to or above the floor of the continental positive control area). As discussed below, this would not change the flight plan requirements applicable to IFR aircraft but would permit cancellation of the IFR flight plan at any time before or after entering the PCA below 18,000 feet, if the CVF rules in § 91.111 are complied with and the aircraft is operated in compliance with visual flight rules.

(2) VFR pilots would be prohibited from entering the PCA without ATC authorization and without at least the equipment required for Group I TCAs. This includes transponders and Mode C encoders as well as the navigational and communications capabilities required in § 91.90. Consistent with this equipment requirement, § 91.24(b)(4) would be amended to apply the en route transponder and Mode C requirement to aircraft "above the floor of the continental positive control area."

(3) To ensure the continued separation capabilities of ATC while a VFR aircraft is under ATC control, new § 91.111 would require that VFR aircraft (a) comply with ATC clearances and instructions, (b) advise ATC if visual flight rules cannot be maintained, (c) maintain a continuous radio watch, and (d) report to ATC the loss of navigational capability. A simple rule for departing from the positive control area following two-way radio failure is also proposed. The intent of these proposals is to tailor the new requirements to the skill level of VFR pilots who now work effectively with ATC in terminal control areas. These skills would include the ability to (i) make altitude changes and fly any radar vectors assigned by the controller to maintain positive separation; (ii) file a flight plan defining the route of flight using VOR airways or point-to-point navigation with reference to navigational aids; and (iii) if so cleared by ATC, fly the flight plan route as filed. Experience with VFR pilots now participating in TCAs and TRSAs indicates that these pilots have the skills to comply with these proposals. The FAA emphasized that the provisions of § 91.111 would not change, in any

way, the duty of pilots, under VFR, to plan and execute their flights in full compliance with all visual flight rules. This includes the pilots' responsibility to avoid situations (such as "VFR-over-the-top" operations in which a noninstrument rated pilot finds himself or herself over a cloud layer) resulting in deteriorating weather that may preclude continued VFR flight or safe descent at the destination. In these cases, ATC's role and responsibility, under the CVF concept, would be limited to the issuance of clearances and instructions, requested by the VFR pilot, and separation of that aircraft from other VFR and IFR aircraft.

(4) Current § 91.75(a) provides that a pilot who has obtained an ATC clearance may cancel an IFR flight plan if operating in VFR weather conditions "except in positive control airspace." There is no intent to prohibit cancellation of an IFR flight plan for IFR aircraft operating in the same airspace as CVF operations. An IFR aircraft should be permitted to cancel its flight plan and proceed in the same manner as CVF aircraft in the positive control area below 18,000 feet. Accordingly, § 91.75(a) would be amended to permit cancellation of an IFR flight plan "except in positive control airspace at and above 18,000 feet." It should be noted that this would not change other rules that may limit the authority of air carriers or other operators to cancel IFR flight plans. Nor would this proposal affect in any way the duty of operators who change from IFR to VFR after entering the positive control area to comply with ATC clearances and instructions, even after an IFR flight plan is cancelled. The CVF rules would apply to these aircraft as well as to the other VFR aircraft in that airspace.

(5) Based on experience in furnishing ATC services to high performance aircraft that are departing from airports served by TCAs, the FAA has determined that the current 250-knot speed limit in § 91.70(a), that now applies below 10,000 feet, can be safely relaxed for certain departing aircraft that are climbing within a TCA. Specifically, once a high performance aircraft has departed from the close-in terminal environment and has reached an altitude of 5,000 feet, the FAA proposes to permit speeds greater than 250 knots, which would reduce the time in which the aircraft is held back in a mix with low altitude traffic, and would achieve improved efficiency in terms of passengers moved and fuel saved. Two alternative concepts are proposed for public comment. Under one proposal, the 250-knot speed limit would simply be eliminated for these climbing aircraft. Under the other alternative, a specific speed limit between 300 and 350 knots would be adopted. Under either concept, ATC would retain full flexibility to restrict the speed of aircraft where necessary for safety. This proposal does not include arriving aircraft since they present a far different traffic management and separation problem by converging, from the high speed en route structure, into the limited low altitude terminal airspace (rather than diverging into the en route environment). For these aircraft, excessive speed must be checked uniformly, by regulation, to assist in safe sequencing, efficient air traffic flow, sector-to-sector hand offs, effective low altitude vectoring, and other ATC tasks that are associated with the approach phase of flight involving the wide ranging mix of different aircraft performances present in the low altitude terminal environment.

(6) Current § 91.97(a) requires all aircraft in positive control areas to comply with specified IFR requirements, including the need for an instrument rating. An exception for aircraft operating under the CVF provisions of § 91.111 is proposed. This would achieve consistency between § 91.97 and the new § 91.111.

(7) In order to avoid unnecessary penalties on a class of sport aviation that has already achieved a high level of safety in operations up to the current floor of the positive control areas (18,000 feet), these proposals would exclude glider operations; although a prior notification of ATC (by radio or telephone) would be required. The modern competition sailplanes that operate in these higher altitudes are highly maneuverable aircraft with excellent cockpit visibility. Their operation frequently involves almost continuous circling flight, which exposes the entire horizon to pilot vision. Because of the necessarily random mode of operation of soaring operations, the CVF requirements proposed herein are virtually incompatible with soaring operations in the high altitudes. The imposition of this kind of impact has not been justified in view of the high safety record established for high altitude glider operations. The equipment and operating rule proposed in §§ 91.111 and 91.24(b) as amended, would contain exceptions for gliders operating between the floor of continental positive control area (10,000 feet or 12,500 feet, as appropriate) and 18,000 feet. It is believed that a requirement for prior notification would provide ATC with an adequate basis for routing other aircraft around the glider operations.

(8) In view of the proposal to add 44 new TCAs, as discussed above, there would be no need for Group III TCAs as an additional airspace category. Accordingly, the references to "Group III" TCAs would be removed from §§ 91.24 and 91.90.

PARACHUTE JUMPS—PART 105

As noted above, the CVF concep intended to ensure that ATC is aware of, and can separate, all traffic in designated airspace. The FAA has become concerned that the presence of unknown jump aircraft, and the random dropping of parachutists, may prevent full attainment of existing aircraft separation capabilities in positive controlled airspace. Experience indicates that the vertical trajectory, near invisibility, and lack of maneuverability of free falling jumpers make it extremely difficult for pilots to see and avoid them. For this reason, this proposal, when combined with the lowered PCA floor, would affect parachutists in three ways. First, the requirements in proposed § 91.111 would apply to the jump aircraft itself. Secondly, by lowering the floor of the continental positive control area to 12,500 feet (10,000 feet in the Western Step and Eastern Step), the current provisions of § 105.21, including the requirement for an ATC authorization, and the information provisions of § 105.25, would apply to jumps at and above that lowered floor. Finally, § 105.21 would be amended to extend these requirements downward into terminal control areas. Comments from the sport parachuting community are requested to assist the FAA in minimizing the impact of this proposal on jump operations.

THE PROPOSED AMENDMENT

Accordingly, the Federal Aviation Administration proposes to amend Parts 1, 71, 91, and 105 of the Federal Aviation Regulations (14 CFR Parts 1, 71, 91, and 105) as follows:

PART 1—DEFINITIONS

§ 1.1 [Amended]

1. By amending § 1.1 by revising the definition of "controlled airspace" by adding the words "positive control area," between the words "control area," and the words "control zone."

2. By amending § 1.1 to add the following new definition following the definition of "controlled airspace": "'Controlled visual flight' means the operation of an aircraft under VFR in designated positive controlled airspace."

3. By amending § 1.1 to add the following definition following the definition of "positive control": "'Positive controlled airspace' means designated airspace in which positive control is exercised."

PART 71—AIRSPACE PROPOSALS

4. By amending § 71.9 to read as follows:

§ 71.9 Continental Control Area.

The Continental Control Area consists of the airspace of the 48 contiguous States and the District of Columbia above flight level 600, and Alaska above 14,500 feet MSL, except—

(a) The Alaska Peninsula west of longitude 160°00′00″ W.;

(b) The airspace less than 1,500 feet above the surface of the earth; and

(c) Prohibited and restricted areas, other than restricted areas prescribed under Subpart D of this part.

5. By amending the first two sentences of § 71.11 to read as follows:

§ 71.11 Control zones.

The control zones listed in Subpart F of this part consist of controlled airspace which extends upward from the surface of the earth. Unless otherwise prescribed by the Administrator in Subpart F, control zones terminate at 10,000 feet MSL, or 3,000 feet above the airport elevation, whichever is higher.

* * * * *

§ 71.12 [Amended]

6. By amending § 71.12 by adding the following new second sentence after the words "of this chapter": "Each terminal control area underlying the continental positive control area listed in Subpart H of this part contains airspace terminating at the base of the continental positive control area, unless otherwise specified in subpart K." The reference to Group III Terminal Control Areas would be removed.

NOTE: The 21 Terminal Control Areas defined in Subpart K would be individually amended, in later airspace actions, to raise their ceilings to the lowered floor of the continental positive control area. This would also be true of the 44 new TCAs that are proposed. Those actions are not included in this notice but would be taken later under Subpart K. Subpart K is not published in the Code of Federal Regulations, but is found in the FEDERAL REGISTER at 43 FR 647, January 3, 1978.

7. By amending § 71.193 by revising the description of the continental positive control area to read as follows:

§ 71.193 Designation of Positive Control Areas.

* * * * *

CONTINENTAL POSITIVE CONTROL AREA

That airspace at and above 12,500 feet MSL (excluding that airspace at and below [2,5]00 feet AGL), up to and including flight [lev]el 600, within the 48 contiguous States [an]d the District of Columbia, excluding the Santa Barbara Island, Farallon Island, and the airspace south of Lat. 25°04′00″ N; and the airspace at and above 10,000 feet MSL (excluding that airspace at and below 2,500 feet AGL), but below 12,500 feet MSL, in the following areas:

(1) Western Step. Within lines extending from Lat. 39°15′00″N., Long. 123°51′00″W., via Lat. 39°15′00″N., Long. 121°00′00″W., Lat. 37°03′00″N., Long. 119°29′00″W., Lat. 36°33′00″N., Long. 119°14′00″W., Lat. 35°14′00″N., Long. 118°42′00″W., Lat. 34°56′00″N., Long. 118°21′00″W., Lat. 34°51′00″N., Long. 118°14′00″W., Lat. 34°48′00″N., Long. 118°05′45″W., Lat. 34°46′00″N., Long. 118°00′00″W., Lat. 33°56′00″N., Long. 116°22′00″W., Lat. 33°28′30″N., Long. 115°42′10″W., Lat. 33°23′40″N., Long. 115°33′20″W., Lat. 32°51′00″N., Long. 115°26′00″W., intersection of the United States/Mexican border with Long. 115°23′00″W., thence via the United States/Mexican border to Lat. 32°31′30″N., Long. 117°11′00″W., thence via a line three miles from and parallel to the coastline to the point of beginning excluding that airspace below 2,500 feet AGL.

(2) Eastern Step. East of the Mississippi River and east of a line extending from Lat. 46°16′30″N., Long. 94°20′30″W., via the 94°20′30″W., line of longitude to the United States/Canadian border.

NOTE.—Section 71.193 is found in the FEDERAL REGISTER only (43 FR 630, January 3, 1978). It is not published in the Code of Federal Regulations.

PART 91—OPERATIONS AND EQUIPMENT

§ 91.24 [Amended]

8. By amending § 91.24(b) to—

(i) Provide an exception from the ATC Transponder and Mode C altitude reporting equipment requirement, for persons operating gliders above the floor of the Continental Positive Control Area "up to; but not including, 18,000 feet MSL" rather than "below the floor of the positive control area" as stated in the current rule; and remove the reference to Group III TCAs in § 91.24(b)(3); and

(ii) Delete the words "above 12,500 feet * * * below 2500 feet AGL" in § 91.24(b)(4) and insert the words "above the floor of the continental positive control area" in place thereof.

9. By amending § 91.70 by revising the flush paragraph following paragraph (b) to read as follows:

§ 91.70 Aircraft Speed.

* * * * *

(b) * * *

Paragraph (b) of this section does not apply to any operations within a Terminal Control Area. Such operations shall comply with paragraph (a) of this section except that, in Terminal Control Areas contacting the base of a positive control area, climbing aircraft over 5,000 feet above the airport elevation, that are cleared for altitudes above 10,000 feet MSL within the TCA, may exceed 250 knots (288 M.P.H.) unless otherwise instructed by ATC. [In the alternative, the FAA proposes to specify a single speed limit, selected from between 300 and 350 knots, for these climbing aircraft.]

§ 91.75 [Amended]

10. By amending § 91.75(a) by deleting the second sentence and substituting for it the words "However, except in positive controlled airspace at and above 18,000 feet MSL, this paragraph does not prohibit the pilot from cancelling an IFR flight plan if the aircraft is operated in BFR weather conditions in compliance with the visual flight rules in this part, including the controlled visual flight provisions of § 91.111.

§ 91.90 [Amended]

11. By deleting § 91.90(c), *Group III Terminal Control Areas.*

§ 91.97 [Amended]

12. By amending § 91.97(a) by revising the introductory clause ("Except * * * section,") to read as follows: "Except as provided in paragraph (b) of this section and in § 91.111, * * *"

13. By adding the new subject heading "CONTROLLED VISUAL FLIGHT" immediately following § 91.109.

14. By adding the following new § 91.111 immediately after the new subject heading "CONTROLLED VISUAL FLIGHT" and immediately before the subject heading "INSTRUMENT FLIGHT RULES":

§ 91.111 Controlled Visual Flights.

(a) Each person who operates an aircraft (other than a glider) under VFR in the continental positive control area designated in Part 71 of this chapter, at below 18,000 feet MSL, shall comply with this section in addition to the other visual flight rules of this part.

(b) Each person who operates a glider in the continental positive control area at and below 18,000 feet MSL shall notify ATC prior to entering that airspace and furnish any information requested by ATC to assure safe separation.

(c) No pilot may operate an aircraft entering the continental positive control area under VFR unless—

(1) A VFR or IFR flight plan is filed in accordance with § 91.83 before entering that airspace;

(2) ATC authorizes the pilot to enter that airspace; and

(3) The aircraft is equipped as required for Group I Terminal Control Areas in § 91.90(a).

(d) Each pilot operating an aircraft in the continental positive control area under VFR shall—

(1) Comply with ATC clearances and instructions in accordance with § 91.75;

(2) Advise ATC if compliance with an ATC clearance or instruction may cause the pilot to violate the visual flight rules of this part:

(4) In the event of two-way radio failure, use the transponder code designated for such failure, continue to comply with visual flight rules, and leave the continental positive control area as soon as possible: and

(5) Report immediately to ATC the loss of VOR or other navigational capability.

* * * * *

PART 105—PARACHUTE JUMPING

15. By amending § 105.21 by amending the section heading and paragraph (a) to read as follows:

§ 105.21 Jumps in or into positive control areas or terminal control areas.

(a) No person may make a parachute jump, and no pilot in command of an aircraft may allow a parachute jump to be made from that aircraft, in or into a positive control area or terminal control area without, or in violation of, an authorization issued under this section.

* * * * *

(Secs. 305, 306, 307, 313(a), 601, and 1110, Federal Aviation Act of 1958, as amended (49 U.S.C. 1346, 1347, 1348, 1354(a), 1421 and 1522); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); and 14 CFR 11.45 and 11.65).

NOTE.—The Federal Aviation Administration has determined that this document involves a proposed regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and implemented by interim Department of Transportation guidelines (43 FR 9582; March 8, 1978).

Issued in Washington, D.C., on December 27, 1978.

FRANKLIN L. CUNNINGHAM,
Acting Director,
Air Traffic Service.

[FR Doc. 78-36467 Filed 12-28-78; 11:38 am]

Federal Aviation Administration

RNAV POLICY STATEMENT

INTRODUCTION

The Federal Aviation Administration (FAA) endorses the concept of area navigation (RNAV) and recognizes the benefits that RNAV offers to both the airspace user and the national airspace system (NAS). This policy statement puts forth a two-part action plan designed to facilitate the use of RNAV in the national airspace system. The mandatory carriage of RNAV avionics in order to use the air traffic control system is not envisioned in the near future.

BACKGROUND

Early in 1972 a task force was formed to make an indepth study of area navigation to determine its potential value in the national airspace system. The task force was comprised of representatives of commercial and general aviation groups, and the FAA. The findings, concepts developed, and recommendations of this group were published in a report titled "FAA/Industry RNAV Task Force Report."

The task force report issued in February 1973 is a concept paper showing how RNAV could be used in the system. The RNAV task force made many assumptions, several of which required extensive R&D efforts. The task force report specified an action plan to implement a charted route and terminal system design concept which would replace the VOR route structure with a charted RNAV route system in an orderly fashion with identification of specific areas which would need detailed attention.

The user/public comments on the task force report did not reveal any significant new facts or issues that were not known and considered by the task force. However, the commentors collectively agree with the task force, concerning the need for the findings to be thoroughly examined, studied and validated, particularly from the cost benefit aspect.

In April 1974, the FAA issued its area navigation interim policy statement which stated in part that: "The agency will, therefore, proceed with the operational and the research and development efforts necessary to validate the concepts in the report and continue to plan for an orderly development and transition toward an RNAV-based system. * * * The most important of the initial R&D tasks will be a comprehensive cost/benefit analysis to determine user and system payoffs as a prerequisite to implementation of the plan."

Since then, significant research and development work has been accomplished. This work culminated in an assessment of RNAV Task Force concepts and payoffs (RD-76-196 Implementation of Area Navigation in the National Airspace System. December 1976.) It concludes that: "The results obtained from economic and operational impact analysis, and from various supporting system studies, indicate that the advantages of area navigation to both the users and the ATC system are sufficient to warrant implementation of the charted route and terminal area navigation concept, particularly when all users are RNAV equipped." This concept is based on the task force recommendations, but modifies those recommendations to insure that maximum benefits will accrue to both the ATC system and the users. Although additional research and development work is still required in some areas, implementation of the area navigation concept can proceed in parallel with these efforts.

User responses to the recommended modification of the RNAV Task Force Concepts and to the RNAV Payoff Study were favorable. There was general agreement that RNAV should not be made mandatory for participation in the ATC system at this time, but FAA should take positive steps to promote RNAV implementation in accordance with the modified concepts persented in this study.

In addition to the studies showing the efficacy of RNAV, the number of aircraft with RNAV capability is increasing. There is a growing immediate demand for routes and procedures which will allow users to obtain the advantages offered by their RNAV avionics.

POLICY STATEMENT

The FAA, under public law 85-726, has the responsibility for development and implementation of radio-navigation systems to meet the needs for safe and efficient navigation and traffic control of all civil and military aviation throughout the national aviation system. This policy statement pertains only to area navigation and is supplementary to overall FAA navigation policy.

The FAA recognizes the advantages that RNAV offers to both the ATC system user and operator, and will pursue a two-part program leading to the ultimate objective of an RNAV based airspace structure. This structure will be based on the modified RNAV task force enroute and terminal concepts. Implementation will be consistent with the rate of user implementation of RNAV avionics, but the mandatory carriage of RNAV avionics as a condition to participate in the ATC system is not envisioned in the near future.

To be responsive to current and near-term RNAV users, the FAA will determine RNAV user needs and take positive steps to facilitate RNAV use within the existing air traffic control environment. This will include:

- Eliminating existing RNAV routes which do not respond to user requirements.
- Establishing, on a case-by-case basis, RNAV routes with the accompanying RNAV transition segments, SIDs and STARs.
- Promoting the establishment of RNAV approaches at noninstrumented airports.
- Establishing a continuing program to educate pilots, air traffic controllers, flight service specialists and flight standards specialists about RNAV and its capabilities.
- Developing a national waypoint system to facilitate pilot selection of direct routes.
- Development and promulgation of RNAV avionics minimum selection standards.

Concurrently, the FAA will undertake a long-range effort to develop a master enroute and terminal RNAV route design and transition plan to bridge the gap between today's structure and the future RNAV structure. Development of the master RNAV design will require close and continuous coordination with all airspace users and will include an environmental analysis.

(Secs. 307(a) and 312(a) of the Federal Aviation Act of 1958 (49 U.S.C. 1348(a) and 1353 (a)) and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

Issued in Washington, D.C., on January 7, 1977.

JOHN L. MCLUCAS,
Administrator.

[FR Doc.77-1227 Filed 1-12-77;8:45 am]

as published in

FEDERAL REGISTER, VOL. 42, NO. 9—THURSDAY, JANUARY 13, 1977

APPENDIX B

AIR TRANSPORTATION ASSOCIATION OF AMERICA ASSESSMENT OF
FAA PROGRAMS RELATED TO FUEL CONSERVATION

Air Transport Association **ata** OF AMERICA

1709 New York Avenue, N.W.
Washington, D. C. 20006
Phone (202) 872-4000

September 5, 1979

Mr. John B. McKinley
Systems Control, Inc. (Vt.)
Champlain Technology Industries Division
2326 S. Congress Avenue, Suite 2-A
West Palm Beach, Florida 33406

Dear Mr. McKinley:

This is in reply to your letter of August 6, 1979 in which you requested an ATA assessment of FAA programs related to fuel conservation. You are probably well aware that the airlines have been vitally concerned with the problem and have taken many steps to control and reduce the amount of fuel used. In preparing our reply we asked for the views of various staff members to determine those areas in which FAA rules, regulations, and procedures had an adverse or beneficial effect on fuel use. Although our reply is not comprehensive, we believe that it covers a major portion of the programs of concern to the airlines. It also covers most of the subprograms given in your checklist. We have generally followed your outline in presenting our staff views. Our specific comments are as follows:

I. FAA ATC Subprogram

Fuel Advisory Departure (FAD)

Airlines are awaiting FAA Headquarters action to supply a revised draft of the FAD Order which is to include changes considered at an airline/FAA Critique in Chicago earlier this year. According to FAA internal sources a revised draft was prepared for FAA in-house review two months ago. The most recent formal contact with Air Traffic Control Systems Command Center indicated that we can expect the revised draft to be provided "shortly" for airline review and comment. Progress on this has been too slow. However, it should be remembered that airlines have not authorized FAD expansion to other terminals.

As a result of FAA/airline discussions at an Air Traffic Control Committee meeting in Denver, Mr. Failor, Director - Air Traffic Service, FAA, has instructed the

ATCSCC Chief to get together with Flow Control Chiefs at five facilities to review the functions and responsibilities for such facilities in terms of ATCSCC. Mr. Failor directed that a definition of the responsibilities and functions of ATCSCC with regard to management of systems flow control be developed. The meeting with ATCSCC has been completed, and a briefing of AT-300 is scheduled for the last week in August. This Division is scheduled to meet with the Director of Air Traffic Service next week to determine the future role of ATCSCC. Early reports indicate that a request for additional ATCSCC manpower is expected.

Flow Control Automation

FAA in-house automation efforts are proceeding essentially as scheduled with data now being exchanged between the flow control computer at Jacksonville and related ATC facilities. Changes have been made in the first phase of the original program which now precludes the rejection of air carrier flight plans that do not contain an estimated time enroute (ETE).

Problems are currently being encountered between Jacksonville flow control computer and ATCSCC. The Data Terminal Equipments (DTE's) in ATCSCC are functioning; however, problems exist in the interface between DTE's and the Jacksonville computer.

An additional problem has appeared in the DTE functional capability which resulted from a reported omission in the specifications by FAA. Reportedly, ATCSCC cannot store data received from the flow control computer for modification and direct re-transmission to the users. Additional hardware is required to achieve this. The required action is now under way with completion of contractor work scheduled for September 30, 1979; and as the DTE interface is accepted, on line operations should be available in mid-October. As an interim fix, FAA plans to reassign teletype operations to the Jacksonville facility so that data can be transmitted directly to the airlines data distribution system.

FAA is awaiting a report on the airlines commitment to participate in the automated flow system data exchange. The ATA staff has advised the Chief of the Jacksonville Facility of airline responses to date. FAA estimates that it will take at least six months to develop the airline-Jacksonville interfaces once a full understanding has been reached.

Wake Vortex Avoidance Systems

The Wake Vortex Avoidance System now installed at O'Hare and awaiting operational use has the potential for significant fuel saving. This would be achieved by decreased spacing between aircraft on final approach. The decreased spacing will have the effect of increasing the airport capacity and will cut fuel-wasting delays during peak traffic periods.

The FAA has been extremely slow in getting this program into operation. There have been numerous postponements over a period of several years. After approval was obtained by all FAA services concerned with the problem, further delays have been encountered because of objections of the airline pilot group. Latest target date for start-up of operation is now January 1, 1980. There is a strong indication that FAA failed to properly educate and prepare the pilot group on the system, and that much of the objection is based upon lack of understanding of the way the system works. There is no assurance at this time that the target date will be met even though the system is ready for operation and substantial fuel saving will result when it is in use.

Area Navigation (RNAV)

FAA has completed action to finalize existing and modified RNAV routes. It has also established some new routes on an "as required" basis. The general FAA approach to enroute RNAV applications appears to be based on "random routes" rather than formalized RNAV route designations. Some terminal RNAV route requests from airlines have not been acted upon by FAA and are still pending. Airline attempts to have FAA prepare a formal RNAV Master Plan have not been very successful. FAA's reluctance appears to be based on the belief that random route usage is adequate. The limited RNAV implementation by airlines is a factor here, but there is little incentive for airlines to install airborne equipment until RNAV routes are available and a benefit can be realized.

Expanded TCA Program

FAA's preliminary economic assessment report for the expanded TCA program indicates a loss in fuel efficiency will occur as a result of more regimented ATC practices. ATA believes that this loss of efficiency is minimal and is an acceptable penalty to pay for the increased margin of safety which results. However, each proposed TCA must be carefully analyzed on an individual basis to determine whether or not the traffic density and complexity warrants its establishment.

II. Airports Subprogram

Airport Surface Traffic Control (ASTC)

It is obvious that a system of Airport Surface Traffic Control that will reduce aircraft congestion and allow the orderly flow of traffic will contribute to fuel conservation.

The extent of this fuel saving will vary widely between airports and would depend upon the effectiveness of the control system. It would be difficult to make a meaningful estimate of the fuel saving from this source. Since the primary function of the system would be to increase safety, the fuel saving would in effect be a bonus. To have maximum effect on fuel saving, the system to be implemented should be effective even during the lowest minimums in use or under all visibility conditions. The airlines have been concerned about the slow pace in implementing an ASTC System. The current ASDE leaves much to be desired; and ASDE III, although a welcome improvement, still leaves open the question of aircraft identification. Airlines have repeatedly urged that the trilateration system known as Tower Automated Ground System (TAGS), which includes identification, be developed to a practical demonstration stage. This will allow a proper assessment to be made of the merits and disadvantages of the existing system in comparison with a developmental system so that a sound decision can be made as to a future course of action.

Fog Dispersal System

Although there are several concepts of fog dispersal that appear to be worthy of test and evaluation, FAA efforts in this area are practically nil. Lack of progress in development of fog dispersal cannot be ascribed to inhibiting FAR's, but is more likely caused by lack of interest in the subject. In all fairness it must be stated that most fog dispersal systems are fuel-intensive, and there is a question as to whether some of the systems will burn more fuel than they save. It would appear to us that such questions must be resolved in some detail before a sound assessment can be made of their value.

Snow-Ice Removal

The fuel shortage has curtailed use of petroleum-derived anti-icing and deicing chemicals. It has also caused airport operators to be more cautious in the use of snow and ice removal equipment. There is currently no accepted standard for runway and taxiway surface friction that can be used by airport operators as a guide to safe operation. Such standards could help prevent waste in snow and ice removal when treatment is provided if called for. High cost and lack of petroleum-derived anti-icing and deicing chemicals has caused an increase in the use of sand on runways and taxiways. This in turn has increased the occurrence of FOD damage to aircraft engines and for this reason should be discouraged.

III. Aircraft Operators Subprogram

Capacity Restraint

Capacity restraints on airline aircraft are the result of several factors. These include limitations of runway length, cabin interior configuration limitations based upon safety requirements, and hot weather operations. The first of these, runway length limitations, becomes a serious problem at some airports where it is necessary to limit the load carried during high temperature conditions. The obvious solution is to increase the runway length and to provide aircraft with improved takeoff performance. Both of these are relatively long-term solutions and are inherently expensive.

The second capacity restraint item involves cabin configurations that are required for fast evacuation in case of an emergency. In some cases this requires seats to be removed or additional aisle space, and a wider passage between seats in the vicinity of emergency exits. Each of these contributes to lower efficiency and fuel economy.

The third item involving operations at high temperature is a common airline problem in which airline aircraft loads are limited because of reduced performance of the engines during high ambient temperature conditions. A solution to the problem is the same as in the case of limited runway length, higher performance characteristics and longer runways.

<u>Reseating Existing Aircraft</u>

Much attention has been paid to maximize the load carrying capacity of airline aircraft, and seating configurations, density of seating have been the subject of intensive study to the point where there is little opportunity for further improvement.

<u>Simulators</u>

Considerable progress has been made in substituting simulator training for training aircraft.

For consideration to be given to legally substitute simulator time for aircraft time, there had to be demonstrations that training in the simulator could in fact be as effective as training in the aircraft. This happened in a variety of ways, but the primary changes in Federal Regulations came about by means of exemptions to those regulations which then permitted demonstration of the effectiveness of training in simulators. These carefully controlled exemptions were conducted under close review of the FAA and demonstrated that not only could training be conducted as effectively in a simulator, but it could be more effective than training in the airplane. All of this has led to the current situation where, with an approved simulator and visual system, there are only a few traffic pattern maneuvers that must be demonstrated and rated in the actual aircraft for transition training. From an approximate transition training in aircraft time of around

30 hours, airlines now report a fairly uniform requirement of only three to five hours of aircraft time.

About 80 simulators are in service with U. S. airlines. In 1978, these simulators saved about 280,000 hours of airplane time and reduced training costs about 123 million dollars. (The current ratio of airplane direct operating cost to simulator direct operating cost is 12 to 1.)

It has been estimated that approximately 204 million gallons of fuel are saved each year through the industry's present use of flight simulators.

The airlines and the FAA agree that complete training in a flight simulator without using a training airplane at all is currently feasible and desirable. Unresolved, however, are questions concerning the circumstances under which total training through simulation will be approved, and to what extent realism should be varied to bring about that approval.

Reduce Fuel Tankering

The practice of fully loading an aircraft with fuel in locations where fuel is available has been useful during the recent critical shortages, and airlines are making extensive use of tankering procedures. Unfortunately, the total savings in fuel are not as great as might be expected because additional fuel is required to carry the extra load of the fuel being tankered; however, it is expected that the practice will continue and will contribute to the overall economy and reliability of operations.

Taxi on Fewer Engines

Airlines started using this technique as an economy measure long before fuel shortages became critical, and it has become a fairly standard practice among airlines. It is doubtful that further economies can be gained in this area.

Climb Procedures in TCA's

Limiting climb performance to speeds of 250 knots or less is highly inefficient. While the imposition of a 250 knots limitation may be considered necessary by some for safety reasons, the airline view is that this limitation in Positive Controlled Airspace is totally unwarranted. As a first phase, the removal of speed limit restrictions within TCA airspace for aircraft climb-out would offer a substantial decrease in fuel burn during this phase of flight.

Optimum Descent

Fuel conservation descent procedures have been implemented at many locations. Assessment of these procedures to date have indicated that with proper application a significant reduction in fuel burn can be realized. Procedures could be refined at most locations and should be implemented at more airports.

Optimum Cruise Speed

Optimum cruise speeds have been adopted by most airlines where feasible.

Optimum Altitude

Long overdue FAA action is needed to permit aircraft to operate at fuel optimum altitudes. First priority should be given to achieving 1,000 feet vertical separation at flight levels above 29,000 feet. There is a long history of FAA foot-dragging on this subject, and a fresh approach needs to be taken. Airlines have studied the problem and are convinced that there are no insurmountable technical problems.

IV. Aircraft Technology Subprograms

New Near Term Aircraft

The fuel economies promised by airline aircraft now on order by airlines are significant and are well recognized as a major factor in the purchase of new aircraft. Improved higher efficiency engines, super-critical wings, and other advanced aeronautical concepts all contribute to this improved efficiency. The extent to which the airlines take advantage of the more efficient aircraft depends to a large extent on cost benefit factors.

Winglets

Winglets are now being tested on airline type aircraft, and information should soon be available on the extent of improved efficiencies resulting from their use. When this information is available, airlines can then consider cost benefit factors to determine whether installation is worthwhile.

Active Controls

Possible future use of active controls can result in reduced structural weight of airframes with resultant increases in fuel efficiencies. There are still questions which must be answered before active controls can be considered suitable for airline operations. These include vulnerability of the electronic control system to damage from lightning strikes and other electrical transients, and the extent to which reliability of the electronic systems can be guaranteed. The concept of having the structural integrity of an aircraft dependent upon electronic systems is a new one which must be carefully considered because of the safety implications.

On-Board Performance Computers

Airlines are already installing performance computers on the basis that fuel savings will result. Actual experience in routine airline operations is still limited, but there is a promise of substantial improvement in fuel efficiency.

Lighter Than Air (LTA) Cargo Vehicles

Interest in lighter than air cargo vehicles as a potential means of fuel conservation is based upon the concept that the power plant can be used solely for propulsion and does not have to provide lifting force for such aircraft. Presumably, studies have been made to show that vehicle efficiencies are derived from such an operation.

Although the elimination of the need for aerodynamic lift may reduce the fuel requirement normally associated with keeping an aircraft aloft, there is a trade-off in that the large frontal area required for the lighter than air envelope will greatly increase drag and hence only slow speed operation would be feasible. It is quite possible that the concept might have advantages for certain special applications involving short range transport of bulky materials such as loading large cargo aboard ships. The speed restriction, however, probably keeps the lighter than air craft in a highly specialized category.

We do not see where FAA should be involved in this type of study. If research is to be done in this area, it should be conducted by NASA.

Large Air Cargo Transports

Highly efficient large transport aircraft have been proposed which offer substantial fuel efficiencies. However, there appears to be no reason to single out cargo transports from other types, because the same technologies can apply to passenger and cargo aircraft. The present practice of combining passengers and cargo appears to offer the greatest economy in fuel use because it effectively increases the load factor by taking advantage of the reservoir of air cargo as a means of filling an aircraft to capacity. The use of aircraft dedicated exclusively to cargo is only feasible on certain high-density routes, and it is unlikely that there would be any significant advantage from a fuel conservation standpoint.

Potential FAA/Airline Actions
To Maximize Fuel Conservation in
Air Traffic Control System
May 10, 1979

1) Reemphasize to air traffic controllers the importance of fuel conservation. There are indications that some air traffic controllers are not sufficiently aware of the urgency of conserving fuel and of the extra fuel consumed by certain ATC practices. FAA should continue to emphasize the importance of this point in briefing sessions and other communications.

2) Make maximum effort to clear flights at the altitudes requested. Airlines are making a strong effort to assure flight planning to conserve fuel. Any deviation from optimum altitude obviously results in excessive fuel consumption. This should be reemphasized to controllers to assure that every effort is made to clear flights at the requested altitudes. If other air traffic temporarily prevents clearance at the requested altitude, the request should be granted as soon as the traffic situation permits.

3) Make maximum use of established fuel conservation descent procedures. Airlines have worked with FAA to assure that pilots be permitted, when practical, to descend at pilots' discretion. We believe it deserves continuing reemphasis in the light of its importance.

4) Assure use of existing gatehold procedures. Fuel can be saved by absorbing departure delays at the loading gates before starting engines or, where gate space is at a premium, vacating the gate and holding at a point on the airport with engines shut down. These procedures should be encouraged and used whenever possible.

5) Minimize circuitous routings. Some air traffic control centers do a better job than others in avoiding circuitous routings. For example, some centers will volunteer "short cut" routings when traffic permits and others only do so on request. All controllers should be encouraged to volunteer such routings whenever traffic permits.

6) Apply high-density traffic procedures only when needed. Many ATC procedures and practices are designed to facilitate control of traffic during peak traffic periods, and such procedures often require extra fuel and time. All facilities should be required to limit application of such procedures only to the periods when they are actually needed.

7) Minimize adverse effect of airspace reservations. Although FAA has made progress over the past years in reducing the adverse effects of airspace reservations, they still cause extra fuel to be consumed. Further efforts should be made to try to reduce the adverse effects by cancelling or reducing the size of airspace reservations or expanding joint use.

8) Better information on expected arrival delays. When good information on arrival delays is provided prior to entry into terminal areas, speed can be reduced to avoid extensive arrival holding and fuel can be saved.

9) Implement optimized runway/taxiway usage based on analytical and simulation results. Important information on optimized airport usage is emerging from analytical and simulation studies which are part of the joint FAA/industry ten-airport improvement effort. These efforts, particularly capacity and delay analysis to yield optimized airport usage, should be expedited and results put into practice. This will require allocation of resources by FAA, but the results are potentially valuable in fuel reduction and ATC delay reduction.

10) Implementation of additional facilities and improvement of availability of aids and services. The 1974 FAA/MITRE Airport Capacity Study identified a series of F & E improvements which would improve the capacity of ten major airports and reduce delays by increasing operational availability -- both VFR and IFR. Much of this implementation is under way -- the remainder should be expedited for completion as soon as possible. In addition, FAA efforts to replace less reliable equipment (such as tube type radar and ILS) with modern solid-state, high-reliability systems should be expedited.

11) Implementation of the wake vortex detection system. The vitally important FAA Research and Development program on wake vortex detection has resulted in the near-completion of a chain of wake vortex detection devices at Chicago O'Hare. Work should be expedited to complete the technical and operational evaluation of the O'Hare system, and to bring it into operational use at the earliest possible date. Work should be started immediately to assure early implementation of similar systems at other major airports.

12) Local flow control procedures. Local flow control procedures such as those developed for Dallas/Ft. Worth International Airport should be adapted for use at other major airports wherever practical.

13) Improvement of Airport Surface Detection Equipment. FAA has belatedly recognized the importance of Airport Surface Detection Equipment and embarked on development of a modern airport surface detection radar and other surface guidance

and control technology programs. It is essential that this work proceed, but that in the meantime all possible improvements to existing ASDE systems be implemented to improve their usability and reliability.

14) Expedite FAA action on the airlines request for 1,000 foot vertical separation above FL 290. We recognize that this will be a longer term effort than many of our other suggestions, but it is an important way to permit more aircraft to be cleared at optimum altitudes.

15) Improvements in handling receipt and issuance of ICAO teletype filed flight plans would avoid delays that increase fuel usage by requiring high speed/high fuel consumption at lower FLs in order to meet curfew required arrival times. (NY frequently losing FPs and requiring flights to delay for clearance North Atlantic.)

16) Thru revised routings and ATC flight plans a 33 1/3 reduction in reserve fuel required to meet the 10% reserve fuel might be realized. (Where does the reduction to 5% in the FAR stand?)

17) Direct routes should be allowed to be planned and filed before departures when conditions allow for such approvals when enroute; otherwise, a waste of fuel occurs as a result of carrying fuel to meet a pre-takeoff requirement only. (Reference 5 above).

18) Descent speeds are too high. Optimum descent speeds should be used. Why install performance computers if they cannot be used efficiently?

19) Eliminate 250 speed restriction to 10000' on climb out.

20) Minimum Fuel Descent. Generally speaking the so-called "Keep Them High" program has helped conserve fuel. We are still seeing cases where aircraft are being cleared to descend too soon and where crossing altitudes are being assigned when not required by actual traffic. We believe there is room for improvement in this area.

21) Careful spacing on approach so as to avoid go-arounds. The amount of fuel consumed by a modern jet transport executing a missed approach is enormous. Controllers can assist in avoiding this waste by very careful spacing of aircraft on final approach.

22) Reduce the required separation between parallel runways for independent approaches. FAA has initiated some action in this regard and anything more that can be done would assist in reducing arrival delays and thus conserve fuel.

23) <u>More use of simulators in lieu of training flights</u>. Considerable progress has been made in substituting simulator training for training flights. FAA consideration of additional airline proposals in this regard should be expedited.

24) <u>Minimize fuel dumping</u>. During 1972 ten airlines dumped over 1.4 million gallons of jet fuel. We suggest that discussions between FAA and airline representatives be scheduled as soon as possible to see if ways can be found to reduce fuel dumping without jeopardizing safety.

APPENDIX C

LISTING OF FEDERAL AVIATION REGULATIONS IMPACTING FUEL CONSERVATION

NOTE: Boxed-in FARs represent those which impact fuel consumption

Part 21—Certification Procedures for Products and Parts

Contents

Section		Page
Preambles		P–1

Subpart A—General

21.1	Applicability	1
21.3	[Reporting of failures, malfunctions, and defects]	1

Subpart B—Type Certificates

21.11	Applicability	2
21.13	Eligibility	2
21.15	Application for type certificate	2
21.16	Special conditions	2
21.17	Designation of applicable regulations	2–1
21.19	Changes requiring a new type certificate	2–1
21.21	Issue of type certificate: normal, utility, acrobatic, and transport category aircraft: aircraft engines: propellers	2–1
21.23	Issue of type certificate: gliders	2–2
21.25	Issue of type certificate: restricted category aircraft	3
21.27	Issue of type certificate: surplus aircraft of the Armed Forces	3
21.29	Issue of type certificate: import products	4
21.31	Type design	5
21.33	Inspection and tests	5
21.35	Flight tests	5
21.37	Flight test pilot	6
21.39	Flight test instrument calibration and correction report	6
21.41	Type certificate	6
21.43	Location of manufacturing facilities	6
21.45	Privileges	6
21.47	Transferability	6
21.49	Availability	6
21.50	Rotorcraft Maintenance Manual: changes to the "Airworthiness Limitations" section	6
21.51	Duration	6–1
21.53	Statement of conformity	6–1

Subpart C—Provisional Type Certificates

21.71	Applicability	7
21.73	Eligibility	7
21.75	Application	7
21.77	Duration	7
21.79	Transferability	7
21.81	Requirements for issue and amendment of Class I provisional type certificates	7

Section		Page
21.83	Requirements for issue and amendment of Class II provisional type certificates	8
21.85	Provisional amendments to type certificates	9
	Subpart D—Changes to Type Certificates	
21.91	Applicability	10
21.93	Classification of changes in type design	10
21.95	Approval of minor changes in type design	10
21.97	Approval of major changes in type design	10
21.99	Required design changes	10
21.101	Designation of applicable regulations	10
	Subpart E—Supplemental Type Certificates	
21.111	Applicability	11
21.113	Requirement of supplemental type certificate	11
21.115	Applicable airworthiness requirements	11
21.117	Issue of supplemental type certificates	11
21.119	Privileges	11
	Subpart F—Production Under Type Certificate Only	
21.121	Applicability	11
21.123	Production under type certificate	11
21.125	Production inspection system: Materials Review Board	12
21.127	Tests: aircraft	12
21.128	Tests: aircraft engines	13
21.129	Tests: propellers	13
21.130	Statement of conformity	13
	Subpart G—Production Certificates	
21.131	Applicability	13
21.133	Eligibility	13
21.135	Requirements for issuance	13
21.137	Location of manufacturing facilities	13
21.139	Quality control	13
21.143	Quality control data requirements; prime manufacturer	14
21.147	Changes in quality control system	14
21.149	Multiple products	14
21.151	Production limitation record	14
21.153	Amendment of the production certificates	14
21.155	Transferability	14
21.157	Inspections and tests	14
21.159	Duration	14
21.161	Display	15
21.163	Privileges	15
21.165	Responsibility of holder	15
	Subpart H—Airworthiness Certificates	
21.171	Applicability	15
21.173	Eligibility	15
21.175	Airworthiness certificates: classification	15

Section		Page
21.177	Amendment or modification	15
21.179	Transferability	15
21.181	Duration	15
21.182	Aircraft identification	15
21.183	Issue of standard airworthiness certificates for normal, utility, acrobatic, and transport category aircraft	16
21.185	Issue of airworthiness certificates for restricted category aircraft	16
21.187	Issue of multiple airworthiness certification	16
21.189	Issue of airworthiness certificate for limited category aircraft	17
21.191	Experimental certificates	17
21.193	Experimental certificates: general	17
21.195	Experimental certificates: aircraft to be used for market surveys, sales demonstrations and customer crew training	18
21.197	Special flight permits	18
21.199	Issue of special flight permits	18
	Subpart I—Provisional Airworthiness Certificates	
21.211	Applicability	18
21.213	Eligibility	19
21.215	Application	19
21.217	Duration	19
21.219	Transferability	20
21.221	Class I provisional airworthiness certificates	20
21.223	Class II provisional airworthiness certificates	20
21.225	Provisional airworthiness certificates corresponding with provisional amendments to type certificates	20
	Subpart J—Delegation Option Authorization Procedures	
21.231	Applicability	20
21.235	Application	20
21.239	Eligibility	20
21.243	Duration	21
21.245	Maintenance of eligibility	21
21.247	Transferability	21
21.249	Inspections	21
21.251	Limits of applicability	21
21.253	Type certificates: application	21
21.257	Type certificates: issue	22
21.261	Equivalent safety provisions	22
21.267	Production certificates	22
21.269	Export airworthiness approvals	22
21.271	Airworthiness approval tags	22
21.273	Airworthiness certificates other than experimental	22
21.275	Experimental certificates	22
21.277	Data review and service experience	22
21.289	Major repairs, rebuilding, and alteration	23
21.293	Current records	23
	Subpart K—Approval of Materials, Parts, Processes and Appliances	
21.301	Applicability	23
21.303	[Replacement and modification parts]	23

Part 36—Noise Standards: Aircraft Type Certification

Contents

Section		Page
Preambles		P–1

Subpart A—General

36.1	Applicability	1
36.2	Special retroactive requirements	1
36.3	Compatibility with airworthiness requirements	1
36.5	Limitation of Part	1

Subpart B—Noise Measurement and Evaluation

36.101	Noise measurement	1
36.103	Noise evaluation	2

Subpart C—Noise Limits

36.201	Noise limits	2

Subpart D (Reserved)

Subpart E (Reserved)

Subpart F (Reserved)

Subpart G—Operating Information and Airplane Flight Manual

36.1501	Procedures and other information	2
36.1581	Airplane Flight Manual	2

Appendixes

Appendix A.	Aircraft noise measurement under § 36.101	3
Appendix B.	Aircraft noise evaluation under § 36.103	19
Appendix C.	Noise levels for subsonic transport category and turbojet powered airplanes under § 36.201	29

FEDERAL AVIATION REGULATIONS

PART 61 CERTIFICATION: PILOTS AND FLIGHT INSTRUCTORS

This part contains all effective amendments through
→ #66, effective June 26, 1978.

TABLE OF CONTENTS

SECTION	SUBPART A - GENERAL	PAGE
61.1	Applicability	5
61.3	Requirement for certificates, ratings, and authorization	5
61.5	Certificates and ratings issued under this Part	6
61.7	Obsolete certificates and ratings	7
61.9	Exchange of obsolete certificates and ratings for current certificates and ratings	7
61.11	Expired pilot certificates, and reissuance	8
61.13	Application and qualification	8
61.15	Offenses involving narcotic drugs, marihuana, and depressant or stimulant drugs or substances	9
61.17	Temporary certificate	9
61.19	Duration of pilot and flight instructor certificates	9
61.21	Duration of category II pilot authorization	10
61.23	Duration of medical certificates	10
61.25	Change of name	10
61.27	Voluntary surrender or exchange of certificates	11
61.29	Replacement of lost or destroyed certificate	11
61.31	General limitations	11
61.33	Tests: general procedure	12
61.35	Written tests: prerequisites and passing grades	13
61.37	Written tests: cheating or other unauthorized conduct	13
61.39	Prerequisites for flight tests	13
61.41	Flight instruction received from flight instructors not certificated by FAA	14
61.43	Flight tests: general procedures	14
61.45	Flight tests: required aircraft and equipment	14
61.47	Flight tests: status of FAA inspectors and other authorized flight examiners	15
61.49	Retesting after failure	15
61.51	Pilot logbooks	16
61.53	Operations during medical deficiency	17
61.55	Second in command qualifications: operation of large airplanes or turbojet-powered multiengine airplanes	17
61.57	Recent flight experience: pilot in command	18
61.58	Pilot in command proficiency check: operation of aircraft requiring more than one qualified pilot	19
61.59	Falsification, reproduction or alteration of applications, certificates, logbooks, reports, or records	20
61.60	Change of address	20

TABLE OF CONTENTS

SECTION		PAGE
	SUBPART B - AIRCRAFT RATINGS AND SPECIAL CERTIFICATES	
61.61	Applicability	21
61.63	Additional aircraft ratings (other than airline transport pilot)	21
61.65	Instrument rating requirements	22
61.67	Category II pilot authorization requirements	23
61.69	Glider towing: experience and instruction requirements	24
61.71	Graduates of certificated flying schools: special rules	25
61.73	Military pilots or former military pilots: special rules	25
61.75	Pilot certificates issued on basis of a foreign pilot license	27
	SUBPART C - STUDENT PILOTS	
61.81	Applicability	29
61.83	Eligibility requirements: general	29
61.85	Application	29
61.87	Requirements for solo flight	29
61.89	General limitations	31
61.91	Aircraft limitations: pilot in command	31
61 [illegible]	Cross-country flight requirements	31
	SUBPART D - PRIVATE PILOTS	
61.101	Applicability	33
61.103	Eligibility requirements: general	33
61.105	Aeronautical knowledge	33
61.107	Flight proficiency	34
61.109	Airplane rating: aeronautical experience	35
61.111	Cross-country flights: pilots based on small islands	36
61.113	Rotorcraft rating: aeronautical experience	36
61.115	Glider rating: aeronautical experience	37
61.117	Lighter-than-air rating: aeronautical experience	37
61.118	Private pilot privileges and limitations: pilot in command	37
61.119	Free balloon rating: limitations	38
61.120	Private pilot-privileges and limitations: second in command of aircraft requiring more than one required pilot	38
	SUBPART E - COMMERCIAL PILOTS	
61.121	Applicability	39
61.123	Eligibility requirements: general	39
61.125	Aeronautical knowledge	39
61.127	Flight proficiency	40
61.129	Airplane rating: aeronautical experience	41
61.131	Rotorcraft ratings: aeronautical experience	42
61.133	Glider rating: aeronautical experience	43
61.135	Airship rating: aeronautical experience	43
61.137	Free balloon rating: aeronautical experience	43
61.139	Commercial pilot privileges and limitations: general	43
61.141	Airship and free balloon ratings: limitations	44

TABLE OF CONTENTS

SECTION		PAGE
	SUBPART F - AIRLINE TRANSPORT PILOTS	
61.151	Eligibility requirements: general	45
61.153	Airplane rating: aeronautical knowledge	45
61.155	Airplane rating: aeronautical experience	45
61.157	Airplane rating: aeronautical skill	46
61.159	Rotorcraft rating: aeronautical knowledge	47
61.161	Rotorcraft rating: aeronautical experience	47
61.163	Rotorcraft rating: aeronautical skill	48
61.165	Additional category ratings	49
61.167	Tests	49
61.169	Instruction in air transportation service	49
61.171	General privileges and limitations	49
	SUBPART G - FLIGHT INSTRUCTORS	
61.181	Applicability	50
61.183	Eligibility requirements: general	50
61.185	Aeronautical knowledge	50
61.187	Flight proficiency	50
61.189	Flight instructor records	51
61.191	Additional flight instructor ratings	51
61.193	Flight instructor authorizations	51
61.195	Flight instructor limitations	52
61.197	Renewal of flight instructor certificates	52
61.199	Expired flight instructor certificates and ratings	52
61.201	Conversion to new system of instructor ratings	53
Appendix A		54

Part 71—Designation of Federal Airways, Controlled Airspace, and Reporting Points

Contents

Section		Page
Preambles		P-1
	Subpart A—General	
71.1	Applicability	1
71.3	Classification of Federal airways	1
71.5	Extent of Federal airways	1
71.7	Control areas	2
71.9	Continental control area	2
71.11	Control zones	2
71.13	Transition areas	2
71.15	Positive control areas	2
71.17	Reporting points	2
71.19	Bearings; radials; miles	2
	Subpart B—Colored Federal Airways	
71.101	Designation	3
71.103	Green Federal airways	3
71.105	Amber Federal airways	3
71.107	Red Federal airways	3
71.109	Blue Federal airways	3
	Subpart C—VOR Federal Airways	
71.121	Designation	3
71.123	Domestic VOR Federal airways	3
71.125	Alaskan VOR Federal airways	3
71.127	Hawaiian VOR Federal airways	3
	Subpart D—Continental Control Area	
71.151	Restricted areas included	3
	Subpart E—Control Areas and Control Area Extensions	
71.161	Designation of control areas associated with jet routes outside the continental control area	3
71.163	Designation of additional control areas	3
71.165	Designation of control area extensions	3
	Subpart F—Control Zones	
71.171	Designation	3

Section *Page*

Subpart G—Transition Areas

71.181 Designation 3

Subpart H—Positive Control Areas

71.193 Designation of positive control areas 3

Subpart I—Reporting Points

71.201 Designation 3
71.203 Domestic low altitude reporting points 3
71.207 Domestic high altitude reporting points 4
71.209 Other domestic reporting points 4
71.211 Alaskan low altitude reporting points 4
71.213 Alaskan high altitude reporting points 4
71.215 Hawaiian reporting points 4

Part 91—General Operating and Flight Rules

Contents

Section		Page
Preambles		P-1

Subpart A—General

Section		Page
91.1	Applicability	1
91.2	Certificate of authorization for certain Category II operations	1
91.3	Responsibility and authority of the pilot in command	1
91.4	Pilot in command of aircraft requiring more than one required pilot	1
91.5	Preflight action	1
91.6	Category II operation: general operating rules	2
91.7	Flight crewmembers at stations	2
91.8	Prohibition against interference with crewmembers	2
91.9	Careless or reckless operation	3
91.10	Careless or reckless operation other than for the purpose of air navigation	3
91.11	Liquor and drugs	3
91.12	Carriage of narcotic drugs, marihuana, and depressant or stimulant drugs or substances	3
91.13	Dropping objects	3
91.14	Fastening of safety belts	3
91.15	Parachutes and parachuting	3
91.17	Towing: gliders	4
91.18	Towing: other than under § 91.17	5
91.19	Portable electronic devices	5
91.21	Flight instruction; simulated instrument flight and certain flight tests	5
91.23	Fuel requirements for flight in IFR conditions	5
91.24	ATC transponder equipment	6
91.25	VOR equipment check for IFR operations	6
91.27	Civil aircraft: certifications required	7
91.28	Special flight authorizations for foreign civil aircraft	7
91.29	Civil aircraft airworthiness	8
91.31	Civil aircraft operating limitations and marking requirements	8
91.32	Supplemental oxygen	9
91.33	Powered civil aircraft with standard category U.S. airworthiness certificates; instrument and equipment requirements	9
91.34	Category II manual	11
91.35	Flight recorders and cockpit voice recorders	11
91.36	Data correspondence between automatically reported pressure altitude data and the pilot's altitude reference	11
91.37	Transport category civil airplane weight limitations	11
91.38	Increased maximum certificated weights for certain airplanes operated in Alaska	12
91.39	Restricted category civil aircraft; operating limitations	13
91.40	Limited category civil aircraft; operating limitations	13
91.41	Provisionally certificated civil aircraft; operating limitations	13
91.42	Aircraft having experimental certificates; operating limitations	14
91.43	Special rules for foreign civil aircraft	15

Contents—Continued

Section		Page
91.45	Authorization for ferry flight with one engine inoperative by air carriers and commercial operators of large aircraft	16
91.47	Emergency exits for airplanes carrying passengers for hire	18
91.49	Aural speed warning device	19
91.51	Altitude alerting system or device; turbojet powered civil airplanes	19
91.52	Emergency locator transmitters	19
91.53	Report on identification and activity of aircraft	21
91.54	Truth in leasing clause requirement in leases and conditional sales contracts	21
91.55	Civil aircraft sonic boom	22

Subpart B—Flight Rules

GENERAL

91.61	Applicability	22
91.63	Waivers	22
91.65	Operating near other aircraft	22
91.67	Right-of-way rules; except water operations	22
91.69	Right-of-way rules; water operations	23
91.70	Aircraft speed	23
91.71	Acrobatic flight	24
91.73	Aircraft lights	24
91.75	Compliance with ATC clearances and instructions	24
91.77	ATC light signals	24
91.79	Minimum safe altitudes; general	24
91.81	Altimeter settings	25
91.83	Flight plan; information required	25
91.84	Flights between Mexico or Canada and the United States	26
91.85	Operating on or in the vicinity of an airport; general rules	26
91.87	Operation at airports with operating control towers	26
91.89	Operation at airports without control towers	27
91.90	Terminal control areas	28
91.91	Temporary flight restrictions	29
91.93	Flight test areas	30
91.95	Restricted and prohibited areas	30
91.97	Positive control areas and route segments	30
91.99	[Reserved]	31
91.101	Operations to, or over, Cuba	31
91.102	Flight limitation in the proximity of space flight recovery operations	31
91.103	Operation of civil aircraft of Cuban registry	31
91.104	Flight restrictions in the proximity of the Presidential and other parties	31

VISUAL FLIGHT RULES

91.105	Basic VFR weather minimums	32
91.107	Special VFR weather minimums	32
91.109	VFR cruising altitude or flight level	33

INSTRUMENT FLIGHT RULES

91.115	ATC clearance and flight plan required	33
91.116	Takeoff and landing under IFR: general	33
91.117	Limitations on use of instrument approach procedures (other than Category II)	34
91.119	Minimum altitudes for IFR operations	35
91.121	IFR cruising altitude or flight level	36
91.123	Course to be flown	36
91.125	IFR, radio communications	36

Contents—Continued

Section		Page
91.127	IFR operations; two-way radio communications failure	37
91.129	Operation under IFR in controlled airspace; malfunction reports	37

Subpart C—Maintenance, Preventive Maintenance, and Alterations

91.161	Applicability	38
91.163	General	38
91.165	Maintenance required	38
91.167	Carrying persons other than crewmembers after repairs or alterations	38
91.169	Inspections	38
91.170	Altimeter system tests and inspections	39
91.171	Progressive inspection	39
91.173	Maintenance records	40
91.174	Transfer of maintenance records	41
91.175	Rebuilt engine maintenance records	41
91.177	ATC transponder tests and inspections	41

Subpart D—Large and Turbine-Powered Multiengine Airplanes

91.181	Applicability	42
91.183	Flying equipment and operating information	43
91.185	Familiarity with operating limitations and emergency equipment	43
91.187	Equipment requirements: over-the-top, or night VFR operations	44
91.189	Survival equipment for overwater operations	44
91.191	Radio equipment for overwater operations	44
91.193	Emergency equipment	45
91.195	Flight altitude rules	45
91.197	Smoking and safety belt signs	45
91.199	Passenger briefing	46
91.201	Carry-on baggage	46
91.203	Carriage of cargo	46
91.205	Transport category airplane weight limitations	47
91.207	VFR fuel requirements	47
91.209	Operating in icing conditions	47
91.211	Flight engineer requirements	47
91.213	Second in command requirements	47
91.215	Flight attendant requirements	48
91.217	Inspection program	48
91.219	Availability of inspection program	49

Appendix A.	Category II operations: manual, instruments, equipment and maintenance	51
Appendix B.	Authorizations to Exceed Mach 1 (§ 91.55)	55

Special Federal Aviation Regulation 27	57
Special Federal Aviation Regulation 27-1	61
[Special Federal Aviation Regulation 27-2]	63

Section *Page*

Subpart I—Locations at which Special VFR Weather Minimums do not Apply

93.111 Applicability ---------- 5
93.113 Control zones within which special VFR weather minimums are not authorized ---------- 5

Subpart J—Lorain County Regional Airport Traffic Rule

93.117 Applicability ---------- 6
93.119 Aircraft operations ---------- 6

Subpart K—High Density Traffic Airports

93.121 Applicability ---------- 6
93.123 High density traffic airports ---------- 6
93.125 Arrival or departure reservation ---------- 7
93.127 [Deleted] ---------- 7
93.129 Additional operations ---------- 7
93.130 Suspension of allocations ---------- 7
93.131 [Deleted] ---------- 7
93.133 Exceptions ---------- 7

Subpart L—Addison (Texas) Airport Traffic Area

93.141 Applicability ---------- 7
93.143 Communications ---------- 7
93.145 Airpark-Dallas Airport Traffic ---------- 8

[Subpart M—Ketchikan International Airport Traffic Rule

[93.151 Applicability ---------- 8
[93.153 Communications ---------- 8
[93.155 Aircraft operations] ---------- 8

Appendix A ---------- 9

Part 95—IFR Altitudes

Contents

Section		Page
Preambles		P-1
Subpart A—General		
95.1	Applicability	1
95.3	Symbols	1
Subpart B—Designated Mountainous Areas		
95.11	General	1
95.13	Eastern United States Mountainous Area	1
95.15	Western United States Mountainous Area	2
95.17	Alaska Mountainous Area	2
95.19	Hawaii Mountainous Area	3
95.21	Puerto Rico Mountainous Area	3
Subpart C—En Route IFR Altitudes Over Particular Routes and Intersections		
95.31	General	8
Subpart D—Changeover Points		
95.8001	General	8

365-893 O - 7

Subpart D—Rules Governing All Certificate Holders Under This Part

Section		Page
121.71	Applicability	8
121.73	Availability of certificate and operations specifications	8
121.75	Use of operations specifications	8
121.77	Amendment of certificate	8
121.79	Amendment of operations specifications	9
121.81	Inspection authority	9
121.83	Change of address	9

Subpart E—Approval of Routes: Domestic and Flag Carriers

121.91	Applicability	10
121.93	Route requirements: general	10
121.95	Route width	10
121.97	Airports	10
121.99	Communications facilities	10
121.101	Weather reporting facilities	10
121.103	En route navigational facilities	11
121.105	Servicing and maintenance facilities	11
121.107	Dispatch centers	11

Subpart F—Approval of Areas and Routes for Supplemental Air Carriers and Commercial Operators

121.111	Applicability	11
121.113	Area and route requirements: general	11
121.115	Route width	11
121.117	Airports	12
121.119	Weather reporting facilities	12
121.121	En route navigational facilities	12
121.123	Servicing and maintenance facilities	12
121.125	Flight following system	12
121.127	Flight following system: requirements	13

Subpart G—Manual Requirements

121.131	Applicability	13
121.133	Preparation	13
121.135	Contents	13
121.137	Distribution	14
121.139	Requirement for manual aboard aircraft: supplemental air carriers and commercial operators	14
121.141	Aircraft Flight Manual	15

Subpart H—Aircraft Requirements

121.151	Applicability	15
121.153	Aircraft requirements: general	15
121.155	Exclusive use requirements: supplemental air carriers and commercial operators	15
121.157	Aircraft certification and equipment requirements	15
121.159	Single-engine airplanes prohibited	16
121.161	Airplane limitations: type of route	16
121.163	Aircraft proving tests	16

Section		Page
121.233	Fuel lines and fittings in designated fire zones	28
121.235	Fuel valves	28
121.237	Oil lines and fittings in designated fire zones	28
121.239	Oil valves	28
121.241	Oil system drains	29
121.243	Engine breather lines	29
121.245	Fire walls	29
121.247	Fire-wall construction	29
121.249	Cowling	29
121.251	Engine accessory section diaphragm	29
121.253	Powerplant fire protection	29
121.255	Flammable fluids	29
121.257	Shutoff means	29
121.259	Lines and fittings	30
121.261	Vent and drain lines	30
121.263	Fire-extinguishing systems	30
121.265	Fire-extinguishing agents	30
121.267	Extinguishing agent container pressure relief	30
121.269	Extinguishing agent container compartment temperature	30
121.271	Fire-estinguishing system materials	30
121.273	Fire-detector systems	30
121.275	Fire detectors	31
121.277	Protection of other airplane components against fire	31
121.279	Control of engine rotation	31
121.281	Fuel system independence	31
121.283	Induction system ice prevention	31
121.285	Carriage of cargo in passenger compartments	31
121.287	Carriage of cargo in cargo compartments	32
121.289	Landing gear: aural warning device	32

Subpart K—Instrument and Equipment Requirements

121.301	Applicability	32
121.303	Airplane instruments and equipment	32
121.305	Flight and navigational equipment	33
121.307	Engine instruments	33
121.309	Emergency equipment	33
121.311	Seat and safety belts	34
121.313	Miscellaneous equipment	34
121.315	Cockpit check procedure	35
121.317	Passenger information	35
121.319	Exterior exits and evacuation markings	35
121.321	Shoulder harness	35
121.323	Instruments and equipment for operations at night	35
121.325	Instruments and equipment for operations under IFR or over-the-top	36
121.327	Supplemental oxygen: reciprocating engine powered airplanes	36
121.329	Supplemental oxygen for sustenance: turbine engine powered airplanes	36
121.331	Supplemental oxygen requirements for pressurized cabin airplanes: reciprocating engine powered airplanes	37
121.333	Supplemental oxygen for emergency descent and for first aid: turbine engine powered airplanes with pressurized cabins	38

Section Page

121.333 Supplemental oxygen for emergency descent and for first aid: turbine engine powered airplanes with pressurized cabins -- 38
121.335 Equipment standards -- 39
121.337 Protective breathing equipment for the flight crew -- 40
121.339 Equipment for extended over-water operations -- 40
121.340 Emergency flotation means -- 40
121.341 Equipment for operations in icing conditions -- 40
121.343 Flight recorders -- 41
121.345 Radio equipment -- 41
121.347 Radio equipment for operations under VFR over routes navigated by pilotage -- 41
121.349 Radio equipment for operations under VFR over routes not navigated by pilotage or for operations under IFR or over-the-top -- 41
121.351 Radio equipment for extended overwater operations and for certain other operations -- 42
121.353 Equipment for operations over uninhabited terrain areas: flag and supplemental air carriers and commercial operators -- 42
121.355 Equipment for operations on which specialized means of navigation are required: flag and supplemental air carriers and commercial operators -- 42
121.357 Airborne weather radar equipment requirements -- 42
121.359 Cockpit voice recorders -- 43

Subpart L—Maintenance, Preventive Maintenance, and Alterations

121.361 Applicability -- 43
121.363 Responsibility for airworthiness -- 43
121.365 Maintenance, preventive maintenance, and alteration organization -- 43
121.367 Maintenance, preventive maintenance, and alterations programs -- 44
121.369 Manual requirements -- 44
121.371 Required inspection personnel -- 45
121.373 Continuing analysis and surveillance -- 45
121.375 Maintenance and preventive maintenance training program -- 45
121.377 Maintenance and preventive maintenance personnel duty time limitations -- 45
121.378 Certificate requirements -- 45
121.379 Authority to perform and approve maintenance, preventive maintenance, and alterations -- 46
[121.380 Maintenance recording requirements] -- 46

Subpart M—Airman and Crewmember Requirements

121.381 Applicability -- 46
121.383 Airman: limitations on use of services -- 46
121.385 Composition of flight crew -- 46
121.387 Flight engineer -- 47
121.389 Flight navigator: flag and supplemental air carriers and commercial operators -- 47
121.391 Flight attendants -- 47

Section		Page
121.395	Aircraft dispatcher: domestic and flag air carriers	48
121.397	Emergency and emergency evacuation duties	48

Subpart N—Crewmember and Aircraft Dispatcher Training Program

121.410	Applicability	48
121.411	Training program: general	48
121.412	Training program: approval and revision	48-1
121.413	Certification of completion of training	49
121.414	Curriculum requirements	49
121.415	Synthetic trainers	50
121.416	Crewmember emergency training	50
121.417	Ground training: pilots	51
121.418	Flight training: all pilots	51
121.419	Flight training: pilot in command and second in command	52
121.421	Flight engineer training	52
121.422	Flight navigator training	52-1
121.423	Aircraft dispatcher training: domestic and flag air carriers	52-1
121.424	Flight attendant training	52-3
121.425	Initial flight assignments on a particular type of airplane	52-3

Subpart O—Flight Crewmember Qualifications

121.431	Applicability	52-4
121.433	General	52-4
121.435	Helicopter operations: supplemental air carriers and commercial operators	52-4
121.437	Pilot qualification: certificates required	52-4
121.439	Pilot qualification: recent experience	53
121.441	Pilot checks	53
121.442	Use of flight simulator	54
121.443	Pilot in command qualification: routes and airports: domestic and flag air carriers	54
121.445	Pilot in command qualification: routes and airports: supplemental air carriers and commercial operators	55
121.447	Pilot route and airport qualifications for particular trips: domestic and flag air carriers	55
121.451	Flight navigator qualification: flag and supplemental air carriers and commercial operators	56
121.453	Flight engineer qualification	56

Subpart P—Aircraft Dispatcher Qualifications and Duty Time Limitations: Domestic and Flag Air Carriers

121.461	Applicability	56
121.463	Aircraft dispatcher qualifications	56
121.465	Duty time limitations: domestic and flag air carriers	56

Subpart Q—Flight Time Limitations: Domestic Air Carriers

121.470	Applicability	57
121.471	Flight time limitations: all flight crewmembers	57

Section		Page
121.561	Reporting potentially hazardous meteorological conditions and irregularities of ground and navigation facilities	65
121.563	Reporting mechanical irregularities	65
121.565	Engine inoperative: landing: reporting	65
121.567	Instrument approach procedures and IFR landing minimums	66
121.569	Equipment interchange: domestic and flag air carriers	66
121.571	Briefing passengers: extended overwater flights	66
121.573	Briefing passengers before takeoff: supplemental air carriers and commercial operators	67
121.575	Alcoholic beverages	67
121.579	Minimum altitudes for use of automatic pilot	67
121.581	Forward observer's seat: en route inspections: air carriers	67
121.583	Carriage of persons aboard airplane in cargo-only operations all-cargo aircraft	68
121.585	Prohibition against carriage of weapons	68
121.587	Closing and locking of flight crew compartment door	68

Subpart U—Dispatching and Flight Release Rules

121.591	Applicability	69
121.593	Dispatching authority: domestic air carriers	69
121.595	Dispatching authority: flag air carriers	69
121.597	Flight release authority: supplemental air carriers and commercial operators	69
121.599	Familiarity with weather conditions	69
121.601	Aircraft dispatcher information to pilot in command: domestic and flag air carriers	69
121.603	Facilities and services: supplemental air carriers and commercial operators	69
121.605	Airplane equipment	69
121.607	Communication and navigation facilities: domestic and flag air carriers	69
121.609	Communication and navigation facilities: supplemental air carriers and commercial operators	70
121.611	Dispatch or flight release under VFR	70
121.613	Dispatch or flight release under IFR or over the top	70
121.615	Dispatch or flight release over water: flag and supplemental air carriers and commercial operators	70
121.617	Alternate airport for departure	70
121.619	Alternate airport for destination: IFR or over-the-top: domestic air carriers	70
121.621	Alternate airport for destination: flag air carriers	71
121.623	Alternate airport for destination: IFR or over-the-top: supplemental air carriers and commercial operators	71
121.625	Alternate airport weather minimums	71
121.627	Continuing flight in unsafe conditions	71
121.629	Operation in icing conditions	72
121.631	Original dispatch or flight release, redispatch or amendment of dispatch or flight release	72
121.633	Dispatch to and from provisional airports: domestic air carriers	72

Section		Page
121.629	Operation in icing conditions	72
121.631	Original dispatch or flight release, redispatch or amendment of dispatch or flight release	72
121.633	Dispatch to and from provisional airports: domestic air carriers	72
121.635	Dispatch to and from refueling or provisional airports: flag air carriers	72
121.637	Takeoffs from unlisted and alternate airports: domestic and flag air carriers	72
121.639	Fuel supply: all operations: domestic air carriers	73
121.641	Fuel supply: nonturbine and turbo-propeller-powered airplanes: flag air carriers	73
121.643	Fuel supply: nonturbine and turbo-propeller-powered airplanes; supplemental air carriers and commercial operators	73
121.645	Fuel supply: turbine-engine-powered airplanes, other than turbo propeller: flag and supplemental air carriers and commercial operators	73
121.647	Factors for computing fuel required	74
121.649	Takeoff and landing weather minimums: VFR: domestic air carriers	74
121.651	Takeoff and landing weather minimums: IFR: domestic and flag air carriers	74
121.652	Landing weather minimums: IFR: all certificate holders	75
121.653	Takeoff and landing weather minimums: IFR: supplemental air carriers and commercial operators	75
121.655	Applicability of reported weather minimums	75
121.657	Flight altitude rules	76
121.659	Initial approach altitude: domestic and supplemental air carriers and commercial operators	76
121.661	Initial approach altitude: flag air carriers	76
121.663	Responsibility for dispatch release: domestic and flag air carriers	76–1
121.665	Load manifest	77
121.667	Flight plan: VFR and IFR: supplemental air carriers and commercial operators	77

Subpart V—Records and Reports

Section		Page
121.681	Applicability	77
121.683	Crewmember and dispatcher record	77
121.685	Aircraft record: flag and domestic air carriers	77
121.687	Dispatch release: flag and domestic air carriers	77
121.689	Flight release form: supplemental air carriers and commercial operators	77
121.691	Load manifest: domestic and flag air carriers	78
121.693	Load manifest: supplemental air carriers and commercial operators	78
121.695	Disposition of load manifest, dispatch release, and flight plans: domestic and flag air carriers	78
121.697	Disposition of load manifest, flight release, and flight plans: supplemental air carriers and commercial operators	79

Subpart C—Operating Rules—Continued

Section		Page
135.72	Second in command required in Category II operations	6
135.73	Second in command required in IFR conditions	6
135.75	Exception to second-in-command requirement: limited IFR conditions	6
135.77	Exception to second-in-command requirement: approval of use of autopilot system	6
135.79	Autopilot: minimum altitudes for use	6–1
135.81	Briefing of occupants: extended overwater operations and operations above 10,000 feet MSL	7
135.83	Requirements for use of oxygen	7
135.85	Icing conditions: operating limitations	7
135.87	Night takeoff and landing carrying passengers: lighting and wind determination requirements	7
135.89	Helicopter operations: emergency landing areas	7
135.91	VFR: minimum altitudes	8
135.93	VFR: visibility requirements	8
135.95	VFR: helicopter ground reference requirements	8
135.97	VFR: fuel supply	8
135.99	VFR over-the-top carrying passengers: operating limitations	8
135.101	IFR: operating limitations	8
135.103	IFR: takeoff limitations	9
135.105	IFR: destination airport weather minimums	9
135.107	IFR: alternate airport requirements	9
135.109	IFR: alternate airport weather minimums	9
135.111	IFR: takeoff, approach, and landing minimums	9

Subpart D—Pilot Qualifications

135.121	Pilot-in-command qualifications: night flight	10
135.123	Pilot-in-command qualifications: carrying passengers under VFR over-the-top	10
135.125	Pilot-in-command qualifications: IFR flight	10
135.127	Second-in-command qualifications	10
135.129	Pilot in command: small multiengine airplane; recent experience requirements	10
135.131	Pilot in command: instrument check requirements	10
135.133	Pilot checks: grace provisions	11
135.135	Check pilot authorization: application and issue	11

Subpart E—Aircraft and Equipment

135.141	Applicability	11
135.143	General requirements	11
135.145	Performance requirements: aircraft operated over-the-top or in IFR conditions	12
135.147	Performance requirements: land aircraft operated over water	12
135.149	Dual controls required	12
135.151	Equipment requirements: general	12
135.153	Equipment requirements: carrying passengers at night or under VFR over-the-top conditions	12–1
135.155	Equipment requirements: airplanes carrying passengers under IFR	13
135.157	Radio and navigational equipment: carrying passengers under VFR at night, over-the-top, or in a control zone	13
135.159	Radio and navigational equipment: extended overwater or IFR operations	14
135.161	Fire extinguishers: passenger-carrying aircraft	14
135.163	Emergency equipment: overwater operations	14
135.165	Oxygen equipment requirements	14

APPENDIX D

RNAV POLICY STATEMENT

BY

JOHN L. MCLUCUS, FAA ADMINISTRATOR

JANUARY 7, 1977

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

RNAV POLICY STATEMENT

Introduction

The Federal Aviation Administration (FAA) endorses the concept of area navigation (RNAV) and recognizes the benefits that RNAV offers to both the airspace user and the national airspace system (NAS). This policy statement puts forth a two-part action plan designed to facilitate the use of RNAV in the national airspace system. The mandatory carriage of RNAV avionics in order to use the air traffic control system is not envisioned in the near future.

Background

Early in 1972 a task force was formed to make an in depth study of area navigation to determine its potential value in the national airspace system. The task force was comprised of representatives of commercial and general aviation groups, and the FAA. The findings, concepts developed, and recommendations of this group were published in a report titled "FAA/Industry RNAV Task Force Report."

The task force report issued in February 1973 is a concept paper showing how RNAV could be used in the system. The RNAV task force made many assumptions, several of which required extensive R&D efforts. The task force report specified an action plan to implement a charted route and terminal system design concept which would replace the VOR route structure with a charted RNAV route system in an orderly fashion with identification of specific areas which would need detailed attention.

The user/public comments on the task force report did not reveal any significant new facts or issues that were not known and considered by the task force. However, the commentors collectively agree with the task force, concerning the need for the findings to be thoroughly examined, studied and validated, particularly from the cost benefit aspect.

In April 1974, the FAA issued its area navigation interim policy statement which stated in part that: "The agency will, therefore, proceed with the operational and the research and development efforts necessary to validate the concepts in the report and continue to plan for an orderly development and transition toward an RNAV-based system. . . . The most important of the initial R&D tasks will be a comprehensive cost/benefit analysis to determine user and system payoffs as a prerequisite to implementation of the plan."

Since then, significant research and development work has been accomplished. This work culminated in an assessment of RNAV Task Force concepts and payoffs (RD-76-196 Implementation of Area Navigation in the National Airspace System, December 1976.) It concludes that: "The results obtained from economic and operational impact analysis, and from various supporting system studies, indicate that the advantages of area navigation to both the users and the ATC system are sufficient to warrant implementation of the charted route and terminal area navigation concept, particularly when all users are RNAV equipped." This concept is based on the task force recommendations, but modifies those recommendations to insure that maximum benefits will accrue to both the ATC system and the users. Although additional research and development work is still required in some areas, implementation of the area navigation concept can proceed in parallel with these efforts.

User responses to the recommended modification of the RNAV Task Force Concepts and to the RNAV Payoff Study were favorable. There was general agreement that RNAV should not be made mandatory for participation in the ATC system at this time, but FAA should take positive steps to promote RNAV implementation in accordance with the modified concepts presented in this study.

In addition to the studies showing the efficacy of RNAV, the number of aircraft with RNAV capability is increasing. There is a growing immediate demand for routes and procedures which will allow users to obtain the advantages offered by their RNAV avionics.

Policy Statement

The FAA, under public law 85-726, has the responsibility for development and implementation of radio-navigation systems to meet the needs for safe and efficient navigation and traffic control of all civil and military aviation throughout the national aviation system. This policy statement pertains only to area navigation and is supplementary to overall FAA navigation policy.

The FAA recognizes the advantages that RNAV offers to both the ATC system user and operator, and will pursue a two-part program leading to the ultimate objective of an RNAV based airspace structure. This structure will be based on the modified RNAV task force enroute and terminal concepts. Implementation will be consistent with the rate of user implementation of RNAV avionics, but the mandatory carriage of RNAV avionics as a condition to participate in the ATC system is not envisioned in the near future.

To be responsive to current and near-term RNAV users, the FAA will determine RNAV user needs and take positive steps to facilitate RNAV use within the existing air traffic control environment. This will include:

- Eliminating existing RNAV routes which do not respond to user requirements.

- Establishing, on a case-by-case basis, RNAV routes with the accompanying RNAV transition segments, SIDs and STARs.

- Promoting the establishment of RNAV approaches at non-instrumented airports.

- Establishing a continuing program to educate pilots, air traffic controllers, flight service specialists and flight standards specialists about RNAV and its capabilities.
- Developing a national waypoint system to facilitate pilot selection of direct routes.
- Development and promulgation of RNAV avionics minimum ~~performance~~ selection standards.

Concurrently, the FAA will undertake a long-range effort to develop a master enroute and terminal RNAV route design and transition plan to bridge the gap between today's structure and the future RNAV structure. Development of the master RNAV design will require close and continuous coordination with all airspace users and will include an environmental analysis.

This policy statement is issued under the authority of Sections 307(a) and 312(a) of the Federal Aviation Act of 1958 (49 U.S.C. 1348(a) and 1353(a)) and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

John McLucas
John L. McLucas
Administrator

Issued in Washington, D.C., on JAN 7 1977

United States
Department of Energy
Washington, DC 20585

Official Business
Penalty for Private Use, $300

Postage and Fees Paid
U.S. Department of Energy
DOE-350

U.S. MAIL

FIRST CLASS MAIL