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**FEDERAL AVIATION
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Office of Aviation Policy and Plans

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FINAL REGULATORY IMPACT ANALYSIS, FINAL REGULATORY FLEXIBILITY DETERMINATION, UNFUNDED MANDATES AND TRADE IMPACT ASSESSMENT

REDUCED VERTICAL SEPARATION MINIMUM OPERATIONS IN UNITED STATES DOMESTIC AIRSPACE (Final Rule, 14 CFR PART 91)

**OFFICE OF AVIATION POLICY, PLANS, AND MANAGEMENT ANALYSIS
OPERATIONS REGULATORY ANALYSIS BRANCH**

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Executive Summary

This Final Rule establishes airspace in which reduced vertical separation minimum (RVSM) operations may be conducted in the 48 contiguous States of the United States (U.S.), the District of Columbia, Alaska, the portion of the Gulf of Mexico where the FAA provides air traffic services, the San Juan Information Region (FIR), and the airspace between Florida and the San Juan FIR.

There are some existing regulations that are applicable to RVSM operations outside the U.S. RVSM was implemented in the North Atlantic (NAT) on March 27, 1997, Pacific (PAC) on February 24, 2000, and in the West Atlantic Route System (WATRS) on December 10, 2001.

The target date for implementation in airspace in the U.S., Gulf of Mexico, Florida-San Juan Corridor and the San Juan FIR is January 20, 2005. This rulemaking action will increase the number of available flight levels, enhance airspace capacity, and permit operators to fly more fuel and time efficient tracks and altitudes. The rule will also enhance air traffic controller flexibility by increasing the number of available flight levels, while maintaining an equivalent level of safety.

The FAA estimates that this rule will cost U.S. operators $869.2 million ($764.9 million discounted) for the fifteen-year time period 2002-2016. For the purposes of this cost analysis, the FAA has assumed that operators will choose to upgrade almost all of their aircraft to meet RVSM standards. Operators of non-RVSM aircraft will, however, retain the option of flying above or

below RVSM airspace. Benefits will begin accruing on January 20, 2005. Estimated benefits, based on fuel savings for the U.S. aircraft fleet over the years 2005 to 2016, are $5.3 billion ($3.0 billion discounted). These benefits will exceed costs by a ratio of more than 6:1 (4:1 for discounted benefits and costs) and will be realized with no reduction in safety. Qualitative benefits for air traffic providers and airspace users will also result from this rule. This rule also requires aircraft that are equipped with TCAS II and used in RVSM operations to incorporate TCAS II Version 7.0.

This document also contains a regulatory flexibility analysis, an international trade impact assessment and an unfunded mandates assessment. The regulatory flexibility analysis has found that 380 small entities would be significantly impacted by this rule due to $211.4 million in upgrade costs or $556,000.00 on average per operator. Despite these costs, the FAA prefers this rule as it provides the best balance of costs and benefits to airspace users and air traffic service providers without compromising safety.

The FAA has also examined the impact of this rule on international trade and has determined that there will be a neutral impact on trade due the rule imposes the same costs on domestic and international operators.

This rule is a significant regulatory action in that it contains a mandate that would result in over $100 million in costs on the private sector in any one year as they upgrade their aircraft to comply with this rule. However, not implementing

this rule would result in foregone fuel savings that greatly exceed the imposed cost of this rule.

I. Introduction

This document contains a final regulatory evaluation for this airspace rulemaking to reduce the vertical separation minimum from 2,000 feet to 1,000 feet for aircraft operating between FL 290 to FL 410 inclusive within airspace in the 48 contiguous States of the U.S., the District of Columbia, Alaska, the Gulf of Mexico, the Florida-San Juan corridor, and the San Juan FIR. It also contains a final regulatory flexibility analysis, which is required by law, an international trade impact statement, which is required by the Office of Management and Budget (OMB), and an unfunded mandate assessment, which is required by law.

The FAA will add a new section to Part 91, similar to existing section 91.706, to make RVSM approvals and operation applicable to all operators conducting RVSM operations within airspace in the U.S., Gulf of Mexico, the Miami-San Juan corridor, and the San Juan FIR. These RVSM requirements include: meeting the specified altimetry system error, automatic altitude keeping system, and altitude alert system standards. These requirements must also be maintained for operations in the RVSM airspace.

II. History and Discussion of the Final Rule

The appropriate amount of vertical separation above Flight Level 290 has been a matter of discussion since the mid-1950's. Originally, the vertical separation standard was 1,000 feet at all altitudes, and high altitude flight was possible for only a

small number of military aircraft. Advances in technology eventually gave large transport and small commercial or general aviation aircraft the ability to operate at higher altitudes, resulting in increased traffic along high altitude route structures. In the 1950's, a vertical separation minimum of 2,000 feet was established between aircraft operating above FL 290. As the number of aircraft capable of operating at higher altitudes increased, competition for the higher altitudes also increased. This competition for the higher altitudes, together with worldwide fuel shortages and increasing fuel prices, sparked an interest in the early 1970’s in implementing a reduced vertical separation minimum above FL 290. In 1973, the Air Transport Association (ATA) petitioned the Federal Aviation Administration (FAA) for a rule change to reduce the vertical separation minimum for aircraft operating above FL 290 to the original separation standard of 1,000 feet. The petition was denied in 1977 in part because (1) aircraft altimeters had not improved sufficiently, (2) improved maintenance and operational standards had not been developed, and (3) altitude correction equipment was not available in all aircraft. In addition, the cost of re-equipping certain aircraft was significant. Based on all of the available information, the FAA decided that granting the petition at that time would adversely affect safety.

Improvements in altimetry system performance provided renewed impetus for the FAA to reduce the vertical separation standard above FL 290. Air data computers (ADC) provided an automatic means of correcting the known static source error,

which resulted in improved aircraft altitude-measurement performance. Altimeters were improved with enhanced transducers and double aneroids for computing altitudes. In addition, the advent of transponded Mode C altitude allowed air traffic control (ATC) within secondary surveillance radar (SSR) coverage to monitor flight level.

In 1982, member States of the International Civil Aviation Organization (ICAO) Review of the General Concept of Separation Panel (RGCSP), including the United States, initiated programs to study the feasibility of safely reducing the vertical separation minimum at and above FL 290. These programs included: studies of precision radar data to analyze aircraft vertical performance, development of the performance requirements necessary for safe implementation of a 1,000-foot vertical separation minimum above FL 290, and a collision risk analysis to evaluate the safety of future operations in a reduced separation environment. RVSM is a more stringent standard than current altitude-keeping standards.

In conclusion, these improvements provided renewed impetus to investigate reducing the vertical separation standard above FL 290.

This rule adds a new section 91.180 and revises existing sections 91.159, 91.179 and part 91 Appendix G. These revisions permit the reduction in the vertical separation minimum from 2,000 feet to 1,000 feet within airspace in the U.S., Gulf of Mexico, San Juan FIR and Florida-San Juan corridor. The rule permits the aircraft of operators that meet altimetry system error requirements, automatic altitude keeping requirements, and

altitude alert system requirements to qualify for RVSM operations between FL290 and FL 410. There is some minor economic impact on operators upgrading to TCAS II Version 7.0, which will require a software change in existing required TCAS II equipment. Most aircraft involved in oceanic operations are already equipped with TCAS II Version 7.0. However, 5,700 (5,100 small commercial or general aviation aircraft and 600 large transport aircraft) in domestic operations are projected to require upgrading to TCAS II Version 7.0 at a cost of $8,000.00 per airframe, for a total estimated cost of $45.6 million.

III. Discussion of Comments Relating to Benefits and Costs

The FAA received 79 comments on the NPRM and eight comments on the SNPRM. This section presents comments relating to the benefits and costs for this rule and the FAA responses.

Comments

1. Fuel savings. Fuel savings is not an adequate justification to proceed with DRVSM implementation. One commenter stated that fuel savings is not an adequate justification for DRVSM implementation.

FAA Response

The Regulatory Impact Analysis cites both quantitative and qualitative benefits to DRVSM implementation. Fuel savings and delay savings due to enhanced access to more fuel-efficient FL's is quantified. $5.3 billion dollars in benefits are forecasted for the 15- year period January 2005 to 2016. The analysis also cites qualitative benefits to air traffic control. These benefits include increased controller flexibility, enhanced

sector throughput allowing more aircraft to operate on time and fuel efficient routes, reduced controller workload allowing them to control traffic more efficiently, enhanced flexibility to allow aircraft to cross intersecting routes, mitigation of traffic congestion at conflict points and potential for enhanced overall enroute airspace capacity in the long term.

2. Benefits not significant to small operators. One commenter stated that DRVSM benefits would not be significant to small operators

FAA Response

The FAA recognizes that the aircraft utilization rate for small operators is significantly lower than that for larger operators and therefore small operators accrue DRVSM benefits at a lower rate. The FAA believes that DRVSM provides significant enhancements to daily operations in the National Airspace System and provides benefits to the operators that conduct the significant majority, or approximately 90 percent of operations in the NAS. The FAA is considering the overall benefit to the majority of operators as well as the overall enhancement to NAS operations

Costs, including downtime issues

1. Contention that average aircraft upgrade costs are in $200-$300,000 range. A number of commenters stated that they believed the average cost to modify aircraft to comply with RVSM standards to be in the $200-300,000 range.

FAA Response

In the Regulatory Impact Analysis the FAA has provided estimates of the costs to modify individual aircraft types for RVSM compliance. The average cost of modification is not $200-300,000. The range of costs varies from less than $100 for some aircraft types up to $175,000-$235,000 for a small number of older aircraft types.

2. Operation of non-compliant aircraft below 290. Comments were made that the costs of operation below FL 290 should be considered in the Benefit/Cost analysis. Also, comments were made that raised issues related to range limitation and fuel burn costs below 290.

FAA Response:

We have examined operations below FL 290. We anticipate that approximately 10 percent of daily flights in the NAS that are currently operated above FL 290 may operate below FL 290 in the initial period of domestic RVSM implementation. We have examined the time of flight in NAS operations and the affect of operating below FL 290 on aircraft range and fuel burn and have posted the study entitled “An Examination of Range and Fuel-Burn Penalties Associated With Operating Business Jet Type Aircraft Beneath Proposed Domestic Reduced Vertical Separation Minimum (DRVSM) Airspace” in the public docket. You can find the public docket on the Internet at http://dms.dot.gov. Search for docket number 12261. For this analysis, we first examined five older small commercial or general aviation aircraft types with high modification costs under the assumption that some operators may

elect to operate these aircraft types below FL 290 rather than incur RVSM modification costs. We next examined all business jet aircraft types operated under 14 CFR part 135. We reached the following conclusions in the study:

We estimate the average annual cost of operation below FL 290 per airframe to be $1,147.

The average fuel penalty for business jet aircraft operated under part 135 is 7.15 percent

Eight percent of operations flown prior to DRVSM above FL 290 could no longer be flown without a fuel stop due to range penalties associated with operating below FL 290.

Other factors that the FAA considered were:

Average flight time at enroute cruise was 1.9 hours for aircraft used in commercial operations and 1.4 hours for aircraft used in general aviation operations

Time at enroute cruise was 2 hours or less for 82 percent of general aviation flights

3. RVSM Compliance Costs Versus Residual Airframe Value. Some commenters stated that after comparing the costs involved in modifying their aircraft for RVSM to the residual value of the aircraft, they could not justify modifying certain aircraft types.

FAA Response

Operators have two basic options. They can upgrade their aircraft to comply with RVSM standards or they can operate their aircraft below FL 290 or, if capable, above FL 410. The FAA

recognizes that in some cases operators may decide for economic reasons not to pursue RVSM compliance.

4. Significant economic and operational impact on part 135 On-demand charter industry. Some commenters stated that DRVSM would have a significant impact on part 135 On-demand charter industry.

FAA Response

As stated previously, the FAA is supporting DRVSM implementation because it provides significant benefits to NAS operations and to the operators that conduct the significant majority of flights in NAS airspace. The FAA recognizes that some operators will have to make economic decisions on whether to retain an aircraft and operate it below FL 290 or to modify it to RVSM standards so that it can operate above FL 290. Based on the FAA's analysis of operations below FL 290, it appears that operation below FL 290 is a viable option for some operators if they choose not to modify their aircraft.

5. Impact on aircraft value if RVSM upgrade not made. One commenter stated that if RVSM modifications were not made there would be a significant impact on its residual value

FAA Response

RVSM is a world-wide program. RVSM has already been implemented in the North and West Atlantic, Pacific and Western Pacific, Europe, Australia and Northern Canada. In addition, there are

implementation groups established for the Middle East and the Caribbean and South America. The FAA believes that the aviation community must recognize the global nature of the RVSM program and plan accordingly. The residual value of aircraft is not a consideration in this rulemaking.

6. Subsidize small operator costs using Airport/Airways Trust fund or have airlines subsidize small operator costs. One commenter proposed that the costs to small operators be subsidized either by the Airport/Airways Trust fund or by the airlines.

FAA Response

It is not feasible for small operator costs to be subsidized by either the airlines or by the Airport/Airways Trust fund as it is beyond the scope of this rulemaking.

7. Update Regulatory Impact Analysis. Some commenters stated that the RIA needed to be updated and the modification costs for small aircraft re-estimated including estimation of the cost when aircraft are out of service undergoing modification.

FAA Response

The RIA that is summarized in the Final Rule package and published in the DOT Docket includes updated costs and benefit estimates. The FAA has estimated the numbers of aircraft that may be affected by out of service time. The FAA has also estimated costs related to the loss of revenue when certain

aircraft are out of service undergoing RVSM modification. It should be noted that many operators have scheduled RVSM compliance work to be completed during scheduled aircraft inspections to avoid the cost of additional out of service time for RVSM modification.

8. RAA operators not considered in NPRM RIA. The Regional Airline Association stated that it did not believe that RAA operators were considered in the NPRM RIA.

FAA Response
RAA operator costs were considered in the RIA that was posted with the NPRM on the DOT Docket and are considered in the RIA posted with this Final Rule.

9. Operators cannot accurately assess monitoring costs. One commenter stated that operators were unable to accurately assess the costs related to monitoring of aircraft altitude-keeping.

FAA Response
The FAA assessed operator costs associated with monitoring in the Regulatory Impact Analysis published in conjunction with the NPRM and the final rule. In that assessment, the FAA estimated that operator costs associated with monitoring of the Domestic RVSM fleet would be approximately $4.3 million. For this assessment, the FAA projected that the GPS-based Monitoring System (GMS) would monitor a portion of the RVSM fleet and the ground based Aircraft Geometric Height Monitoring

Element (AGHME) would monitor those not monitored by the GMS. The $4.3million in monitoring costs are not significant when compared to estimated fleet upgrade costs of $735 million.

Operators have two options for obtaining information on monitoring systems and procedures. They can obtain information by accessing the FAA RVSM web site at www.faa.gov/ats/ato/rvsm1.htm and they can also obtain that information by contacting one of the Flight Standards District Offices in their area.

IV. Costs and Benefits

The analysis described in this regulatory evaluation is based on the following assumptions:

- All costs and benefits are presented in 2002 dollars.
- Projections of current air carrier and small commercial or general aviation fleets are current as of 2002.
- A discount rate of 7 percent is applied.
- Benefits of RVSM implementation will begin to accrue in January 2005.
- Aircraft operator and ATC costs started accruing in January 2002.
- The implementation plan is to implement RVSM for FL's 290-410 January 20, 2005.

Based on analysis updated and adopted by the FAA, this rule will cost U.S. operators $869.2 million over a fifteen-year time period from 2002-2016, or $764.9 million, discounted. However, operators of non-RVSM aircraft will still be able to fly above or

beneath RVSM airspace. The potential quantifiable benefits are based on fuel savings for the large transport and small commercial and general aviation aircraft fleets. The benefits will begin accruing on January 20, 2005. The fuel savings are estimated at $5.3 billion ($3.0 billion, discounted) over the years 2002-2016. This rulemaking will not adversely impact safety.

A. Costs

The cost of the following elements of RVSM implementation will be considered:

- Aircraft downtime for Part 135 operators
- Aircraft Airworthiness Approval
- TCAS II Version 7.0 software upgrade costs
- Monitoring
- ATC
- Operator Training

1. Aircraft Airworthiness Approval Costs

Under this rule, U.S. Domestic operators seeking RVSM approval are required to ensure that their aircraft meet various equipment and altimetry system requirements. These standards are contained in part 91 Appendix G. Aircraft engineering packages have been developed for most aircraft types. The estimated costs associated with these requirements are grouped by aircraft type for both large transport and small commercial or general aviation aircraft (See Table 1).

Table 1: Aircraft Engineering Costs		
Type	**Estimate**	**Source**
A300	****	Manufacturer (Visual inspection only)
A320	****	Manufacturer (Visual inspection only)
A330	****	Manufacturer (Visual inspection only)
A340	****	Manufacturer (Visual inspection only)
B701,B703	$175,000.00	Engineering design organization
B712	****	Manufacturer (Visual inspection only)
B721, B722	$130,000.00	Engineering design organization
B731	$130,000.00	Engineering design organization
B732	$130,000.00	Engineering design organization
B733-B735	$17,500.00	Operator Survey 1/01
B736-B739	****	Manufacturer (Visual inspection only)
B741, B742, B743	$58,400.00	FAA Survey 12/97 and OWG Survey 6/97
B744	$33,300.00	OWG Survey 6/97
B752, B753	$50,700.00	FAA Survey 12/97 and OWG Survey 6/97
B762, B763, B764	****	Manufacturer (Visual inspection only)
B772, B773	****	Manufacturer (Visual inspection only)
F100	$8,000.00	Operator Survey 6/01
DC8	$150,000.00	Engineering design organization
DC9	$150,000.00	Engineering design organization
DC10	$2,200.00	OWG Survey 6/97
MD11	$2,200.00	Engineering analysis, similar to DC10
MD80	$33,300.00	Engineering analysis, similar to B744
MD90	$33,300.00	Engineering analysis, similar to B744
L101	$25,000.00	Manufacturer, 1/01
ASTR	$110,000.00	Manufacturer
BE40	$25,000.00	Manufacturer
CL60 (1A)	$62,500.00	Manufacturer
CL60 (3A/3R)	$17,500.00	Manufacturer
CL60 (604)	****	Manufacturer
CRJ1	****	Manufacturer
CRJ2	****	Manufacturer
CRJ7	****	Manufacturer
C500	$101,259.00	Manufacturer, 11/02
C501	$101,259.00	Manufacturer, 11/02
C525	$58,000.00	Manufacturer, 11/02
C525A	$22,647.00	Manufacturer, 11/02
C550	$111,500.00	Manufacturer, 11/02
C551	$111,500.00	Manufacturer, 11/02
C560	$42,953.00	Manufacturer, 11/02

Table 1: Aircraft Engineering Costs		
C56X	****	Manufacturer, 11/02
C650	$74,918.00	Manufacturer, 11/02
C750	$7,680.00	Manufacturer, 11/02
E135	$17,500.00	Manufacturer
E145	$17,500.00	Manufacturer
F2TH	$15,000.00	Manufacturer
F900	$15,000.00	Manufacturer
FA50	$15,000.00	Manufacturer
FA10	$150,000.00	Engineering design organization
FA20	$15,000.00	Manufacturer
GALX	****	Manufacturer
GLEX	****	Manufacturer
GLF2	$235,000.00	Manufacturer, 11/02
GLF3 (S/N 426 and lower)	$226,200.00	Manufacturer, 11/02
GLF3 (S/N 427 and higher)	$14,000.00	Manufacturer, 11/02
GLF4	$14,000.00	Manufacturer, 11/02
GLF5	****	Manufacturer, 11/02
H25A	$150,000.00	Engineering design organization
H25B	$32,500.00	Manufacturer, 3/01
H25C	$32,500.00	Manufacturer, 3/01
L29B	$150,000.00	Engineering design organization
LJ20 Series	$149,000.00	Engineering design organization
LJ31	$46,000.00	Manufacturer, 11/02
LJ35	$145,000.00	Manufacturer, 11/02
LJ45	****	Manufacturer, 11/02
LJ55	$155,000.00	Manufacturer, 11/02
LJ60	$20,000.00	Manufacturer, 11/02
MU30	$110,000.00	Engineering design organization
PRM1	****	Manufacturer, 11/02
SBR1	$139,000.00	Engineering design organization
SBR2	$175,000.00	Engineering design organization
WW23	$140,000.00	Engineering design organization
WW24	$140,000.00	Engineering design organization

****** Costs anticipated to be less than $100 per aircraft**

These estimates represent the cost of the engineering work associated with making an aircraft RVSM compliant or the airworthiness approval cost. An additional cost consideration involves aircraft equipped with TCAS Version 6.04 upgrading to

TCAS II Version 7[1]. The FAA estimates this cost to be $8000.00 per aircraft with 5,100 small commercial or general aviation and 600 large transport aircraft needing this upgrade for a total estimated cost of $45.6 million. In order to determine the number of operators and the size of their fleets within RVSM airspace, a sample of Enhanced Traffic Management System (ETMS) data was studied. The traffic sample consisted of 7 days of data from July 2002. The ETMS data is comprised of actual aircraft traffic data that identifies operators, aircraft types, and the frequency of operations. For the U.S. large transport carriers, U.S. domestic operator and aircraft type information from ETMS data was combined with projected aircraft fleet data obtained for operators appearing in the sample. Operator fleet data was then queried against approved aircraft data from the NAT Central Monitoring Agency (CMA) and the

[1] The FAA published Airworthiness Directives in 1994 that required TCAS II units to be upgraded to Version 6.04. The FAA assumes that all aircraft equipped with TCAS II have upgraded to Version 6.04a. Although Part 91 operators are not required to be TCAS equipped, a majority of these aircraft have TCAS.

Asia/Pacific Approvals Registry and Monitoring Organization (APARMO). The results of this analysis provide the number of aircraft by type that will need to be airworthiness approved or upgraded for RVSM for each US Domestic operator (See Table 2).

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
AIR TRANSPORT INTERNATIONAL	DC86	8		8	$150,000.00	$1,200,000.00
	DC87	11		11	$150,000.00	$1,650,000.00
AIR WISCONSIN AIRLINES CORPORATION	CRJ2	9		9	$0.00	$0.00
AIRBORNE EXPRESS, INC.	B762	22	6	16	$0.00	$0.00
	DC86	34	2	32	$150,000.00	$4,800,000.00
	DC9	74		74	$150,000.00	$11,100,000.00
AIRTRAN AIRWAYS, INC.	B712	60		60	$0.00	$0.00
	DC9	31		31	$150,000.00	$4,650,000.00
ALASKA AIRLINES INC.	B732	9		9	$130,000.00	$1,170,000.00
	B734	40		40	$17,500.00	$700,000.00
	B737	18		18	$0.00	$0.00
	B739	12		12	$0.00	$0.00
	MD80	32		32	$33,300.00	$1,065,600.00
ALLEGIANT AIR, INC.	DC92	1		1	$150,000.00	$150,000.00
	MD87	2		2	$33,300.00	$66,600.00
ALOHA AIRLINES	B737	10	2	8	$0.00	$0.00
AMERICA WEST AIRLINES	A319	33		33	$0.00	$0.00
	A320	54		54	$0.00	$0.00
	B733	39		39	$17,500.00	$682,500.00
	B733	51		51	$17,500.00	$892,500.00
	B752	13		13	$50,700.00	$659,100.00
AMERICAN AIRLINES INC.	A306	34	33	1	$0.00	$0.00
	B738	118	77	41	$0.00	$0.00
	B752	151	80	71	$50,700.00	$3,599,700.00
	B762	29	21	8	$0.00	$0.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
	B763	67	49	18	$0.00	$0.00
	B772	47	40	7	$0.00	$0.00
	F100	74		74	$8,000.00	$592,000.00
	MD80	362		362	$33,300.00	$12,054,600.00
AMERICAN TRANS AIR, INC.	B738	39		39	$0.00	$0.00
	B752	16	15	1	$50,700.00	$50,700.00
	B753	12	9	3	$50,700.00	$152,100.00
	L101	18	18	0	$25,000.00	$0.00
AMERIJET INTERNATIONAL	B727	7		7	$130,000.00	$910,000.00
AMERISTAR JET CHARTER, INC.	B732	2		2	$130,000.00	$260,000.00
AMR AMERICAN EAGLE, INC.	CRJ7	25		25	$0.00	$0.00
	E135	40		40	$17,500.00	$700,000.00
	E145	195		195	$17,500.00	$3,412,500.00
	DC8	20		20	$150,000.00	$3,000,000.00
ARROW AIRWAYS, INC.	L101	4		4	$25,000.00	$100,000.00
ATLANTIC COAST AIRLINES	CRJ2	69		69	$0.00	$0.00
ATLANTIC SOUTHEAST AIRLINES, INC.	CRJ2	79		79	$0.00	$0.00
	CRJ7	30		30	$0.00	$0.00
ATLAS AIR, INC.	B742	22	21	1	$58,400.00	$58,400.00
	B744	16	11	5	$33,300.00	$166,500.00
BRITT AIRWAYS, INC.	E135	50		50	$17,500.00	$875,000.00
	E145	222		222	$17,500.00	$3,885,000.00
CAPITAL CARGO INTERNATIONAL AIRLINES	B722	16		16	$130,000.00	$2,080,000.00
CASINO EXPRESS AIRLINES	B732	3		3	$130,000.00	$390,000.00
CHALLENGE AIR CARGO INC.	DC10	3	3	0	$2,200.00	$0.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
CHAUTAUQUA AIRLINES	E145	38		38	$17,500.00	$665,000.00
COMAIR, INC.	CRJ1	110		110	$0.00	$0.00
	CRJ2	27		27	$0.00	$0.00
CONTINENTAL AIR LINES INC.	B733	65		65	$17,500.00	$1,137,500.00
	B735	66	2	64	$17,500.00	$1,120,000.00
	B737	51	36	15	$0.00	$0.00
	B738	115	77	38	$0.00	$0.00
	B739	15	12	3	$0.00	$0.00
	B752	41	41	0	$50,700.00	$0.00
	B753	15	4	11	$50,700.00	$557,700.00
	B762	10	10	0	$0.00	$0.00
	B764	16	16	0	$0.00	$0.00
	B772	18	18	0	$0.00	$0.00
	MD81	3		3	$33,300.00	$99,900.00
	MD82	50		50	$33,300.00	$1,665,000.00
	MD83	4		4	$33,300.00	$133,200.00
CUSTOM AIR TRANSPORT, INC.	B721	1		1	$130,000.00	$130,000.00
	B722	6		6	$130,000.00	$780,000.00
DELTA AIR LINES, INC.	B722	32		32	$130,000.00	$4,160,000.00
	B733	26		26	$17,500.00	$455,000.00
	B738	132	69	63	$0.00	$0.00
	B752	121	25	96	$50,700.00	$4,867,200.00
	B762	15		15	$0.00	$0.00
	B763	87	86	1	$0.00	$0.00
	B764	21	18	3	$0.00	$0.00
	B772	13	7	6	$0.00	$0.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
	MD11	15	15	0	$2,200.00	$0.00
	MD88	120		120	$33,300.00	$3,996,000.00
	MD90	16		16	$33,300.00	$532,800.00
DHL AIRWAYS, INC.	A30B	6		6	$0.00	$0.00
	B721	10		10	$130,000.00	$1,300,000.00
	B722	19		19	$130,000.00	$2,470,000.00
	DC87	7	7	0	$150,000.00	$0.00
EXPRESS AIRLINES I, INC.	CRJ2	30		30	$0.00	$0.00
EXPRESS NET AIRLINES	A30B	9	1	8	$0.00	$0.00
	B721	2		2	$130,000.00	$260,000.00
EXPRESS ONE INTERNATIONAL, INC.	B722	19		19	$130,000.00	$2,470,000.00
FALCON AIR EXPRESS	B722	7		7	$130,000.00	$910,000.00
FEDERAL EXPRESS CORPORATION	A306	43		43	$0.00	$0.00
	A310	50	18	32	$0.00	$0.00
	B721	50		50	$130,000.00	$6,500,000.00
	B722	94		94	$130,000.00	$12,220,000.00
	DC10	119	19	100	$2,200.00	$220,000.00
	MD11	42	41	1	$2,200.00	$2,200.00
FINE AIRLINES, INC.	DC86	11		11	$150,000.00	$1,650,000.00
	L101	4		4	$25,000.00	$100,000.00
FLORIDA WEST AIRLINES	B763	1		1	$0.00	$0.00
FRONTIER AIRLINES, INC.	A319	25		25	$0.00	$0.00
	B733	17		17	$17,500.00	$297,500.00
GEMINI AIR CARGO, LLC	DC10	12	12	0	$2,200.00	$0.00
	MD11	4	4	0	$2,200.00	$0.00
GRAND HOLDINGS, INC. CHAMPION AIR	B722	13		13	$130,000.00	$1,690,000.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
HAWAIIAN AIRLINES	B763	16	1	15	$0.00	$0.00
	DC10	10	10	0	$2,200.00	$0.00
HORIZON AIRLINES, INC.	CRJ7	30		30	$0.00	$0.00
	F28	15		15	$8,000.00	$120,000.00
JETBLUE AIRWAYS CORPORATION	A320	84	26	58	$0.00	$0.00
KALITTA AIR, LLC	B741	2	2	0	$58,400.00	$0.00
	B742	4	4	0	$58,400.00	$0.00
KITTY HAWK AIRCARGO, INC.	B722	38		38	$130,000.00	$4,940,000.00
MESA AVIATION SERVICES, INC.	CRJ2	32		32	$0.00	$0.00
	E145	36		36	$17,500.00	$630,000.00
MIAMI AIR INTERNATIONAL, INC.	B722	5		5	$130,000.00	$650,000.00
	B738	2	2	0	$0.00	$0.00
MID-WEST EXPRESS	DC91	8		8	$150,000.00	$1,200,000.00
	DC93	16		16	$150,000.00	$2,400,000.00
	MD81	8		8	$33,300.00	$266,400.00
	MD82	3		3	$33,300.00	$99,900.00
	MD88	2		2	$33,300.00	$66,600.00
NATIONAL AIRLINES, INC.	B752	19		19	$50,700.00	$963,300.00
NORTH AMERICAN AIRLINES, INC.	B738	1	1	0	$0.00	$0.00
	B752	4	4	0	$50,700.00	$0.00
NORTHWEST ORIENT AIRLINES INC.	A319	78		78	$0.00	$0.00
	A320	84	9	75	$0.00	$0.00
	B722	34		34	$130,000.00	$4,420,000.00
	B742	33	33	0	$58,400.00	$0.00
	B744	16	16	0	$33,300.00	$0.00
	B752	56	9	47	$50,700.00	$2,382,900.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
	B753	16	2	14	$50,700.00	$709,800.00
	DC10	36	28	8	$2,200.00	$17,600.00
	DC91	9		9	$150,000.00	$1,350,000.00
	DC93	114		114	$150,000.00	$17,100,000.00
	DC94	12		12	$150,000.00	$1,800,000.00
	DC95	35		35	$150,000.00	$5,250,000.00
OMNI AIR EXPRESS, INC.	DC10	5	4	1	$2,200.00	$2,200.00
PAN AMERICAN AIRWAYS CORPORATION	B722	24		24	$130,000.00	$3,120,000.00
PLANET AIRWAYS	B721	1		1	$130,000.00	$130,000.00
	B722	5		5	$130,000.00	$650,000.00
POLAR AIR CARGO, INC.	B741	8	3	5	$58,400.00	$292,000.00
	B742	6	6	0	$58,400.00	$0.00
	B743	3	3	0	$58,400.00	$0.00
	B744	5	5	0	$33,300.00	$0.00
ROSS AVIATION, INC.	DC91	2		2	$150,000.00	$300,000.00
RYAN AVIATION CORPORATION	A320	1		1	$0.00	$0.00
	B727	15		15	$130,000.00	$1,950,000.00
	B734	1		1	$17,500.00	$17,500.00
	DC10	2	2	0	$2,200.00	$0.00
SIERRA PACIFIC AIRLINES	B732	2		2	$130,000.00	$260,000.00
SKY WEST AVIATION, INC.	CRJ2	55		55	$0.00	$0.00
SOUTHERN AIR, INC.	B742	4	4	0	$58,400.00	$0.00
SOUTHWEST AIRLINES CO.	B732	31		31	$130,000.00	$4,030,000.00
	B733	194		194	$17,500.00	$3,395,000.00
	B735	25		25	$17,500.00	$437,500.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
	B737	238		238	$0.00	$0.00
SPIRIT AIRLINES, INC.	DC9	6		6	$150,000.00	$900,000.00
	MD81	6		6	$33,300.00	$199,800.00
	MD82	15		15	$33,300.00	$499,500.00
	MD83	3		3	$33,300.00	$99,900.00
SUN COUNTRY AIRLINES, INC.	B722	12		12	$130,000.00	$1,560,000.00
	B738	3		3	$0.00	$0.00
SUN JET INTERNATIONAL, INC.	DC93	8		8	$150,000.00	$1,200,000.00
	MD82	2		2	$33,300.00	$66,600.00
	MD88	2		2	$33,300.00	$66,600.00
TRADEWINDS INTERNATIONAL	A300	9		9	$0.00	$0.00
	L101	1	1	0	$25,000.00	$0.00
TRANS STATES AIRLINES, INC.	E145	12		12	$17,500.00	$210,000.00
TRANSMERIDIAN AIRLINES	B722	5		5	$130,000.00	$650,000.00
UNITED AIR LINES INC.	A319	78	2	76	$0.00	$0.00
	A320	117	18	99	$0.00	$0.00
	B733	101		101	$17,500.00	$1,767,500.00
	B735	57		57	$17,500.00	$997,500.00
	B744	44	43	1	$33,300.00	$33,300.00
	B752	97	16	81	$50,700.00	$4,106,700.00
	B762	18	8	10	$0.00	$0.00
	B763	37	33	4	$0.00	$0.00
	B772	61	44	17	$0.00	$0.00
UNITED PARCEL SERVICE COMPANY	A306	90	23	67	$0.00	$0.00
	B721	51	9	42	$130,000.00	$5,460,000.00

Table 2. Large Transport Aircraft Upgrade Costs						
Operator	**Aircraft Type**	**Fleet**	**Approved**	**To Upgrade**	**$ Per A/C**	**Total Cost**
	B722	8		8	$130,000.00	$1,040,000.00
	B741	10	10	0	$58,400.00	$0.00
	B742	8	8	0	$58,400.00	$0.00
	B752	75	12	63	$50,700.00	$3,194,100.00
	B763	32	22	10	$0.00	$0.00
	DC87	49		49	$150,000.00	$7,350,000.00
	MD11	13	5	8	$2,200.00	$17,600.00
US AIRWAYS	A319	69		69	$0.00	$0.00
	A320	45	16	29	$0.00	$0.00
	A321	41		41	$0.00	$0.00
	A333	10	9	1	$0.00	$0.00
	B733	85		85	$17,500.00	$1,487,500.00
	B734	54		54	$17,500.00	$945,000.00
	B752	34	12	22	$50,700.00	$1,115,400.00
	B762	11	11	0	$0.00	$0.00
USA JET AIRLINES, INC.	DC91	8		8	$150,000.00	$1,200,000.00
	DC93	4		4	$150,000.00	$600,000.00
VANGUARD AIRLINES, INC.	B732	4		4	$130,000.00	$520,000.00
	MD80	8		8	$33,300.00	$266,400.00
WORLD AIRWAYS INC.	DC10	7	4	3	$2,200.00	$6,600.00
	MD11	8	8	0	$2,200.00	$0.00
		7,079	**1,413**	**5,666**		**$205,972,500.00**

As previously mentioned, many small commercial or general aviation operators have been approved for RVSM operations with approximately 2,300 small commercial or general aviation aircraft being airworthiness approved for RVSM (See Table 3).

Table 3. Small Commercial or General Aviation Aircraft Engineering Costs

Type	Population	Approved	To Upgrade	Cost per A/C	Total
ASTR	109	34	75	$110,000.00	$8,250,000.00
BE40	350	13	337	$25,000.00	$8,425,000.00
C500	218		218	$101,259.00	$22,074,462.00
C501	263	1	262	$101,259.00	$26,529,858.00
C525	352	32	320	$58,000.00	$18,560,000.00
C550	599	29	570	$111,500.00	$63,555,000.00
C551	54	1	53	$111,500.00	$5,909,500.00
C560	530	33	497	$42,953.00	$21,347,641.00
C56X	167	76	91	****	****
C650	290	35	255	$74,918.00	$19,104,090.00
C750	184	153	31	$7,680.00	$238,080.00
CL60	450	338	112	$25,000.00	$2,800,000.00
F2TH	135	110	25	$15,000.00	$375,000.00
F900	179	167	12	$15,000.00	$180,000.00
FA10	167	3	164	$150,000.00	$24,600,000.00
FA20	110	28	82	$15,000.00	$1,230,000.00
FA50	225	195	30	$15,000.00	$450,000.00
GALX	65	26	39	****	****
GLEX	80	45	35	****	****
GLF2	137	50	87	$235,000.00	$20,445,000.00
GLF3*	38	33	5	$226,200.00	$1,131,000.00
GLF3**	83	77	6	$14,000.00	$84,000.00
GLF4	424	373	51	$14,000.00	$714,000.00
GLF5	201	110	91	****	****
H25A	153		153	$150,000.00	$22,950,000.00
H25B	594	206	388	$32,500.00	$12,610,000.00
H25C	27	13	14	$32,500.00	$455,000.00
L29B	88		88	$150,000.00	$13,200,000.00
LJ23	48		48	$149,000.00	$7,152,000.00
LJ24	181		181	$149,000.00	$26,969,000.00

Table 3. Small Commercial or General Aviation Aircraft Engineering Costs					
Type	**Population**	**Approved**	**To Upgrade**	**Cost per A/C**	**Total**
LJ25	257		257	$149,000.00	$38,293,000.00
LJ31	190	6	184	$46,000.00	$8,464,000.00
LJ35	476	2	474	$145,000.00	$68,730,000.00
LJ36	39		39	$145,000.00	$5,655,000.00
LJ45	157	39	118	****	****
LJ55	113	7	106	$155,000.00	$16,430,000.00
LJ60	193	83	110	$20,000.00	$2,200,000.00
MU30	81		81	$110,000.00	$8,910,000.00
PRM1	58		58	****	****
SBR1	95	8	87	$139,000.00	$12,093,000.00
SBR2	37		37	$175,000.00	$6,475,000.00
WW23	17		17	$140,000.00	$2,380,000.00
WW24	219	1	218	$140,000.00	$30,520,000.00
	8,433	**2,327**	**6,106**		**$529,488,631.00**

* SERIAL # 427 AND HIGHER
** SERIAL #426 AND LOWER
**** Costs Anticipated To Be Less Than $100 Per Aircraft

The FAA believes that small commercial or general aviation aircraft operators started seeking approval for RVSM operations in 2002 in order to have the flexibility to operate in any airspace, including airspace where RVSM will be applied. In order to account for those aircraft seeking approval for RVSM operations, the FAA assumed that operators having RVSM-capable aircraft would upgrade to enjoy the benefits of RVSM.

2. Maintenance Costs

Aircraft altimetry systems, auto-pilots and altitude alerters are already maintained under existing maintenance programs. RVSM programs do not impose significant additional maintenance tasks for these systems for the fleet of aircraft operating above

FL 290. For the purposes of this analysis, maintenance and maintenance training costs were not considered significant.

3. Pilot Training Costs

Operational program requirements include flight crew training to ensure familiarity with RVSM operations. Most operators provide RVSM information to pilots by distributing a pilot bulletin containing policies/procedures unique to RVSM operations. The cost of compliance with the bulletin is estimated to be $500.00 for each operator or $3.1 million for 70 large transport plus 6,106 small commercial or general aviation operators.

4. Monitoring Costs

Monitoring is a quality control process that enables authorities to assess the actual in-service altitude-keeping performance of individual airframes, individual aircraft groups and the aircraft population as a whole. Its major objectives are to ensure that RVSM standards and practices are applied in a uniform manner and to identify and resolve potential adverse trends in RVSM operations. A central monitoring agency (CMA) will be required to oversee the ground-based monitoring units and global positioning system (GPS)-based monitoring system (GMS) and determine the overall height-keeping performance of aircraft operating in U.S. Domestic Airspace. The North American Approvals and Registry Monitoring Organization (NAARMO) managed by FAA ACB-310 will serve as the U.S. Domestic RVSM CMA. The NAARMO will be responsible for coordinating with local FSDO

offices and ICAO member states and tracking the overall performance of monitoring.

The FAA will deploy three to five ground-based AGHME units underlying the most frequently over flown areas in U.S. Domestic Airspace. The ground-based units will provide operators a cost-free method to meet their monitoring goals. An alternative monitoring choice will be the FAA-developed GMS that has been provided to operators at a nominal cost since 1996. The costs associated with the GMS cover the logistics of positioning monitoring technicians to locations requested by the operators and data collection and processing charges.

The GMS consists of a portable measurement device and a data collection and processing system. The portable measurement device or GPS-based Monitoring Unit (GMU) includes a GPS receiver, a small computer, and power supply contained in a small case, plus two antennas that are temporarily affixed to the inside of the windows of the aircraft to be measured. The GMU records GPS pseudoranges throughout the flight of the aircraft. After the flight, the recorded data is processed and differentially corrected using data recorded by ground reference stations. This information is used to accurately determine the geometric height of the aircraft and is compared to the nearest flight level as determined from meteorological data. Mode C height for the aircraft is obtained separately from radar recordings. The information is used to determine total vertical error, altimetry system error, and the assigned altitude deviation.

The capital investment to develop the GMS was made during the implementation of NAT RVSM. To meet the monitoring goals for the NAT RVSM implementation, GMU's were built and the infrastructure necessary to collect the data, to process the data, and to determine height-keeping performance was created. This infrastructure is managed by the FAA William J. Hughes Technical Center and consists of the resources required to operate the GMS. The GMS staff performs the following tasks:

- Schedules GMU usage
- Collects GPS data onboard or trains the operator to collect data
- Collects Mode C and meteorological data
- Processes the data
- Determines height-keeping errors
- Reports results

Since the primary goals of the NAT, PAC and WATRS monitoring programs have been met, it is expected that the RVSM monitoring effort will take advantage of available GMS assets. Sufficient GMU's exist to complete the remaining NAT, PAC, and WATRS monitoring and to meet the monitoring goals of the domestic RVSM monitoring program. Enhanced GMU's are being built to replace GMU's as they reach the end of their service life.

As monitoring data is accumulated and acceptable in-service altitude-keeping performance is demonstrated, the FAA will continue to assess monitoring program goals. For the purpose of this analysis, however, it is assumed that the monitoring goals

for individual operators used in oceanic RVSM programs will also be applied in domestic airspace.

The FAA projects that 20% (1,413) of the 7,064 aircraft to be monitored will choose to utilize the GMS. Monitoring costs for operators using the GMS are estimated to be $3,000.00 per aircraft. The actual monitoring cost to an operator could be substantially lower as it is dependent on factors such as the use of a monitoring contractor or service center and any travel expenses associated with positioning a GMS technician at the operator's desired location. The forecasted monitoring rate for years 2002-2003 is 24 aircraft per month with a monthly cost of $72,000.00. The monthly monitoring costs for 2004 will increase to $213,000.00 as on average 71 aircraft will be monitored monthly. The RVSM monitoring goals assumed for this analysis can be summarized as follows[2]:

- For operators with prior RVSM experience: 2 aircraft of each type are to be monitored.
- For operators with no prior RVSM experience: 3 aircraft of each type are to be monitored.
- For aircraft types with insufficient in-service data due to limited or no experience with the approval process, 60% of the aircraft are to be monitored.

Applying these monitoring goals to U.S. Domestic large transport aircraft fleets determined from traffic analysis yields

[2] As significant performance data is obtained, the FAA will update the minimum monitoring requirements. Experience has shown that data will normally justify reducing the requirements.

the estimates contained in Table 4. The small commercial or general aviation estimate in Table 4 is the number of aircraft estimated to be upgraded for RVSM operations from Table 3.

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
AIR TRANSPORT INTERNATIONAL	DC86	8		3
	DC87	11		3
AIR WISCONSIN AIRLINES CORPORATION	CRJ2	9		5
AIRBORNE EXPRESS, INC.	B762	22	6	0
	DC86	34	2	0
	DC9	74		2
AIRTRAN AIRWAYS, INC.	B712	60		3
	DC9	31		3
ALASKA AIRLINES INC.	B732	9		3
	B734	40		3
	B737	18		3
	B739	12		3
	MD80	32		3
ALLEGIANT AIR, INC.	DC92	1		3
	MD87	2		3
ALOHA AIRLINES	B737	10	2	0
AMERICA WEST AIRLINES	A319	33		3
	A320	54		3
	B733	39		3
	B733	51		3
	B752	13		3
AMERICAN AIRLINES INC.	A306	34	33	0
	B738	118	77	0
	B752	151	80	0
	B762	29	21	0
	B763	67	49	0
	B772	47	40	0
	F100	74		44
	MD80	362		2
AMERICAN TRANS AIR, INC.	B738	39		2
	B752	16	15	0
	B753	12	9	0
	L101	18	18	0
AMERIJET INTERNATIONAL	B727	7		3

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
AMERISTAR JET CHARTER, INC.	B732	2		2
AMR AMERICAN EAGLE, INC.	CRJ7	25		15
	E135	40		24
	E145	195		117
ARROW AIRWAYS	DC8	20		3
	L101	4		3
ATLANTIC COAST AIRLINES	CRJ2	69		41
ATLANTIC SOUTHEAST AIRLINES, INC.	CRJ2	79		47
	CRJ7	30		18
ATLAS AIR, INC.	B742	22	21	0
	B744	16	11	0
BRITT AIRWAYS, INC.	E135	50		30
	E145	222		133
CAPITAL CARGO INTERNATIONAL AIRLINES	B722	16		3
CASINO EXPRESS AIRLINES	B732	3		3
CHALLENGE AIR CARGO INC.	DC10	3	3	0
CHAUTAUQUA AIRLINES	E145	38		23
COMAIR, INC.	CRJ1	110		66
	CRJ2	27		16
CONTINENTAL AIR LINES INC.	B733	65		2
	B735	66	2	0
	B737	51	36	0
	B738	115	77	0
	B739	15	12	0
	B752	41	41	0
	B753	15	4	0
	B762	10	10	0
	B764	16	16	0
	B772	18	18	0
	MD81	3		2
	MD82	50		2

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
	MD83	4		2
CUSTOM AIR TRANSPORT, INC.	B721	1		1
	B722	6		3
DELTA AIR LINES, INC.	B722	32		2
	B733	26		2
	B738	132	69	0
	B752	121	25	0
	B762	15		2
	B763	87	86	0
	B764	21	18	0
	B772	13	7	0
	MD11	15	15	0
	MD88	120		2
	MD90	16		2
DHL AIRWAYS, INC.	A30B	6		2
	B721	10		2
	B722	19		2
	DC87	7	7	0
EXPRESS AIRLINES I, INC.	CRJ2	30		18
EXPRESS NET AIRLINES	A30B	9	1	1
	B721	2		2
EXPRESS ONE INTERNATIONAL, INC.	B722	19		2
FALCON AIR EXPRESS	B722	7		2
FEDERAL EXPRESS CORPORATION	A306	43		2
	A310	50	18	0
	B721	50		2
	B722	94		2
	DC10	119	19	0
	MD11	42	41	0
FINE AIRLINES, INC.	DC86	11		3
	L101	4		3
FLORIDA WEST AIRLINES	B763	1		1
FRONTIER AIRLINES, INC.	A319	25		3
	B733	17		3

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
GEMINI AIR CARGO, LLC	DC10	12	12	0
	MD11	4	4	0
GRAND HOLDINGS, INC. CHAMPION AIR	B722	13		3
HAWAIIAN AIRLINES	B763	16	1	1
	DC10	10	10	0
HORIZON AIRLINES, INC.	CRJ7	30		18
	F28	15		9
JETBLUE AIRWAYS CORPORATION	A320	84	26	0
KALITTA AIR, LLC	B741	2	2	0
	B742	4	4	0
KITTY HAWK AIRCARGO, INC.	B722	38		3
MESA AVIATION SERVICES, INC.	CRJ2	32		19
	E145	36		22
MIAMI AIR INTERNATIONAL, INC.	B722	5		2
	B738	2	2	0
MID-WEST EXPRESS	DC91	8		3
	DC93	16		3
	MD81	8		3
	MD82	3		3
	MD88	2		3
NATIONAL AIRLINES, INC.	B752	19		3
NORTH AMERICAN AIRLINES, INC.	B738	1	1	0
	B752	4	4	0
NORTHWEST ORIENT AIRLINES INC.	A319	78		2
	A320	84	9	0
	B722	34		2
	B742	33	33	0
	B744	16	16	0
	B752	56	9	0
	B753	16	2	0
	DC10	36	28	0
	DC91	9		2

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
	DC93	114		2
	DC94	12		2
	DC95	35		2
OMNI AIR EXPRESS, INC.	DC10	5	4	0
PAN AMERICAN AIRWAYS CORPORATION	B722	24		3
PLANET AIRWAYS	B721	1		1
	B722	5		3
POLAR AIR CARGO, INC.	B741	8	3	0
	B742	6	6	0
	B743	3	3	0
	B744	5	5	0
ROSS AVIATION, INC.	DC91	2		2
RYAN AVIATION CORPORATION	A320	1		1
	B727	15		2
	B734	1		1
	DC10	2	2	0
SIERRA PACIFIC AIRLINES	B732	2		2
SKY WEST AVIATION, INC.	CRJ2	55		33
SOUTHERN AIR, INC.	B742	4	4	0
SOUTHWEST AIRLINES CO.	B732	31		3
	B733	194		3
	B735	25		3
	B737	238		3
SPIRIT AIRLINES, INC.	DC9	6		3
	MD81	6		3
	MD82	15		3
	MD83	3		3
SUN COUNTRY AIRLINES, INC.	B722	12		3
	B738	3		3
SUN JET INTERNATIONAL, INC.	DC93	8		3
	MD82	2		3
	MD88	2		3

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
TRADEWINDS INTERNATIONAL	A300	9		2
	L101	1	1	
TRANS STATES AIRLINES, INC.	E145	12		7
TRANSMERIDIAN AIRLINES	B722	5		3
UNITED AIR LINES INC.	A319	78	2	0
	A320	117	18	0
	B733	101		2
	B735	57		2
	B744	44	43	0
	B752	97	16	0
	B762	18	8	0
	B763	37	33	0
	B772	61	44	0
UNITED PARCEL SERVICE COMPANY	A306	90	23	0
	B721	51	9	0
	B722	8		2
	B741	10	10	0
	B742	8	8	0
	B752	75	12	0
	B763	32	22	0
	DC87	49		2
	MD11	13	5	0
US AIRWAYS	A319	69		2
	A320	45	16	0
	A321	41		2
	A333	10	9	0
	B733	85		2
	B734	54		2
	B752	34	12	0
	B762	11	11	0
USA JET AIRLINES, INC.	DC91	8		3
	DC93	4		3
VANGUARD AIRLINES, INC.	B732	4		3
	MD80	8		3
WORLD AIRWAYS INC.	DC10	7	4	0
	MD11	8	8	0

Table 4. RVSM Monitoring Estimate				
Operator	**Aircraft Type**	**Fleet**	**Approved**	**Monitoring Requirements**
LARGE TRANSPORT OPERATOR TOTAL		**7,079**	**1,413**	**958**
SMALL COMMERCIAL OR GENERAL AVIATION TOTAL				**6,106**
AIRCRAFT TO MONITOR				**7,064**
AIRCRAFT TO MONITOR VIA AGHME				**5,651**
AIRCRAFT TO MONITOR VIA GMS				**1,413**
GMS MONITORING COST TO OPERATORS				**$ 4,239,000.00**
**The FAA estimates that operators of 20% of the aircraft to be monitored will choose to utilize the GMS at an estimated charge of $3,000.00 per airframe. The cost to monitor the projected 1,413 airframes is $4,239,000.00.*				

The cost to complete the monitoring goals for U.S. domestic operators electing to utilize the GMS will be $4.2 million in 2002 dollars. The total monitoring and training costs between 2002 and 2004 will be $7.3 million ($6.2 million, discounted).

5. Estimated Costs for Operators Flying Beneath RVSM Stratum

The FAA projects that the aircraft conducting approximately 90% of NAS operations will be RVSM approved by January 2005. The other aircraft, which generate the 10% of operations, would not be approved for RVSM operations but could operate beneath the RVSM stratum due to non-participation in RVSM or planning to upgrade after the implementation date.

Modeling conducted by the FAA ACB-330 has shown that the domestic RVSM aircraft population incurs on average a 6% fuel penalty when operating beneath the RVSM stratum. When using this estimate with the annual forecasted fuel burn for all operations, the FAA estimates that the 10% of NAS operations conducted beneath the RVSM stratum will realize $103.7 million in total fuel penalties based on $18.2 billion in annual fuel consumption for all operations.

6. Downtime Costs For Part 135 Operators

The FAA recognizes that some Part 135 operators will experience lost revenue from downtime costs associated with upgrading their aircraft for RVSM operations. Part 135 operators typically have smaller fleets than scheduled airlines with less flexibility to rotate their aircraft through RVSM upgrades without short-term disruption to their charter service.

This downtime analysis presents the potential lost revenue to Part 135 operators with turbojet aircraft among their fleets. Of the 2,756 operators holding certification to operate under 14 CFR Part 135, approximately 380 of these operators utilize 2,780 turbojet aircraft. As of December 2002, 422 of these airframes possess RVSM approval with the remaining 2,358 non-approved. An analysis of these operators was conducted to quantify the potential costs associated with removing the 2,358 aircraft from service to upgrade for RVSM (see Table 5). An ETMS sample was analyzed to determine an average annual flying time of 280 hours for the aircraft types represented in the 2,358 airframes. Further analysis was conducted using estimated hourly charter

rates charged by operators for the various aircraft types. Using this information in conjunction with an estimated downtime estimate of two weeks for upgrading for RVSM, weighted averages were calculated for the values: hourly charter rate ($2,600.51), downtime (12.06 hours), and downtime cost per Part 135 aircraft ($31,400.29). The total downtime cost estimate for the 2,358 Part 135 airframes to upgrade for RVSM is $74.1 million.

Type	Population	Hourly Charter Rate	On FAR 135	Approved on FAR 135	Cost To Upgrade	To Approve on FAR 135	Total Upgrade Costs	Estimated Revenue by Type	Estimated Downtime Hours for 135 by Type to be Approved	Total Lost Revenue by Type	AvgOfTotal Duration (min)	Ops During 22-28 July 2002	Approved	Avg. Yearly Hours Flown	Avg. Weekly Hours Flown
ASTR	109	3,000	5	5	$110,000.00	0	$0.00	$85,400,900.00	0.00	-	91.75	358	34	261.16	5.02
BE40	350	2,000	105	3	$25,000.00	102	$2,550,000.00	$281,839,731.96	1579.54	3,159,083	99.51	1634	13	402.63	7.74
C500	218	1,500	46		$101,259.00	46	$4,657,914.00	$33,520,500.00	181.36	272,044	114.60	225		102.51	1.97
C501	263	1,500	28		$101,259.00	28	$2,835,252.00	$35,583,326.32	97.14	145,705	100.63	272	1	90.20	1.73
C525	352	1,700	52	1	$58,000.00	51	$2,958,000.00	$125,346,237.19	410.88	698,498	98.93	860	32	209.47	4.03
C550	599	1,800	191		$111,500.00	191	$21,296,500.00	$282,093,268.71	1922.00	3,459,600	106.81	1693	29	261.63	5.03
C551	54	1,800	3		$111,500.00	3	$334,500.00	$8,444,800.00	10.02	18,044	93.33	58	1	86.88	1.67
C560	530	2,000	157	1	$42,953.00	156	$6,700,668.00	$370,872,911.29	2099.28	4,198,561	99.01	2161	33	349.88	6.73
C56X	167	2,000	52	22	$0.00	30	$0.00	$134,216,694.44	463.67	927,338	92.29	839	76	401.85	7.73
C650	290	2,900	82		$74,918.00	82	$6,143,276.00	$247,429,640.22	927.89	2,690,879	95.21	1034	35	294.21	5.66
C750	184	3,700	85	53	$7,680.00	32	$245,760.00	$215,155,627.07	388.96	1,439,168	107.70	623	153	316.03	6.08
CL60	450	4,000	125	72	$25,000.00	53	$1,325,000.00	$673,339,642.86	762.54	3,050,171	120.27	1615	338	374.08	7.19
F2TH	135	4,000	34	16	$15,000.00	18	$270,000.00	$180,662,687.72	231.62	926,475	115.55	451	110	334.56	6.43
F900	179	5,500	30	22	$15,000.00	8	$120,000.00	$339,300,058.76	106.04	583,240	145.86	488	167	344.64	6.63
FA10	167	2,000	34		$150,000.00	34	$5,100,000.00	$56,592,064.29	221.57	443,144	93.02	351	3	169.44	3.26
FA20	110	2,700	102	3	$15,000.00	99	$1,485,000.00	$162,791,494.41	2087.07	5,635,090	102.01	682	28	548.12	10.54
FA50	225	3,700	48	18	$15,000.00	30	$450,000.00	$322,860,347.33	447.48	1,655,694	128.26	785	195	387.82	7.46
GALX	65	3,500	50	8	$0.00	42	$0.00	$39,377,520.00	279.60	978,613	120.20	108	26	173.09	3.33
GLEX	80	7,000	4	3	$0.00	1	$0.00	$48,761,440.00	3.35	23,443	118.20	68	45	87.07	1.67
GLF2	137	4,000	102	9	$235,000.00	93	$21,855,000.00	$154,661,684.21	1009.51	4,038,051	118.03	378	50	282.23	5.43
GLF3	83	5,000	69	30	$226,200.00	39	$8,821,800.00	$212,565,476.19	768.31	3,841,545	146.43	335	110	512.21	9.85
GLF4	424	6,000	106	78	$14,000.00	28	$392,000.00	$611,401,503.03	258.82	1,552,907	136.24	863	373	240.33	4.62
GLF5	201	7,000	30	19	$0.00	11	$0.00	$167,076,000.00	50.24	351,672	153.00	180	110	118.75	2.28
H25A	153	2,700	27		$15,000.00	27	$405,000.00	$73,051,646.09	183.64	495,826	126.39	247		176.84	3.40
H25B	594	3,000	234	43	$32,500.00	191	$6,207,500.00	$713,883,164.58	2942.93	8,828,780	121.60	2258	206	400.61	7.70
H25C	27	3,300	29	2	$32,500.00	27	$877,500.00	$105,054,592.50	1224.41	4,040,561	118.88	309	13	1179.06	22.67
LJ23	48	1,500	9		$149,000.00	9	$1,341,000.00	$908,142.86	4.37	6,549	116.43	6		12.61	0.24
LJ24	181	1,500	78		$149,000.00	78	$11,622,000.00	$31,037,903.45	342.96	514,440	84.97	281		114.32	2.20
LJ25	257	1,500	169		$149,000.00	169	$25,181,000.00	$66,826,650.00	1126.78	1,690,168	84.83	606		173.35	3.33
LJ31	190	1,750	46		$46,000.00	46	$2,116,000.00	$73,933,189.47	393.40	688,447	77.13	632	6	222.36	4.28
LJ35	476	2,000	302		$145,000.00	302	$43,790,000.00	$379,028,073.50	4624.53	9,249,069	94.17	2322	2	398.14	7.66
LJ36	39	2,000	23		$145,000.00	23	$3,335,000.00	$11,058,666.67	125.42	250,838	145.00	44		141.78	2.73
LJ45	157	2,400	14		$0.00	14	$0.00	$138,355,410.73	197.72	474,516	87.29	762	39	367.19	7.06
LJ55	113	2,700	71	2	$155,000.00	69	$10,695,000.00	$97,298,431.58	846.33	2,285,089	104.74	397	7	318.91	6.13
LJ60	193	3,000	60	12	$20,000.00	48	$960,000.00	$249,654,093.51	796.03	2,388,082	114.04	842	83	431.18	8.29
MU30	81	1,800	30		$110,000.00	30	$3,300,000.00	$21,776,040.00	172.33	310,200	99.00	141		149.36	2.87
PRM1	58	3,500	49		$0.00	49	$0.00	$8,326,500.00	77.30	270,556	45.00	61		41.02	0.79
SBR1	95	2,900	31		$139,000.00	31	$4,309,000.00	$97,153,073.33	420.46	1,219,330	98.86	391	8	352.64	6.78
SBR2	37	2,900	7		$175,000.00	7	$1,225,000.00	$9,517,155.56	23.88	69,252	118.33	32		88.70	1.71
WW24	219	2,000	61		$140,000.00	61	$8,540,000.00	$118,571,281.36	635.13	1,270,258	121.29	564	1	270.71	5.21
	8,290	**2,969**	**2,780**	**422**		**2,358**	**$211,444,670.00**	**$6,984,727,571.17**	**28,444.52**	**74,140,927**	**109**	**25,956**	**2327**	**279.69**	**5.38**
									AVG. COST PER 135 A/C	**31,442.29**					
									AVG. HOURLY RATE	**2,606.51**					
									AVG. DOWNTIME	**12.06**					

Table 5: This table presents the average per-aircraft downtime estimate for Part 135 operators to upgrade their aircraft for RVSM operations.

7. Air Traffic Control Costs

RVSM implementation in the NAT and PAC has shown that controller workload will decrease and controller training for RVSM could be accomplished during the existing training cycle. Implementing RVSM in U.S. domestic airspace will result in costs associated with system upgrades and air traffic controller training. The FAA projects these costs for U.S. Domestic RVSM to total $6.65 million and to be evenly distributed among the years 2002-2003. This cost projection includes $1.25 million for the system upgrade to be evenly distributed among the years 2002-2003 and controller costs of $5.4 million to be incurred in 2004based on eight hours of training for 7,500 controllers at a rate of $90.00 per hour.

Summary of RVSM Implementation Costs

The FAA projects that the airworthiness approval implementation costs for large transport carriers and small commercial or general aviation aircraft will occur as follows:

- 20% of costs in year 2002
- 20% of costs in year 2003
- 60% of costs in year 2004

The FAA expects operators will incur flight crew training costs of $3.1 million for both small commercial or general aviation and large transport operators in the year prior to implementation. The FAA estimates that the total will be $869.2 million or $764.9 million discounted (See Table 6).

Table 6. Implementation Costs

	Commercial A/C Upgrade	GA A/C Upgrade	Total Upgrade	Training/ Monitoring/ TCAS v. 7.0/ATC/Downtime	Total	Discount Rate Factor	Discounted Total
2002	$41,194,500.00	$317,693,178.60	$358,887,678.60	$25,661,941.40	$384,549,620.00	0.9346	$359,400,074.85
2003	$41,194,500.00	$105,897,726.20	$147,092,226.20	$25,661,941.40	$172,754,167.60	0.8734	$150,883,489.98
2004	$123,583,500.00	$105,897,726.20	$229,481,226.20	$82,385,824.20	$311,867,050.40	0.8163	$254,577,073.24
Total	$205,972,500.00	$529,488,631.00	$735,461,131.00	$133,709,707.00	$869,170,838.00		$764,860,638.08

B. Cost Savings and other Benefits

The FAA concludes that implementing RVSM will offer some operational benefits to operators without any reduction in aviation safety. Estimated benefits, based on fuel savings for the large transport aircraft fleet over the years 2005 to 2016, will be $5.3 billion ($3.0 billion, discounted).

Fuel Savings

The greater availability of fuel-efficient altitudes and the utilization of efficient cruise climbs will yield fuel savings for large transport operators. To calculate the quantifiable benefits of improved fuel consumption, the Simulation and Analysis Branch (ACB-330) of the FAA Technical Center completed a study of RVSM benefits and estimated the fuel savings for all operations in U.S. domestic airspace to be 1.86%. Total annual savings are presented in Table 7 and were determined by multiplying the total estimated annual fuel savings, 505.2 million gallons, by an estimated jet fuel price of $0.67 per gallon. Fuel savings are estimated to increase 2.0% per annum in accordance with current traffic growth forecasts provided by the FAA Statistics and Forecast Branch (APO-110).

Further analysis revealed that small commercial or general aviation aircraft could realize an average per-flight fuel savings of 1.42% from RVSM. The study also

found that small commercial or general aviation operators (including aircraft operated under part 91 and part 135) not participating in RVSM and conducting operations below FL290 would realize an average per-flight fuel penalty of 6.2%.

Table 7. Fuel Savings			
2002	$ -	0.9346	$ -
2003	$ -	0.8734	$ -
2004	$ -	0.8163	$ -
2005	$ 359,201,928.67	0.7629	$ 293,216,534.37
2006	$ 366,385,967.25	0.713	$ 279,515,854.41
2007	$ 373,713,686.59	0.6663	$ 266,457,858.54
2008	$ 381,187,960.32	0.6227	$ 253,985,537.96
2009	$ 388,811,719.53	0.582	$ 242,113,057.75
2010	$ 396,587,953.92	0.5439	$ 230,814,189.18
2011	$ 404,519,713.00	0.5083	$ 220,018,271.90
2012	$ 412,610,107.26	0.4751	$ 209,729,717.52
2013	$ 420,862,309.40	0.444	$ 199,951,683.20
2014	$ 429,279,555.59	0.415	$ 190,600,122.68
2015	$ 437,865,146.70	0.3878	$ 181,714,035.88
2016	$ 446,622,449.64	0.3624	$ 173,200,185.97
Total	$4,817,648,497.87		$2,741,317,049.37

Other Benefits

Airborne and Ground Delay Reductions

In addition to fuel savings, considerable cost savings will result from forecasted reductions in airborne and ground delays. FAA ACB-330 utilized the National Airspace Analysis and Capability (NASPAC) model to determine potential savings from delay reductions and concluded that $31.6 million in annual airborne operational delays would result from this rule. Airborne operational delays represent the amount of time flights lose due to rerouting, altitude changes, or speed adjustments for competing airborne resources in the NAS. These resources include sectors, arrival and departure fixes, and static and dynamic flow control restrictions. The additional flight levels and

airborne efficiencies created by RVSM result in the improved utilization of airport resources due to delay reductions. The annual savings in ground operational delays was calculated to be $800,000. Ground operational delays accumulate when flights compete for airport resources such as runways, taxiways, and gates. The total annual delay savings from this rule was calculated to be $32.4 million in 2004. Delay savings are estimated to increase 2.0% per annum in accordance with current traffic growth forecasts provided by the FAA Statistics and Forecast Branch (APO-110). This 2% increase in traffic growth would result in $34.4 million in expected delay savings for year 2005. Total savings from airborne and ground delay reductions for 2005 to 2016 is $461.7 million or $262.7 million discounted (Table 8.)

Table 8. Delay Savings

2002	$	-	0.9346	$ -
2003	$	-	0.8734	$ -
2004	$	-	0.8163	$ -
2005	$	34,422,600.22	0.7629	$ 28,099,168.56
2006	$	35,111,052.22	0.713	$ 26,786,221.74
2007	$	35,813,273.27	0.6663	$ 25,534,863.84
2008	$	36,529,538.73	0.6227	$ 24,339,631.66
2009	$	37,260,129.51	0.582	$ 23,201,882.64
2010	$	38,005,332.10	0.5439	$ 22,119,103.28
2011	$	38,765,438.74	0.5083	$ 21,084,522.13
2012	$	39,540,747.52	0.4751	$ 20,098,561.96
2013	$	40,331,562.47	0.444	$ 19,161,525.33
2014	$	41,138,193.71	0.415	$ 18,265,358.01
2015	$	41,960,957.59	0.3878	$ 17,413,797.40
2016	$	42,800,176.74	0.3624	$ 16,597,908.54
Total	$	461,679,002.82		$262,702,545.10

Many non-quantifiable or value-added benefits will result from the implementation of RVSM airspace in the U.S. and Gulf of Mexico. Air traffic managers, controllers, and operators have identified numerous additional benefits.

Through implementation of RVSM in the NAT and PAC regions, operators and controllers have realized some additional benefits, such as:

- Enhanced airspace capacity;
- Reduced airspace complexity;
- Decreased operational errors in these regions;
- Reduction of user-requested off course climbs for altitude changes;
- Improved flexibility for peak traffic demands;
- Diminishes the effect of traffic converging at critical points in high-density traffic areas; and
- Increase number of options in deviating aircraft during periods of adverse weather.

The benefits outlined above for RVSM in the NAT and PAC regions are anticipated for RVSM in the airspace contained in this rule. There should be expected efficiencies through reduced airspace complexity, the availability of six additional flight levels, and fewer altitude changes needed for crossing traffic.

Operators can expect enhanced operational efficiency due to improved airspace efficiency. Specific benefits cited by aircraft operators are:

- Improved access to desired flight levels;
- Reduced average flight times;
- Increased likelihood of receiving a clearance for weather deviations;
- Seamless, transparent, and harmonious operations between other RVSM regions;
- Consistent procedural environment throughout the entire flight; and
- Reduced impact of adverse weather by permitting aircraft deviations to other airways without any efficiency loss.

C. Analysis of Alternatives

This NPRM is a "significant regulatory action" as defined by Executive Order (E.O.) 12866 (Regulatory Planning and Review) because this rule imposes costs exceeding $100 million annually. The E.O. requires that promulgating economically significant rules provide an assessment of feasible alternatives to their respective rulemaking actions. In addition, the E.O. requires that an explanation of why the final rule, which is significant, is preferable to the identified potential alternatives. The FAA identified and considered three alternatives to the rule.

Alternative One – The Status Quo

This alternative would maintain the 2,000-foot separation above FL 290 and would avoid the equipment and testing requirements of this NPRM, which impose a cost of

$869.2 million ($764.9 million, discounted) between 2002 and 2004 on the aviation industry and the FAA. But maintaining the status quo also means that aviation industry would not receive any of the cost-savings afforded by Domestic RVSM. As mentioned earlier, the cost-savings or NAS operation enhancements afforded by this NPRM are estimated to be $5.3 billion ($3.0 billion, discounted) in fuel savings over the same 15-year period. Since the foregone cost-savings of the alternative greatly exceed the avoided NPRM costs, the FAA rejects this alternative in favor of the rule.

Alternative Two – Implement Domestic RVSM Without the Equipment and Testing Requirements

This alternative would allow RVSM between FL 290 and FL 410 without requiring aircraft system engineering to 14 CFR Part 91, Appendix G. This alternative would allow the aviation industry to receive the estimated $5.3 billion ($3.0 billion, discounted) in fuel savings while the aviation industry and the FAA avoids the NPRM costs of $869.2 million ($764.9 million, discounted). Unfortunately, this is not a viable alternative due to safety considerations.

Studies by the FAA and European civil aviation authorities have shown that many aircraft that have not been calibrated to RVSM standards exhibit altitude-keeping errors that exceed the standards established for RVSM safety. In these studies, non-RVSM calibrated aircraft were observed

with errors of up to 700 feet. Under RVSM aircraft are allowed to operate with only 1,000 feet vertical separation. If non-RVSM calibrated aircraft were allowed to operate with only 1,000 feet vertical separation, there could be a 400-foot altitude overlap in altitude-keeping errors for two non-RVSM calibrated aircraft operating in close proximity to each other. Thus, there is an increase risk of midair collisions if non-RVSM calibrated aircraft are allowed to operate under RVSM. Since there are some aviation safety concerns with this alternative, this alternative is also rejected in favor of the rule.

Alternative Three – Delay Implementation of the RVSM by Seven or Eight Years

This alternative would delay implementation of the rule by seven or eight years. This would allow the costs to be spread over a longer period of time so that costs in any one-year would be below $100 million. This would no longer make the rule economically significant under E.O. 12866. The cost of this alternative would still be the same as the cost of the rule, although the discounted costs would be lower than the discounted costs of the rule. However, if implementation of the rule were delayed by seven or eight years, the estimated cost-savings would be reduced by $2.0 billion or $2.4 billion, respectively ($1.5 billion, discounted or $1.8 billion, discounted, respectively). This is a considerable amount of cost-savings to forego in order for the FAA to avoid issuing an economically significant

rule. For this reason, this alternative is rejected in favor of the rule.

D. Economic Summary: Comparison of Costs and Benefits

The FAA estimates that this rule will cost U.S. operators $869.2 million for the period 2002-2016 ($764.9 million, discounted). Estimated benefits, based on fuel savings for U.S. operators over the years 2005 to 2016, will be $5.3 billion ($3.0 billion, discounted). These benefits exceed their costs by a ratio of more than 6:1 (4:1 discounted) and will be realized without a reduction in safety as discussed in the preamble.

V. Regulatory Flexibility Analysis

The Regulatory Flexibility Act of 1980 establishes as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation. To achieve that principle, the Act requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions. The Act covers a wide-range of small entities including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. If the determination is that it will, the agency must prepare a regulatory flexibility analysis (RFA) as described in the Act.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the 1980 Act provides that the head of the agency may so certify and an RFA is not required. The certification must include a statement providing the

factual basis for this determination, and the reasoning should be clear.

Findings of the Regulatory Flexibility Analysis

Operators of large transport aircraft meeting the Small Business Administration (SBA) small entity criteria were identified in the 6-day traffic sample of ETMS data and appear in Table 2. Revenue information for the small entity operators was obtained from the *Air Carrier Financial Statistics Quarterly, Dun and Bradstreet Million Dollar Directory, J&P Airline Fleets International, and the Department of Transportation Bureau of Transportation Statistics Office of Airline Information Web Site*.

Operators of small commercial or general aviation aircraft are typically operated under either 14 CFR Part 91 or 14 CFR Part 135. This study focuses on Part 135 operators. Since they utilize their aircraft as their primary means of revenue generation through offering non-scheduled charter flights, they are more prone to being impacted by this rule. The FAA estimates that 380 operators with less than 1,500 employees operate 2,780 turbojet aircraft on Part 135 generating $7.0 billion in charter revenue per annum. As of December 2002, 422 of these aircraft are RVSM approved leaving 2,358 non-approved aircraft. The FAA estimates the cost to upgrade the non-approved airframes is $211.4 million. In addition, the FAA estimates that these operators will

incur approximately $74.1 million, or $195,000 per operator, in lost revenue associated with the downtime necessary to upgrade these airframes for RVSM operations. Based on these estimates, the FAA has determined that this group of approximately 380 operators is significantly impacted by this rule.

The following reviews some of the factors associated with the costs of upgrading part 135 aircraft that the FAA considered in the Regulatory Flexibility Analysis (RFA):

- Table 1 of the Regulatory Impact Analysis (RIA) provides projected costs associated with upgrading individual aircraft types. The FAA recognizes that the costs may change. In some cases, the FAA has seen costs decrease as more upgrade options become available. The FAA also recognizes, however, that in the period before the RVSM implementation date competition for upgrade facilities may lead to an increase in costs. Therefore, the FAA concludes that this cost may vary and can only be estimated.
- For the purposes of estimating costs associated with upgrading part 135 aircraft to RVSM standards, the FAA used the conservative assumption in RIA Tables 2 and 3 that all operators will incur upgrade costs during the 15-year cost analysis period, 2002-2016 . The FAA recognizes that some operators of high upgrade cost aircraft may elect to fly below flight

level 290 for an indefinite period of time. The FAA conducted a study entitled “An Examination of Range and Fuel-Burn Penalties Associated with Operating Business Jet Type Aircraft Beneath Proposed U.S. Domestic Reduced Vertical Separation Minimum (DRVSM) Airspace”. The study is available in the rulemaking docket. The study provides costs for flight operation below 290 for such aircraft. The FAA concluded that the costs associated with flight below flight level 290 are less than that for upgrade. The FAA, therefore, believed that assuming all aircraft would incur upgrade costs was a conservative approach.

- RIA Table 5 provides an estimate of revenue lost to part 135 operators when their aircraft are in service centers undergoing RVSM upgrade. For the purpose of developing this table, the FAA assumed an average aircraft downtime of two weeks. The FAA recognizes that actual downtime can vary in individual situations, however, we believe two weeks to be a reasonable assumption for average downtime. These costs can be mitigated if upgrades occur during other scheduled maintenance.
- In the RFA Affordability Analysis, the FAA recognizes that the 380 part 135 operators will fund upgrade costs from company sources, lenders or through the issuance of equity capital.

- Although in January 2005 approximately 90 per cent of flights in domestic U.S. RVSM airspace are projected to be conducted by RVSM-compliant aircraft, approximately 10 percent of flights that now operate above FL 290 are projected to operate below that level. The FAA recognizes that some operators may not complete RVSM engineering work and FAA Flight Standards office processing by the RVSM implementation date. Such operators retain the option to fly below FL 290 until they receive RVSM authority. FAA flight simulations have shown that the approximate 10 percent increase in traffic below FL290 can be accommodated without degrading safety.
- The FAA examined the fuel consumption penalties and range limitations associated with flight below FL 290. The study entitled “An Examination of Range and Fuel-Burn Penalties Associated with Operating Business Jet Type Aircraft Beneath Proposed U.S. Domestic Reduced Vertical Separation Minimum (DRVSM) Initial Simulation” is available for review in the docket. Using data from the FAA Enhanced Traffic Management System, the study examined the actual leg lengths and city-pairs that part 135 aircraft fly. The study concluded that part 135 aircraft would incur a fuel consumption penalty of approximately 7.15 percent. The penalty imposes an average annual cost of $1,147 per airframe or $3.1

million for the part 135 aircraft population that has not already been upgraded. In addition the study concluded that approximately 92percent of flights would not require a fuel stop when flown beneath FL 290. The study can be found in the public docket at http://dms.dot.gov and searching docket number 12261.

- In the past 7years of RVSM operations, maintenance costs have not been a significant factor in comparison to initial aircraft approval costs. RVSM required systems are already standard for most aircraft and maintenance is already a requirement for them. The FAA recognizes that RVSM requires additional maintenance measures for some aircraft. However, they have not been factored here because they have not been factors in previous RVSM implementations.
- In the “Costs” section of the “Discussion of Comments”, the FAA states that the residual value of aircraft was not a primary consideration in this rulemaking. The FAA believes that compliance with RVSM standards will actually increase the residual value of some aircraft. The FAA recognizes that aircraft that are not upgraded will decrease in residual value, however, RVSM is a global program that has been implemented in a large portion of global airspace and operators must plan accordingly.

The analysis of the operators of large transport aircraft shows that of the 22 potential small entity operators identified in the traffic sample, none were determined to have upgrade costs resulting in their being significantly impacted by this rule. However, 380 Part 135 operators are significantly impacted by this rule. Therefore, the FAA has determined that this rule will impact a substantial number of small entities

V. Initial Regulatory Flexibility Analysis

Under section 603(b) of the RFA (as amended), each initial regulatory flexibility analysis is required to address the following points: (1) reasons why the FAA is considering the proposed rule, (2) the objectives and legal basis for the proposed rule, (3) the kind and number of small entities to which the proposed rule would apply, (4) the projected reporting, record-keeping, and other compliance requirements of the proposed rule, and (5) all Federal rules that may duplicate, overlap, or conflict with the proposed rule.

Reasons Why the FAA is Implementing This Rule

This rulemaking action will increase the number of available flight levels, enhance airspace capacity, and permit operators to fly more fuel and time efficient tracks and altitudes. The rule will also enhance air traffic controller flexibility by increasing the number of available flight levels, while maintaining an equivalent level of safety.

The Objectives and Legal Basis for the Proposed Rule

The objective of this rule is to enhance operational efficiency and air traffic flexibility. Specifically, this rule aims to create flexibility and resultant benefits for operators and air traffic providers. The legal basis for this rule is found in 49 U.S.C. 106(g), 1155, 40103, 40113, 40120, 44101, 44111, 44701, 44709, 44711, 44712, 44715, 44716, 44717, 44722, 46306, 46315, 46316, 46504, 46506-46507, 47122, 47508, 47528-47531, and articles 12 and 29 of the Convention on International Civil Aviation (61 stat. 1180).

The Kind and Number of Small Entities to Which the Proposed Rule Would Apply

This rule applies to 70 scheduled airlines operating large transport aircraft under Part 121 of which 22 are small operators with 1,500 or fewer employees. In addition, this rule also applies to 380 operators operating under Part 135 with all considered to be small entities. The FAA estimates that 1,900 corporations also operate non-approved turbojet aircraft under Part 91 that will be upgraded for this rule. These aircraft are primarily used for private non-revenue transportation and were considered in the Benefit/Cost analysis.

The Projected Reporting, Recordkeeping, and Other Compliance Requirements of the Rule

Information collection requirements in the final rule have been previously approved by the Office of Management and Budget (OMB) under the provisions of the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) and have been assigned OMB Control Number: 2120-0679.

The following paperwork costs would be imposed on aircraft operators:

a. Section 14 CFR Part 91, Section 91.180 would require aircraft operators seeking operational approval to conduct RVSM operations within the 48 contiguous States of the United States (U.S.), Alaska, the portion of the Gulf of Mexico where the FAA provides air traffic services, the Miami-San Juan corridor and the San Juan flight information region (FIR), to submit their application to their CHDO. This submission by the estimated 2,275 respondents would require each organization to spend 30 hours on the paperwork at a cost of approximately $950 for each operator.

All Federal Rules That May Duplicate, Overlap, or Conflict With the Rule

The FAA is unaware of any Federal rules that duplicate, overlap, or conflict with the rule.

Other Considerations:

Affordability Analysis[3]

For the purpose of this analysis, the degree to which small entities can afford the cost of compliance is based on the availability of financial resources. Initial upgrade costs can be funded from company funds, lenders, or through the issuance of equity capital. These compliance costs can be accommodated by accepting reduced profits, increasing ticket prices or charter rates, or through other cost-savings measures to offset costs.

The cost of compliance for the 380 impacted small entity operators is $211.4 million, or $556,000.00 per small entity for upgrade costs and $74.1 million in downtime costs. Small entity operators are expected to enjoy smaller benefits than large transport operators due to their disproportionate cost-benefit ratio of upgrade costs to forecasted benefits. FAA analysis has determined that the average operator will realize a 1.86% fuel saving. However, part 135 operators electing not to upgrade or delay their aircraft upgrade plans would incur

[3] Small entity operators have the following options. They may elect to:

- Modify their aircraft to RVSM standards
- Operate at and below FL 280 for a period of time until they either modify their aircraft or purchase RVSM compliant aircraft
- Operate at and below FL 280 indefinitely.

In past RVSM implementation programs, some operators have modified their aircraft despite the costs involved. They have taken this decision because they do not wish to operate with a restriction. Instead, they wish to have access to all flight levels up to FL 410 in order to retain all available options to avoid weather, to be accommodated in prevailing traffic flows and to operate at the most fuel efficient FL's and on preferred routes.

on average a 7.15% fuel penalty from conducting operations beneath FL290. Although the FAA recognizes these upgrade costs have a significant impact on these operators, the operational penalties associated with not upgrading or delaying aircraft upgrade plans do not prevent the operators from continuing to operate.

Disproportionality Analysis[4]

On average, the 380 small entities would be disadvantaged relative to operators of large transport aircraft due to disproportionate cost impacts. Operators of large transport aircraft enjoy greater revenues than the small entities and typically operate larger fleets. Due to their fleet sizes, large transport aircraft operators enjoy more flexibility to rotate their fleet through the RVSM approval process without a disruption in service while many of the small entities operate only one aircraft. Further, operators of large transport aircraft enjoy having their own maintenance facilities.

[4] The FAA examined alternatives for operators that do not elect to modify their aircraft to RVSM standards and reached the conclusions discussed below:
Allowing Un-approved Aircraft to Operate Unconditionally in RVSM Airspace. The FAA concluded that it would not be feasible or safe to allow large numbers of un-approved aircraft to operate in RVSM airspace with RVSM approved aircraft. A mix of approved and un-approved aircraft increases ATC complexity, controller work load and the potential for error.
Delaying DRVSM Implementation. It is in the best interest of the majority of the operators and to the overall enhancement of NAS operations to proceed with DRVSM implementation in January 2005. Each year that implementation is delayed will result in the loss of $394 million dollars in operator benefits and delay enhancements to NAS operations.

Competitiveness Analysis

The 380 small-entity operators do not compete with large transport operators but could experience significant costs through upgrading their aircraft for RVSM operations. However, FAA analysis has shown that aircraft operated under part 135 experience on average a 7.15% reduction in fuel efficiency if they were operated beneath the RVSM stratum. Further, FAA RVSM readiness projections for the January 2005 DRVSM implementation timeframe indicate that the aircraft generating approximately 90% of the operations in the NAS will be approved for RVSM operations. The estimated annual increase in fuel-burn for the projected 10% of non-approved NAS traffic would result in $103.7 million in total fuel penalties for these operators based on $18.2 billion in annual fuel consumption for all operations.

Description of Alternatives

The agency has considered a number of alternatives to the rule. The FAA finds that this rule achieves the desired airspace enhancements and delivers the maximum benefits to operators and air traffic providers while maintaining system safety.

The following alternatives to the rule have been considered:

- Status Quo
- Not enforce the rule for small entities

- Delay the rule
- Phased RVSM implementation

Alternative One – Status Quo

This alternative would maintain the current 2,000 ft. vertical separation minimum above FL290 thereby avoiding the $869.2 million ($764.9 million, discounted) in costs between 2002 and 2004 for the aviation industry and the FAA. However, maintaining the status quo does not provide the desired airspace enhancements for operators and air traffic providers. As noted earlier, the cost savings and NAS operational enhancements are estimated to be $5.3 billion ($3.0 billion, discounted) over the 15-year period. Under this alternative, the foregone cost-savings would be more than seven times the cost of this rule. Therefore, the FAA rejects this alternative in favor of the rule.

Alternative Two – Not Enforce the Rule for Small Entities

This alternative would permit small operators to operate in RVSM airspace without upgrading their aircraft for such operations. Under this scenario, small operators would avoid $285.5 million ($211.4 million in upgrade costs and $74.1 in downtime costs) or $751,316.00 per operator. However, this would compromise safety as it would result in some 2,400 non-approved aircraft

operating in the RVSM stratum. Therefore, the FAA rejects this alternative in favor of the rule.

Alternative Three – Phased Implementation of RVSM

This alternative would involve the implementation of RVSM for a smaller altitude band such as FL330-370 with eventual expansion to the full RVSM envelope of FL290-410. Although this alternative would create some flexibility for small operators to continue operating near their desired flight levels and delaying their implementation plans, airspace complexity would be increased. The simulations conducted at the FAA Technical Center showed that when RVSM was applied in any altitude band other than FL 290-410, system safety and airspace management were negatively impacted. Controller workload, potential for controller error and operational complexity all increased. Therefore, we reject this alternative in favor of the rule. The "Final Report for Domestic Reduced Vertical Separation Minimum (DRVSM) Initial Simulation" is in the docket and can be accessed at http://dms.dot.gov and searching for docket number 12261.

Alternative Four – The Final Rule

This alternative represents the Final Rule. Under this alternative, airspace users and air traffic providers would receive $5.3 billion ($3.0 billion, discounted) in cost-savings for the years 2005 to 2016.

These benefits will be realized through the investment of $869.2 million ($764.9 million discounted) in costs associated with this rule. The FAA estimates that the costs for 380 small entities would be $211.4 million, or $556,000.00 on average. This alternative is preferred, as the FAA believes it provides the best balance of costs and benefits for airspace users and air traffic providers without a reduction in aviation safety.

VI. International Trade Impact Statement

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activity that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. The FAA has assessed the potential effect of this rulemaking and has determined that it will impose the same costs on domestic and international entities and thus has a neutral trade impact.

VII. Unfunded Mandates

The Unfunded Mandates Reform Act of 1995 (the Act), enacted as Pub. L. 104-4 on March 22,1995, is intended, among other things, to curb the practice of imposing unfunded Federal mandates on State, local, and tribal governments.

Title II of the Act requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule, that may result in a $100 million or more expenditure (adjusted annually for inflation) in any one year by State, local, and tribal governments in the aggregate, or by the private sector; such as a mandate is deemed to be a "significant regulatory action".

This rule does contain a mandate that would impose over $100 million on private industry only. As explained in the alternative analysis of the RIA, delay in implementation of the rule or not implementing the rule would involve the industry foregoing fuel savings that greatly exceed the imposed cost of this rule. Implementing this rule without imposing the equipment requirements, which would eliminate the cost of this rule, would be unsafe. Therefore, of all of the alternatives examined in the RIA, the rule would provide the greatest net benefit while maintaining aviation safety.