DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA–2004–18775; Notice No. 04–11]

RIN 2120–AI41

Safety Standards for Flight Guidance Systems

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: The Federal Aviation Administration proposes to amend the airworthiness standards for transport category airplanes concerning flight guidance systems. The proposed standards address the performance, safety, failure protection, alerting, and basic annunciation of these systems. This proposed rule is necessary to address flight guidance system vulnerabilities and to consolidate and standardize regulations for functions within those systems. This proposed rule would also update the current regulations regarding the latest technology and functionality. Adopting this proposal would eliminate significant regulatory differences between the airworthiness standards of the U.S. and the Joint Aviation Authorities of Europe.

DATES: Send your comments on or before October 12, 2004.

ADDRESSES: You may send comments [Docket Number FAA–2004–18775] using any of the following methods:

- DOT Docket Web site: Go to *http://dms.dot.gov* and follow the instructions for sending your comments electronically.
- Government-wide rulemaking Web site: Go to *http://www.regulations.gov* and follow the instructions for sending your comments electronically.
- Mail: Docket Management Facility; U.S. Department of Transportation, 400 Seventh Street, SW., Nassif Building, Room PL–401, Washington, DC 20590–001.
- Fax: 1–202–493–2251.
- Hand Delivery: Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

For more information on the rulemaking process, see the **SUPPLEMENTARY INFORMATION** section of this document.

Privacy: We will post all comments we receive, without change, to *http://dms.dot.gov,* including any personal information you provide. For more information, see the Privacy Act discussion in the **SUPPLEMENTARY INFORMATION** section of this document.

Docket: To read background documents or comments received, go to *http://dms.dot.gov* at any time or to Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Gregg Bartley, FAA, Airplane and Flight Crew Interface Branch (ANM–111), Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98055–4056; telephone (425) 227–2889; facsimile 425–227–1320; e-mail *gregg.bartley@faa.gov.*

SUPPLEMENTARY INFORMATION:

How Do I Submit Comments to This NPRM?

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. We also invite comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. We ask that you send us two copies of written comments.

We will file in the docket all comments we receive, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. The docket is available for public inspection before and after the comment closing date. If you wish to review the docket in person, go to the address in the **ADDRESSES** section of this preamble between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. You may also review the docket using the Internet at the web address in the **ADDRESSES** section.

Privacy Act: Using the search function of our docket Web site, anyone can find and read the comments received into any of our dockets, including the name of the individual sending the comment (or signing the comment on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–78) or you may visit *http://dms.dot.gov.*

Before acting on this proposal, we will consider all comments we receive on or before the closing date for comments. We will consider comments filed late if it is possible to do so without incurring expense or delay. We may change this proposal in light of the comments we receive.

If you want the FAA to acknowledge receipt of your comments on this proposal, include with your comments a pre-addressed, stamped postcard on which the docket number appears. We will stamp the date on the postcard and mail it to you.

How Can I Obtain a Copy of This NPRM?

You can get an electronic copy using the Internet by:

(1) Searching the Department of Transportation's electronic Docket Management System (DMS) Web page (*http://dms.dot.gov/search*);

(2) Visiting the Office of Rulemaking's Web page at *http://www.faa.gov/avr/arm/index.cfm;* or

(3) Accessing the Government Printing Office's Web page at *http://www.access.gpo.gov/su_docs/aces/aces140.html.*

You can also get a copy by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the docket number, notice number, or amendment number of this rulemaking.

Background

What Prompted This Proposed Rule?

In response to several incidents and accidents that highlight difficulties for flightcrews interacting with the increasing automation of flight decks, the FAA formed a Human Factors Team (HFT). The team included representatives of the National Aeronautics and Space Administration (NASA) and the Joint Aviation Authority of Europe (JAA), as well as technical advisers from Ohio State University, the University of Illinois, and the University of Texas. The HFT evaluated flightcrew/flight deck automation interfaces for the current generation of transport category airplanes. They issued a report on June 18, 1996, titled ''The Interfaces Between Flightcrews and Modern Flight Deck Systems.'' A copy of the HFT report is included in the official docket.

The main impetus for the HFT study was an accident in Nagoya, Japan, on April 26, 1994, involving an Airbus 300–600 operated by China Airlines. Contributing to that accident were conflicting actions taken by the

flightcrew and the airplane's autopilot. The flightcrew tried to correct the autopilot's directions. The combination of out-of-trim conditions, high engine thrust, and flaps that were retracted too far led to a stall, which resulted in an accident involving 264 fatalities. Although this particular accident involved an A300–600, other accidents, incidents, and safety indicators demonstrate that this problem is not confined to any one airplane type, manufacturer, operator, or geographic region. On November 12, 1995, an MD–80 operated by American Airlines descended below the minimum descent altitude, clipped some trees, and landed short of the runway, in what was very nearly a fatal accident. On July 13, 1996, a McDonnell Douglas MD–11 operated by American Airlines experienced an in-flight upset near Westerly, Rhode Island. When the airplane was cleared to descend to 24,000 feet, the first officer initiated a descent by means of the autopilot. With approximately 1,000 feet left in the descent, the captain became concerned that the airplane might not level off at the assigned altitude and instructed the first officer to slow the rate of descent. The first officer adjusted the pitch thumbwheel on the autopilot control panel. This maneuver proved ineffective. The captain then took manual control of the airplane, began applying back pressure to the control column, and disconnected the autopilot. Flight data recorder data show the airplane experienced an immediate 2.3 G pitch upset followed by more oscillations, resulting in four injuries.

The HFT identified issues that show vulnerabilities in flightcrew management of automation and situation awareness. Specifically, there were concerns about:

• *Pilot understanding of automation's capabilities, limitations, modes, and operating principles and techniques.* The HFT frequently heard about automation ''surprises,'' where the automation behaved in ways the flightcrew did not expect. The flightcrews, from operational experience, commonly asked: ''Why did it do that?'' ''What is it doing now?'' and ''What will it do next?'

• *Differing pilot decisions about the appropriate automation level to use or whether to turn the automation on or off when they get into unusual or non-normal situations.* This may also lead to potential mismatches with the manufacturer's assumptions about how the flightcrew will use the automation.

Flightcrew situation awareness issues included vulnerabilities in, for example:

• *Automation/mode awareness.* This was an area where the researchers heard a universal message of concern about each of the aircraft in the study.

• *Flight path awareness, including insufficient terrain awareness (sometimes involving loss of control or controlled flight into terrain) and energy awareness (especially low energy state).*

The team concluded that these vulnerabilities exist because of some interrelated deficiencies in the current aviation system:

• *Insufficient communication and coordination.* Examples include lack of communication about in-service experience within and between organizations; incompatibilities between the air traffic system and airplane capabilities; poor interfaces between organizations, and lack of coordination of research needs and results between the research community, designers, regulators, and operators.

• *Processes used for design, training, and regulatory functions that inadequately address human performance issues.* As a result, users can be surprised by subtle behavior or overwhelmed by the complexity embedded in systems within the current operating environment. Process improvements are needed to provide the framework for consistent application of principles and methods for removing vulnerabilities in design, training, and operations.

• *Insufficient criteria, methods, and tools for design, training, and evaluation.* Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues. It is fairly easy to get agreement that automation should be human-centered, or that potentially hazardous situations should be avoided; it is much more difficult to get agreement on how to achieve these objectives.

• *Insufficient knowledge and skills.* Designers, pilots, operators, regulators, and researchers do not always have adequate knowledge and skills in certain areas related to human performance. The team was concerned that investments in necessary levels of human expertise were being reduced in response to economic pressures. For example, two-thirds to three-quarters of all accidents had flightcrew error cited (during the study) as a major factor.

• *Insufficient understanding and consideration of cultural differences in design, training, operations, and evaluation.* The aviation community has an inadequate understanding of the influence of culture and language on flightcrew/automation interaction. Cultural differences may reflect differences in the country of origin, philosophy of regulators, organizational philosophy, or other factors. There is a need to improve the aviation community's understanding and consideration of the implications of cultural influences on human performance.

Not all wide-reaching problems uncovered by the human factors team listed above can be corrected in one rulemaking project. The safety issues addressed in this proposal are the following:

• Insufficient crew awareness of flight guidance system (FGS) behavior and operation.

• Hazardous autopilot transients resulting from disengagement, including a manual pilot override of an engaged autopilot.

• FGS mode confusion resulting in crew errors (for instance, altitude violation).

• History of lack of awareness of unusual/hazardous attitudes during FGS operations (accidents and incidents).

• History of lack of speed awareness (accidents and incidents).

• Operation in icing conditions.

Function of the Flight Guidance System

The FGS is intended to assist the flightcrew in the basic control and guidance of the airplane. The FGS provides workload relief to the flightcrew and a means to more accurately fly an intended flight path. The following functions make up the flight guidance system:

1. Autopilot—automated airplane maneuvering and handling capabilities.

2. Autothrust—automated propulsion control.

3. Flight Director—the display of steering commands that provide vertical and horizontal path guidance, whether displayed ''heads down'' or ''heads up.'' A heads up display is a flight instrumentation that allows the pilot of an airplane to watch the instruments while looking ahead of the airplane for the approach lights or the runway.

Flight guidance systems functions also include the flight deck alerting, status, mode annunciations (instrument displays), and any situational information required by those functions displayed to the flightcrew. Also included are those functions necessary to provide guidance and control with an approach and landing system, such as:

• Instrument landing system (ILS).

• Microwave landing system (MLS) (an instrument landing system operating in the microwave spectrum that provides lateral and vertical guidance to airplanes having compatible avionics equipment).

• Global navigation satellite system landing system (GLS).

The FGS definition does not include flight planning, flight path construction, or any other function normally associated with a Flight Management System (FMS).

Statement of the Problem

Several NTSB safety recommendations, as well as the FAA study discussed above, have highlighted flight guidance system vulnerabilities. The current regulations (§ 25.1329) regarding flight guidance systems address only the autopilot system, except for one specific regulation regarding the flight director switch position (§ 25.1335). Not addressed is the autothrust system, and how it relates to flight guidance. Therefore, there is a need to consolidate and standardize regulations for all flight guidance system functionality (autopilot, autothrust, and flight director).

Also needed is an updating of existing regulations to match technology advances. Current regulations do not fully address the latest technology or new functionality available. In addition, proposed and recent rulemaking activity, such as the interaction of systems and structure, flight test, and human factors, will make certain aspects of the existing flight guidance systems regulations redundant, in conflict with other regulations, or confusing and difficult to understand.

Finally, there is a need to harmonize regulations between the FAA and the Joint Aviation Authorities (JAA) that would not only benefit the aviation industry economically, but also maintain the necessary high level of aviation safety.

NTSB Recommendations

Safety recommendations issued by the NTSB in recent years that highlight vulnerabilities in the flight guidance systems of today's transport airplanes are listed below:

• NTSB Safety Recommendation A–92–035: ''Revise Advisory Circular 25.1329–1A to add guidance regarding autopilot failures that can result in changes in attitude at rates that may be imperceptible to the flightcrew and thus remain undetected until the airplane reaches significant attitude deviations.''

• NTSB Safety Recommendation A–98–098: ''Require all manufacturers of transport-category airplanes to incorporate logic into all new and existing transport-category airplanes that have autopilots installed to provide a cockpit aural warning to alert pilots when the airplane's bank and/or pitch exceeds the autopilot's maximum bank and/or pitch command limits.''

• NTSB Safety Recommendation A–99–043: ''Require all new transport category airplane autopilot systems to be designed to prevent upsets when manual inputs to the flight controls are made.''

What Are the Relevant Airworthiness Standards in the United States?

In the United States, the airworthiness standards for type certification of transport category airplanes are contained in Title 14, Code of Federal Regulations (CFR) part 25. Manufacturers of transport category airplanes must show that each airplane they produce of a different type design complies with the appropriate part 25 standards. These standards apply to:

• Airplanes manufactured within the U.S., and

• Airplanes manufactured in other countries and imported to the U.S. under a bilateral airworthiness agreement.

What Are the Relevant Airworthiness Standards in Europe?

In Europe, the airworthiness standards for type certification of transport category airplanes are contained in Joint Aviation Requirements (JAR)–25, which are based on part 25. These were developed by the Joint Aviation Authorities (JAA) of Europe to provide a common set of airworthiness standards within the European aviation community. Thirty-seven European countries accept airplanes type certificated to the JAR–25 standards, including airplanes manufactured in the U.S. that are type certificated to JAR–25 standards for export to Europe.

What Is ''Harmonization'' and How Did It Start?

Although part 25 and JAR–25 are very similar, they are not identical in every respect. When airplanes are type certificated to both sets of standards, the differences between part 25 and JAR–25 can result in substantial added costs to manufacturers and operators. These added costs, however, often do not bring about an increase in safety. Often, part 25 and JAR–25 may contain different requirements to accomplish the same safety intent. Consequently, manufacturers are usually burdened with meeting the requirements of both sets of standards without a corresponding increase in the level of safety.

Recognizing that a common set of standards would not only benefit the aviation industry economically, but also maintain the necessary high level of safety, the FAA and the JAA began an effort in 1988 to ''harmonize'' their respective aviation standards. The goal of the harmonization effort is to ensure that:

• Where possible, standards do not require domestic and foreign parties to manufacture or operate to different standards for each country involved; and

• The standards adopted are mutually acceptable to the FAA and the foreign aviation authorities.

The FAA and JAA have identified many significant regulatory differences (SRD) between the wording of part 25 and JAR–25. Both the FAA and the JAA consider ''harmonization'' of the two sets of standards a high priority.

What Is the European Aviation Safety Authority?

The new European Aviation Safety Authority (EASA) was established and formally came into being on September 28, 2003. The JAA worked with the European Commission (EC) to develop a plan to ensure a smooth transition from JAA to EASA. As part of the transition, the EASA will absorb all functions and activities of the JAA, including its efforts to harmonize JAA regulations with those of the U.S. This rule is a result of the FAA and JAA harmonization rulemaking activities. These JAR standards have already been incorporated into the EASA ''Certification Specifications for Large Aeroplanes'' CS–25, in similar if not identical language. The EASA CS–25 became effective October 17, 2003.

What Is ARAC and What Role Does It Play in Harmonization?

After initiating the first steps towards harmonization, the FAA and JAA soon realized that traditional methods of rulemaking and accommodating different administrative procedures was neither sufficient nor adequate to make appreciable progress towards fulfilling the harmonization goal. The FAA identified the Aviation Rulemaking Advisory Committee (ARAC) as an ideal resource for assisting in resolving harmonization issues, and, in 1992, the FAA tasked ARAC to undertake the entire harmonization effort.

The FAA had formally established ARAC in 1991 (56 FR 2190, January 22, 1991), to provide advice and recommendations concerning the full range of the FAA's safety-related rulemaking activity. The FAA sought this advice to develop better rules in less overall time and using fewer FAA resources than previously needed. The committee provides the FAA firsthand

information and insight from interested parties regarding potential new rules or revisions of existing rules.

There are 74 member organizations on the committee representing a wide range of interests within the aviation community. Meetings of the committee are open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act.

The ARAC establishes working groups to develop recommendations for resolving specific airworthiness issues. Tasks assigned to working groups are published in the **Federal Register**. Although working group meetings are not generally open to the public, the FAA solicits participation in working groups from interested members of the public who possess knowledge or experience in the task areas. Working groups report directly to the ARAC, and the ARAC must accept a working group proposal before ARAC presents the proposal to the FAA as an advisory committee recommendation.

The activities of the ARAC will not, however, circumvent the public rulemaking procedures; nor is the FAA limited to the rule language ''recommended'' by ARAC. If the FAA accepts an ARAC recommendation, the agency proceeds with the normal public rulemaking procedures. Any ARAC participation in a rulemaking package is fully disclosed in the public docket.

This rulemaking has been identified as a ''fast track'' project. Further details on the Fast Track Program can be found in the tasking statement (64 FR 66522, November 26, 1999) and the first NPRM published under this program, Fire Protection Requirements for Powerplant Installations on Transport Category Airplanes (65 FR 36978, June 12, 2000).

What Are the Current 14 CFR and JAR Standards, Certification Specifications for Large Airplanes?

The current text of 14 CFR 25.1329 (amendment 25–46) is:

§ 25.1329 Automatic pilot system.

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in §§ 25.777(b) and 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

(h) If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the flight crew the current mode of operation. Selector switch position is not acceptable as a means of indication.

The current text of 14 CFR 25.1335 (amendment 25–41) is:

§ 25.1335 Flight director systems.

If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

The current text of JAR 25.1329 (Change 15) is:

JAR 25.1329 Automatic Pilot System.

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the aeroplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in JAR 25.777(b) and JAR 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the aeroplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use, either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

(h) Means must be provided to indicate to the flight crew the current mode of operation and any modes armed by the pilot. Selector switch position is not acceptable as a means of indication.

(i) A warning must be provided to each pilot in the event of automatic or manual disengagement of the automatic pilot. (See JAR 25.1322 and its AMJ.)

The current text of JAR 25.1335 (Change 15) is:

JAR 25.1335 Flight Director Systems.

Means must be provided to indicate to the flight crew the current mode of operation and any modes armed by the pilot. Selector switch position is not acceptable as a means of indication.

What Are the Differences in the Standards and What Do Those Differences Result In?

The only appreciable difference between the U.S. and European rules is that the JAR requires a warning to each pilot in the event of automatic or manual disengagement of the automatic pilot. This requirement does not appear in 14 CFR 25.1329. American manufacturers have been providing such a warning, however, as part of compliance with 14 CFR 25.1309, which requires that warning information be provided to alert the crew to unsafe operating conditions. There is a minor difference in the sounding period of the warning provided in American- and European-manufactured airplanes that has resulted from differences in advisory materials and accepted practice, and that difference does affect certification. The harmonization of this rule (and accompanying advisory material) would remove that difference.

What, if Any, Are the Differences in the Means of Compliance?

Compliance with the § 25.1329 rule has largely followed the advisory material found in FAA AC 25.1329–1A, dated July 8, 1968, or in JAA Advisory Circular Joint (ACJ) 25.1329. Advances in autopilot technology have outpaced both the FAA guidance and the more current JAA ACJ 25.1329 material. Autopilot-related issue papers and interim policy have been used to fill these gaps in the regulatory and acceptable means of compliance material.

The regulations are applied in certification and validation of products. To market American-manufactured airplanes in Europe, the applicant must meet the requirements of part 25 and

JAR–25. As a result, the certification is typically done to the more stringent JAR–25 requirement.

Related Activity

Under the ARAC rulemaking process, the FAA provides ARAC with an opportunity to review, discuss, and comment on the FAA's draft NPRM. For this rulemaking, ARAC recommended several changes to the NPRM. (A more detailed discussion of this process appears later in this document.) The FAA agrees with some of those recommendations and has revised the NPRM accordingly. However, we disagree with others, and those recommendations, and our reasons for disagreeing are described below in the Discussion of the Proposal section.

Discussion of the Proposal

What Is the General Scope of the Proposal?

The proposed change would revise, reorganize, and add additional material to § 25.1329. This change would address the autopilot, autothrust, and flight director in a single section. It would change the name of § 25.1329 from ''Automatic pilot system'' to ''Flight guidance system'' to reflect the inclusion of autothrust and flight director. This proposed rule would cover the portion of the Heads Up Display (HUD) that contains flight-guidance information displayed to the pilot while manually flying the airplane. Other aspects of HUDs are covered by various regulations that govern flight deck displays and navigation information. This ensures consistency between the Heads Up and Heads Down flight-guidance information displayed in the flight deck.

The proposed change would incorporate new requirements specifically to target potential pilot confusion about automatic mode reversions, hazardous disengagement transients, speed protection, and potential hazards during an autopilot override. The proposed change would remove § 25.1335, ''Flight director systems,'' and would amend § 25.1329 to add a new paragraph (i).

How Does the Changed Product Rule (CPR) (§ 21.101—Designation of Applicable Regulations) Relate to This Change?

The CPR must be considered when updating or adding a flight guidance system. If a proposed change to a flight guidance system is part of a significant product change, then § 21.101(a) is applicable unless one of the other exceptions of § 21.101(b) applies. Section 21.101(a) states that ''An applicant for a change must show that the changed product complies with the airworthiness requirements applicable to the category of the product in effect on the date of the application for the change and with parts 34 and 36 of this chapter.'' If a flight guidance system change is categorized as (or is part of) a product change that is not significant, then the applicable regulation would be § 21.101(b), which states that ''an applicant may show that the changed product complies with an earlier amendment of a regulation required by paragraph (a) of this section.'' The operative question used to determine whether a change is significant or not is, ''Does the change invalidate the original design and certification assumptions at the product level?'' If the answer is ''yes,'' an applicant must comply with the latest regulations, in accordance with § 21.101(a) unless one of the other exceptions of § 21.101(b) applies. If the answer is ''no,'' an applicant may show that the product meets an earlier amendment of the regulation, provided the earlier amendment has been determined by the FAA to be adequate.

Advisory Circular 21.101–1, Change 1, further discusses how to evaluate whether a change made to a previously certified product is significant or not significant. Appendix 1 gives several examples involving autopilot systems for part 23 and part 25 aircraft. (The reference to part 23 aircraft is helpful in making a determination of significance because the examples given in AC 21.101–1 for autopilots in that section are much more descriptive than those provided in the part 25 examples.)

The FAA's position on the Changed Product Rule is documented in § 21.101 and AC 21.101–1. The only time a change may be considered a ''significant change'' is when a substantially new function is included to an already certified product. The AC gives the initial addition of an autoland system as an example of a significant change. That addition invalidates the original design assumptions and certification basis for that airplane. Therefore, for the changed system, an applicant would be required to comply with the regulations in effect on the date of the application. If, on the other hand, an applicant is updating an airplane by replacing an old, analog-based technology autopilot system with a new digital technology autopilot, that change, by itself is considered not significant. The original configuration of the airplane has not been changed and the certification assumptions remain valid. In that case, representative of a change made under a supplemental type certificate (STC), the applicant may choose to use a previous amendment of the regulations, as it applies to the autopilot system. The applicant cannot use an amendment level in effect any earlier than the time of the original certification of the product, but it can use one earlier than the ones in effect at the time of application for the STC.

An exception would be when making a change to the autopilot system as part of a larger change, such as an update of the flight deck from analog ''steam gauges'' to a modern flight deck with large displays, an addition of a flight management system, for example. The overall change to the airplane may be, in total, categorized as a significant change. In that case, the regulations in effect on the date of application would apply to the flight guidance system, as well as to the rest of the flight deck upgrade.

The FAA provided this guidance to help clarify when a flight guidance system change may be considered significant for addressing the Changed Product Rule (§ 21.101). However, the FAA did not consider those potential certification projects in the economic evaluation for this proposed rule. While a change may be determined significant under § 21.101, one of the additional exceptions in that rule is that the applicant may show that complying with the latest requirement is impractical (§ 21.101(b)(3)). One method to show that complying with the latest requirement is impractical is to show that applying the latest amendment of the rule would result in added resource requirements that are not commensurate with safety benefits. That method is further discussed in paragraph 8c(2)(b) and Appendix 2 of AC 21.101–1.

The FAA assumes that those applicants proposing significant changes would not use the latest amendment of the flight guidance system rule if it was determined to be impractical. So, all such applications of the latest amendment will occur only if it is cost beneficial. Therefore, the final conclusions from the economic evaluation of this proposed rule would not be affected by considering the economic impact of flight guidance system changes. The applicant and the FAA may consider the question of whether or not complying with the latest amendment of the rule is impractical during the certification of a changed product.

What Are the Specific Proposed Changes?

This action would change the name of § 25.1329 and remove § 25.1335. It would revise paragraphs (a) through (h),

and add new paragraphs (i) through (m) of § 25.1329.

Proposed § 25.1329(a)

Paragraph (a) would be revised to contain the requirements relative to quick disengagement controls and their placement on both control wheels for easy accessibility [currently contained in paragraphs (a), (c) and (d)]. Requirements for quick and easily accessible disengagement controls for the automatic thrust systems would be added. These requirements would meet the recognized need for the pilot to be able to disengage the autothrust system during a high workload condition without moving his or her hands from the primary controls and throttle levers, a situation that would hinder task performance. The phrase ''or equivalent'' would be added after the reference to the control wheel. This is because some FGS designs would feature flight deck controls other than the traditional control wheels as the pilot's primary control mechanism.

Proposed § 25.1329(b)

Paragraph (b) would be revised to add a new requirement that would address the specific failure of the disconnect switch(es). Paragraph (b) would mandate that designers and manufacturers must assess what would happen if a system fails to disengage the autopilot or autothrust when the pilot manually commands them. That failure would then have to be addressed in relation to § 25.1309 which requires that a warning be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. The entire FGS must be evaluated to show compliance with § 25.1309. If the § 25.1309 assessment asserts that the aircraft can be landed manually with the autopilot or autothrust system engaged, then this should be demonstrated during a flight test.

Proposed § 25.1329(c), (d), and (e)

Current paragraphs (c), (d) and (e) would be revised to provide updated standards for transients for FGS engagement, switching, and normal and other-than-normal (rare normal and non-normal) disengagements. The current paragraph (b) addresses the need to limit transients during engagement, disengagement, and mode changes of the autopilot system. Current paragraph (b) is technically obsolete and does not have any bearing on modern autopilot systems. The intent of the current paragraph (b) regulation would be encompassed in revised paragraphs (c), (d), and (e).

Use the following definitions when determining compliance with proposed paragraphs (c), (d), and (e). The definitions of minor and significant transients are part of the proposed rule text. They are included here for completeness and understandability.

Transient: A disturbance in the control or flight path of the airplane that is not consistent with response to flight crew inputs or current environmental conditions.

Minor transient: A transient that would not significantly reduce safety margins, and which involves flightcrew actions that are well within their capabilities involving a slight increase in flightcrew workload or some physical discomfort to passengers or cabin crew.

Significant transient: A transient that would lead to a significant reduction in safety margins, a significant increase in flightcrew workload, discomfort to the flightcrew, or physical distress to passengers or cabin crew, possibly including non-fatal injuries. The flightcrew are able to respond to any significant transient without:

1. Exceptional piloting skill, alertness, or strength,

2. Forces greater than those given in § 25.143(c), and

3. Accelerations or attitudes in the airplane that might result in further hazard to secured or non-secured occupants.

The definition of a ''minor transient'' correlates to the definition provided in Advisory Circular 25.1309–1A of a ''minor failure condition.'' Section 25.1309 addresses failure conditions. Therefore, the term ''minor transient'' used in § 25.1329 cannot be directly related to the hazard classification used in § 25.1309, as the transients may or may not have anything to do with failure conditions. However, the concept for a result of a minor transient can be correlated to a failure condition that result in a minor hazard in § 25.1309. Similarly, the definition of a ''significant transient'' correlates to the definition of a ''major failure condition'' defined in the same AC. A transient larger than significant corresponds to a hazardous or catastrophic failure condition. In this way, the transient response of the flight guidance system can be correlated to well-understood hazard classifications provided by § 25.1309 and AC 25.1309–1A.

The terms ''minor transient'' and ''significant transient,'' are not absolute, that is, there is not always an unequivocally ''correct/incorrect'' or ''yes/no'' answer to each item being evaluated. They are dependent on the specific airplane type being evaluated. An example of this might be acceleration levels (also known as ''g'' forces) experienced by the cabin occupants inside a small commuter airplane during a transient. This transient, based on the criteria above, is determined to be significant. The ''g'' forces during this transient were measured to be a certain value. However, an identical ''g'' force value experienced by a jumbo transport category airplane during a transient does not necessarily mean that this transient must also be categorized as a significant transient. Other possible mitigating factors, such as those listed in the definition of ''significant transient'' above, should also be included in the evaluation. As with other terms used in § 25.1329, each case must be assessed individually, with consideration given to factors considered appropriate for that specific case.

Proposed paragraphs (c), (d), and (e) have been revised from the original ARAC proposal. The original proposed paragraphs read as follows:

(c) Engagement or switching of the flight guidance system, a mode, or a sensor must not produce a significant transient response affecting the control or flight path of the airplane.

(d) Under normal conditions, the disengagement of any automatic control functions of a flight guidance system must not produce any significant transient response affecting the control or flight path of the airplane, nor require a significant force to be applied by the pilot to maintain the desired flight path.

(e) Under other than normal conditions, transients affecting the control or flight path of the airplane resulting from the disengagement of any automatic control functions of a flight guidance system must not require exceptional piloting skill or strength to remain within, or recover to, the normal flight envelope.

The FAA has revised the ARAC report for proposed paragraphs (c), (d), and (e) of § 25.1329. The ARAC proposed paragraphs (c) and (d) did not allow a significant transient. There was no distinction made between the lesser transients allowed by proposed paragraphs (c) and (d) and the more substantial transient allowed by proposed paragraph (e). Therefore, proposed paragraphs (c) and (d) are revised to not allow anything more than a minor transient. The definition of ''minor transient'' is contained in proposed paragraph (c). Proposed paragraph (e) is revised to refer to the significant transient, and that term is then defined. These changes allow proposed rule paragraphs (c) and (d) to be independent of proposed rule paragraph (e).

Another change that was made to the original ARAC recommendation was to include the definitions for ''minor transient'' and ''significant transient'' in the rule text. The ARAC preferred to have these definitions included in the advisory material, rather than attempt to define very complicated technical terms in a way that can be included in a rule paragraph. An FAA advisory circular describes an acceptable means for showing compliance with the requirements. The guidance is neither mandatory nor regulatory in nature. The AC may explain or define what specific rule language means. One option would be to put these definitions in the preamble. This may be acceptable from a legal standpoint, as the preamble can be used to interpret or explain the rule language. However, for these particular rule paragraphs, the FAA finds that the rule will be more clear and effective if these definitions are included in the rule text. These concepts are difficult to grasp and do not have universally understood definitions. The FAA considers that an applicant is better served to have these terms defined within the rule text, rather than have an applicant research these terms.

Also, the original proposal for paragraph (e) referred to ''other than normal conditions.'' This is revised for clarity to ''rare normal and non-normal conditions.'' The ARAC discussed and accepted these proposed changes.

Proposed paragraphs (c), (d), and (e) use the terms ''normal conditions,'' ''rare normal conditions,'' and ''non-normal conditions.'' ''Rare normal'' refers to challenging environmental operating conditions that are not normally encountered during routine service of the airplane. The proposed terms ''normal'' and ''rare normal'' are not intended to imply a specific probability of these events occurring. ''Rare normal'' is within the normal operating envelope of the airplane and encompasses all foreseeable operating conditions. ''Rare normal'' is intended to make a distinction regarding the severity of the environmental and operational conditions encountered, not the probability of encountering those conditions, from those contained in the ''normal'' conditions. The proposed term ''non-normal conditions'' refers to failure conditions, both of the FGS and of other airplane systems. Note that with these definitions, ''rare normal conditions'' and ''non-normal conditions'' are two different concepts. That is, ''rare normal'' is not a subset of ''non-normal'' conditions. They can both be grouped under the term ''other than normal conditions.''

The following table gives examples of what constitutes ''normal,'' ''non-normal'' and ''rare normal'' conditions. It does not fully define every condition that may be encountered during an airplane's life and clearly categorize that condition. Rather, the table is intended to explain the intent of the rule language. There will always be, by the nature of the phenomena involved, some subjectivity to these categorizations. In addition, the same conditions may affect different airplane models in very different ways. These differences should be considered in determining how to characterize the severity of the conditions discussed below.

The three categories of operating conditions as discussed in this proposed rule are the following:

Normal Conditions	
No failure conditions	All airplane systems that are associated with airplane performance are fully operational. Failures of those systems could impair the flight guidance system's ability to perform its functions.
Light to moderate winds	Constant wind in a specific direction that may cause a slight deviation in intended flight path or a small difference between airspeed and groundspeed.
Light to moderate wind gradients	Variation in wind velocity as a function of altitude, position, or time, which may cause slight erratic or unpredictable changes in intended flight path.
Light to moderate gusts	Non-repetitive momentary changes in wind velocity that can cause changes in altitude and/or attitude to occur, but the aircraft remains in positive control at all times.
Light turbulence	Turbulence that momentarily causes slight, erratic changes in altitude and/or attitude (pitch, roll, or yaw).
Moderate turbulence	Similar to light turbulence but of greater intensity. Changes in altitude and/or attitude occur but the aircraft remains in positive control at all times.
Light chop	Turbulence that causes slight, rapid, and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude.
Moderate chop	Similar to light chop but of greater intensity. It causes rapid bumps or jolts without appreciable changes in aircraft altitude or attitude.
Icing	All icing conditions covered by 14 CFR Part 25, Appendix C, with the exception of ''asymmetric icing'' discussed under ''Rare Normal Conditions'' below.
Rare Normal Conditions	
Significant winds	Constant wind in a specific direction that may cause a large change in intended flight path or groundspeed, or cause a large difference between airspeed and groundspeed.
Significant wind gradients	Variation in wind velocity as a function of altitude, position, or time, which may cause large changes in intended flight path.
Windshear/microburst	A wind gradient of such magnitude that it may cause damage to the aircraft.
Large gusts	Non-repetitive momentary changes in wind velocity that can cause large changes in altitude and/or attitude to occur. Aircraft may be momentarily out of control.
Severe turbulence	Turbulence that causes large, abrupt changes in altitude or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control.
Asymmetric icing	Icing conditions that result in ice accumulations that cause the flight guidance system, if engaged, to counter the aerodynamic effect of the icing conditions with a sustained pitch, roll, or yaw command that approaches its maximum authority.
Non-Normal Conditions	
Significant fuel imbalance	Large variation of the amount of fuel between the two wing tanks (and center and tail tanks, if so equipped) that causes the flight guidance system, if engaged, to counter the aerodynamic effect of the fuel imbalance with a pitch, roll, or yaw command that is approaching maximum system authority.

Asymmetric lift or drag	Asymmetric lift between the left and right wings due to high lift or primary flight control system failures, or damage to the aerodynamic surfaces on wing or tail.
Inoperative engine(s)	Loss of one or more engines that causes the flight guidance system, if engaged, to counter the aerodynamic effect of the difference in thrust with a pitch, roll, or yaw command that is approaching maximum system authority.
Loss of one or more hydraulic systems.	Loss of one or more hydraulic systems, down to the minimum amount of remaining operational systems that the FGS is certified to operate.
Inoperative ice detection/protection system.	Loss of ice detection/protection system on an airplane so equipped, in a situation where the FGS is certified for operation in icing conditions with that failure present.

The intent of these proposed paragraphs is that all FGS function disconnects, both manual and automatic, result in the least disturbance to the flight path of the airplane possible. Under more adverse operating conditions, a larger transient may be impossible for the FGS by itself to prevent. Proposed paragraph (e) recognizes that the FGS will not be able to cope as well in these adverse conditions as they might in the relatively benign, no-failure conditions defined in proposed paragraph (d). Therefore, the proposed requirement for the allowable transient upon autopilot disengagement has been relaxed for these more adverse conditions.

Unless the FGS design uses a specific flight deck alert to let the flightcrew know of a significant/sustained out-of-trim condition, compliance with these proposed paragraphs should be assessed with an assumption of a reasonable response to the upset event by the pilot. The pilot should be ''hands off'' at the point of autopilot disengagement. Appropriate time delays for pilot recognition of and reaction to the failure or anomalous airplane behavior must be added to the upset recovery maneuver. The time for pilot recognition of an upset is normally less than one second. Reaction time varies with the phase of flight. In cruise, climb, descent, and holding, the pilot should not initiate the recovery action until at least three seconds after the recognition point. During approach, since the pilot is actively engaged in monitoring the progress of the airplane, an assumed reaction time of one second is appropriate.

A flight deck alert (sometimes referred to as ''bark before bite'') may be used to prompt the flightcrew to mitigate transients and therefore would be used to show compliance with these proposed paragraphs. The flight deck alert would notify the crew that an out-of-trim condition exists that would, if a disconnect were to occur at that time, cause a significant transient or more. The crew procedure would be, in response to this alert, to firmly grasp the controls, manually disconnect the autopilot, and retrim the flight control system as necessary. Having been alerted, the pilot is aware of the possibility of a transient and is expecting to counter it when the autopilot releases control. None of the failure recognition or reaction times discussed above need be applied during the recovery maneuver if the airplane is equipped with such an alert.

These proposed paragraphs would cover transients resulting from engagement, switching, and automatic and manual disengagements of the flight guidance system. A subset of automatic autopilot disengagement is when an autopilot disengages because of pilot override. An override occurs when the pilot or co-pilot applies input to the flight deck controls without first manually disengaging the autopilot. Autopilot systems have not always been designed to safely deal with this situation. Designers assumed the pilot would always manually disengage the autopilot before making inputs into the flight deck controls if he or she was not satisfied with the performance of the autopilot. These proposed regulations have been developed to address the accidents and incidents that have occurred involving this specific scenario. The proposed § 25.1329(d) would include transients occurring from autopilot disconnect caused by pilot override and specifies that under normal conditions autopilot override must not result in a significant transient. An automatic autopilot disconnect that results from a pilot override is a normal event. The system is to be designed for this occurrence, and should react in a safe, predictable manner. This is not intended to mean that a pilot override is the normal or preferred method of disengaging an engaged autopilot. It is just intended to mean that a pilot override is not a non-normal event.

Note: For the situation involving either an autopilot override that does not result in automatic disengagement of the autopilot or the resultant airplane configuration that occurs prior to an automatic disengagement, see proposed paragraph § 25.1329(l).

Proposed § 25.1329(f)

The proposed paragraph (f) is adapted from the requirements in the current §§ 25.1329(e) and 25.777(b). Proposed paragraph (f) would state that attitude controls must operate relative to the sense of motion involved, including the motion effect of the controls and airplane operation. For cockpit controls, proposed paragraph (f) would state that the attitude controls must have the direction of motion plainly indicated on, or adjacent to, each control. The proposed paragraph (f) would extend the requirement beyond attitude controls to all command reference controls.

The increasing variety of flight guidance systems can lead to non-intuitive designs that may promote flightcrew error. Command reference controls, which are parameters the pilot can set for airspeed, vertical speed, flight path angle, heading, altitude, and so on, are considered vulnerable to crew error if the sense of motion and control marking and the resulting airplane response are not consistent. If a specific FGS mode is active, changing that particular control position may have an immediate impact on the heading, altitude, or speed of the airplane. If, however, the appropriate FGS mode is not active, then manipulation of this control may only set a referenced target (for example, selected altitude). That referenced target remains until the control is manipulated again, or the appropriate FGS mode becomes active. At this point, the FGS will then actively ''seek'' that target. The FAA chose the term ''command reference controls'' instead of ''attitude controls,'' because the use of a term limited specifically to ''attitude'' might lead to confusion in the application of this rule.

Proposed paragraph (f) has been revised from the original ARAC recommendation. The original proposed paragraph read as follows:

(f) Command reference controls, such as heading select or vertical speed, must operate consistently with the criteria specified in §§ 25.777(b) and 25.779(a) for cockpit controls. The function and direction of motion of each control must be plainly indicated on, or adjacent to, each control if necessary to prevent inappropriate use or confusion.

After discussion of proposed paragraph (f) within ARAC, the proposed wording was revised to remove the first sentence. The ARAC

felt that this information was redundant. The FGS controls must already comply with § 25.777(b) without restating it in § 25.1329. Also, the reference to § 25.779(a) was incorrect, because that paragraph deals with trim tabs, primary controls, and flaps. This reference was therefore removed.

Proposed Changes to § 25.1329(g)

Proposed paragraph (g) would have the same requirement stated in current § 25.1329(f). This proposed requirement has been reworded and reformatted for clarity. It mandates that the system must be designed so it cannot produce hazardous loads on the airplane or create hazardous deviations in the flight path. This requirement applies during normal operation or in the event of a malfunction, assuming corrective action begins within a reasonable period. The phrase ''within the range of adjustment available to the human pilot'' contained in the original wording of § 25.1329(f) has been removed from proposed § 25.1329(g). This phrase adds little to the meaning of the regulation, as there is no real adjustment of the autopilot system available to the pilot that could affect airplane loads.

Proposed paragraph (g) has been revised from the original ARAC working group proposal. The original proposed paragraph read as follows:

(g) Under any condition of flight appropriate to its use, the Flight Guidance System must not:

- Produce unacceptable loads on the airplane (in accordance with § /JAR 25.302), or
- Create hazardous deviations in the flight path.

This applies to both fault-free operation and in the event of a malfunction, and assumes that the pilot begins corrective action within a reasonable period of time.

The first ARAC recommendation referred to proposed § 25.302 titled ''Interaction of systems and structure.'' During the FGS Harmonization Working Group activities, the ARAC Structures Harmonization Working Group was developing proposed § 25.302. The FAA planned to issue and publish these two proposed rules (§§ 25.1329 and 25.302) concurrently in the **Federal Register**. The FAA has since placed proposed § 25.302 on hold because of other rulemaking priorities. Therefore, the working group revised their proposed paragraph (g) to remove the reference to proposed § 25.302. This change, with minor editing and reformatting, removes the current text of paragraph (f) and adds it to proposed paragraph (g).

This proposed change does not affect the harmonization effort between the FAA and JAA. The JAA version (which is the original ARAC working group proposal) references the new material in JAR 25.302, and it defines exactly how to assess what is an ''unacceptable load.'' With the current § 25.1329(f), an assessment of compliance must actually come from the analyses and testing required by § 25.1309. This will also be true of proposed § 25.1329(g). Therefore, the intent of the JAA and proposed FAA rules remains identical. The FAA proposed § 25.1329(g) would depend upon compliance with § 25.1309 for evaluating the interaction of the FGS and the airplane structure.

One member of the working group expressed a concern that the FAA may assume a mandatory compliance method, and that flight testing would be the only method acceptable to show compliance with some proposed paragraphs of § 25.1329. Of particular concern is flight guidance system operation in icing conditions. Section 25.1329 proposed paragraphs (d), (e), and (g) do not specify a compliance method. They simply set forth design criteria. Proposed AC 25.1329–XX would provide guidance for one method of compliance. However, as with all advisory material, that proposed guidance would be one acceptable means, but not the only means for demonstrating compliance with this proposed regulation. Public comments concerning proposed AC 25.1329–XX are invited by separate notice published elsewhere in this issue of the **Federal Register**.

These paragraphs are not intended to require proof of compliance for amended type certificates (ATC) and supplemental type certificates (STC) solely through flight tests, especially when relevant service history data exists. An analysis of such data, and its determination of applicability to a given project, may be used by the applicant to meet the proposed requirement(s). Regarding certain environmental factors such as icing, and for ATC and STC projects (for example where an existing, approved autopilot is replaced by another autopilot), conducting a review of field history data may help in determining the extent of required flight testing. If the applicant can show that there is a lack of autopilot-related accidents and/or incidents in the icing environment involving a type certificated airplane, it may be possible to show compliance without needing additional flight tests with ice shapes or in natural icing. The responsible aircraft certification office must approve the applicant's justification.

Proposed § 25.1329(h)

This would be a new requirement for speed protection. It would include both high and low speed protection. It would require that when the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the airplane experiences an excursion outside this range, the flight guidance system must not provide guidance or control to an unsafe speed. The phrase ''to an unsafe speed'' is intended to mean that the flight guidance system should not control or provide guidance that would eventually lead to an aerodynamic stall or a speed that is in excess of the maximum operating speed, regardless of the maneuver being conducted at the time.

The FAA Human Factors Team completed a report in 1996 that evaluated flightcrew/flight deck automation interfaces. The Background section of this document contains a summary of that report. One of the Team's conclusion was that during FGS operation, flightcrew awareness of, or attention to, airspeed may not be sufficient to provide timely detection of unintended speed changes that could possibly compromise safety. In addition, in certain conditions, the current modes of the autopilot and/or autothrust may not be designed to prevent speed excursions outside the normal range.

This proposed requirement would prevent unwanted airspeed excursions. The preferred implementation is for the FGS to automatically provide control and/or guidance to avoid these excursions. However, an implementation providing increased awareness of airspeed and/or alerts for immediate crew recognition and intervention of a potential airspeed excursion may also be an acceptable means of complying with this regulation. Proposed AC 25.1329–XX would provide guidance for several methods of compliance. However, as with all advisory material, that proposed guidance would be one acceptable means, but not the only means, for demonstrating compliance with this proposed regulation. Public comments concerning proposed AC 25.1329–XX are invited by separate notice published elsewhere in this issue of the **Federal Register**.

When applying these proposed regulations to amended type certification or supplemental type certification programs, it may not always be possible to have the updated FGS be in compliance with this proposed paragraph without updating

some other, non-flight-guidance systems. Some of these previously certified airplanes, particularly the smaller part 25 airplanes, may not be fully equipped with interfacing airplane systems (specifically, angle-of-attack sensors) that are normally required to implement fully a speed protection function in the flight guidance system. It is the intent of this proposed rule that, with programs of this nature and given limitations such as the one discussed above, the applicant design the best system possible that meets the intent of this proposed regulation. However, an applicant for an STC or ATC flight guidance system update would not be required to also install angle-of-attack sensors to support the speed protection function. To require that could possibly make the entire STC/ATC program so expensive that the applicant might not choose to update an earlier technology autopilot with the latest technology available. Such a decision would result in the loss of all other substantial increases in safety that otherwise would have been gained if the applicant had chosen to continue with that STC/ATC program.

Proposed § 25.1329(i)

This proposed paragraph (i) would have the same text as current paragraph (h), requiring indication of current mode of operation. It would also specify that these indications must include any armed modes, transitions, and reversions. It would add a statement of the safety objective to minimize crew errors and confusion. It would address logical grouping and presentation of mode indications and controls for the sake of visibility from each pilot position and for flightcrew awareness of active modes and mode changes. This proposed paragraph would also incorporate the current § 25.1335 text requiring indication of the mode of operation of any flight director.

Studies have shown that lack of sufficient flightcrew awareness of modes, transitions, and reversions is a key safety vulnerability. This paragraph would provide the regulatory basis for several provisions of the proposed advisory circular related to enhanced flightcrew awareness of flight guidance system active and armed modes. It would also address the need for awareness of changes in flight guidance system behavior that may otherwise be unanticipated by the flightcrew.

Proposed § 25.1329(j)

This proposed requirement for a visual and auditory warning of autopilot disengagement would be adopted from the current JAR 25.1329(i) and does not exist in the current 14 CFR part 25. This JAR requirement is appropriate because disengagement of the autopilot, for whatever reason, makes timely flightcrew intervention necessary to assume manual control of the airplane. Timely, in this case, is meant to specify a period suitable for the specific situation, without mandating a specific time period within the rule itself. The proposed requirement that the warning look and sound distinct from other cockpit warnings is meant to provide unequivocal awareness that the flightcrew must assume manual control of the airplane.

The term ''warning'' is defined in FAA Advisory Circular 25–11, Section 10. Current FAA harmonization and rulemaking activity regarding to § 25.1322, ''Warning, caution, and advisory lights,'' when issued, would result in the definition of this term within the rule itself.

The original ARAC recommendation contained the wording ''a visual and aural warning.'' The working group membership discussed that wording and changed it to ''a warning (visual and aural).'' This would ensure there was no confusion by the reader that there are two components to a warning, one visual and one aural.

Proposed § 25.1329(k)

This proposed paragraph is a new requirement. It would mandate providing a ''caution'' to each pilot when the autothrust has been disengaged.

The flightcrew needs to be aware that the autothrust system has disengaged, so they do not continue to expect the desired speed control to be provided. Normally, however, autothrust disengagement would not require immediate thrust control changes by the flightcrew. Therefore, the less specific ''caution'' rather than ''warning'' is required.

The term ''caution'' is defined in FAA Advisory Circular 25–11, Section 10. Also, current FAA harmonization and rulemaking activity regarding § 25.1322, ''Warning, caution, and advisory lights,'' when issued, would result in the definition of this term within the rule itself.

Proposed § 25.1329(l)

This new paragraph requires that flightcrew override of the autopilot must not create a potential hazard when the flightcrew applies an override force to the flight controls. As stated previously in the discussion on § 25.1329(d), an override occurs when the pilot or first officer applies input to the flight deck controls without first manually disengaging the autopilot. Pilot override may not always result in autopilot disengagement. If the autopilot does not disengage during override, the result might be an out-of-trim condition (for example, a horizontal stabilizer/elevator jackknife, where the surfaces are aerodynamically opposing each other). This could result in a significant transient and/or loss of control if the autopilot were to be disconnected or if the pilot were to suddenly release the force being applied to the flight deck controls while the airplane is in this configuration. Several accidents and incidents have occurred after flightcrew override of the autopilot. Nevertheless, it is not advisable to prohibit flightcrew override in all cases, because override might be the last resort for the flightcrew to regain control of the airplane in certain abnormal (failure) conditions or in an emergency avoidance maneuver.

This rule paragraph is changed from the original ARAC recommendation. That proposed rule language used the term ''unsafe condition.'' The FAA revised this rule paragraph to use the term ''potential hazard'' instead of ''unsafe condition.'' The reason behind this revision is that the term ''unsafe condition'' has a very definite meaning within the context of FAA regulations. Under 14 CFR part 39, we issue airworthiness directives when we determine that an ''unsafe condition'' is likely to exist or develop on other products of the same type design. Proposed paragraph (l) addresses a specific type of hazard, and so the use of the broad term ''unsafe condition,'' with its many implications under part 39, is inappropriate. Also, § 21.21(b)(2) prohibits certification of any aircraft which contains unsafe design features, so the original wording of this paragraph would be redundant of the part 21 rule. Therefore, the FAA revised this rule paragraph to refer to ''potential hazard'' instead.

This preamble does not attempt to give a complete definition of the term ''potential hazard.'' The FAA cannot define all airplane configurations that should be considered potentially hazardous that may occur during a flightcrew override. To do so would be too restrictive, as this would assume the FAA is able to fully define all hazardous or potentially hazardous conditions that might result for all current and future FGS and airplane designs. What this term means is anything that could significantly reduce safety margins or invalidate any assumption or premise made by the System Safety Assessment.

The term ''potential hazard'' used above is intended to describe possible

future hazards if another event were to happen with the airplane in a specific configuration during the override. That event might be an autopilot disengagement, the pilot abruptly releasing the controls, or another failure that occurs during the flightcrew override. Therefore, the term ''potential hazard'' is not fully defined. Rather, a description of the concept has been used to explain what is meant and how compliance with this paragraph could be demonstrated. Proposed paragraph (l) should be evaluated under ''normal conditions'' discussed elsewhere in this document.

Proposed § 25.1329(m)

This new paragraph requires that the flightcrew be able to move the thrust levers during autothrust operation without using excessive force. It requires that the autothrust response to flightcrew override must not create a potential hazard.

This rule paragraph is changed from the original ARAC recommendation. That proposed rule language used the term ''unsafe condition.'' For the reasons described for § 25.1329(l), the FAA revised this rule paragraph to use the term ''potential hazard'' instead of ''unsafe condition.'' We intend ''potential hazard'' under this paragraph to have the same meaning as under § 25.1329(l). Examples of potentially hazardous situations include a rapid and unexpected change in the pitch attitude of the airplane (because of a change in engine thrust on an airplane with underslung engines) or an uncontrolled increase or decrease in the thrust settings.

As under § 25.1329(l), the term ''potential hazard'' is used to describe possible future hazards if another event were to happen with the airplane in a specific configuration during the override. That event might be an autothrust system disengagement, the pilot abruptly releasing the controls, or another failure that occurs during the flightcrew override. Therefore, the term ''potential hazard'' is not fully defined. Rather, a description of the concept has been used to explain what is meant and how compliance with this paragraph could be demonstrated.

There may be times when the flightcrew needs to immediately change thrust without first manually disengaging the autothrust system. There may be cases when the normal controls for disengaging the autothrust system have failed and the ability to override the autothrust system is the only means available to manually control thrust.

Proposed § 25.1335

Current § 25.1335 requires that if a flight director system is installed, its current mode of operation must be indicated to the flightcrew. The text of § 25.1335 would be removed and added to proposed § 25.1329(i). Section 25.1335 would be removed from the CFR.

What Comments Were Received From the ARAC in Response to the Proposal?

A ''Fast Track Harmonization'' rulemaking project provides for a formal review of the draft NPRM, if requested, by the ARAC. The ARAC did not request a formal review.

A meeting with the FAA, JAA, and FGS working group was held in Toulouse, France, in February 2004. Discussions concerning disposition of comments on the JAA NPA for JAR 25.1329 prompted the FAA to request comments on the NPRM from attending ARAC FGS working group members. The FAA received three comments. Although ARAC did not request a review of the NPRM, the intent of an ARAC review has been fulfilled.

The JAA proposed to adopt ARAC's recommendation without change. While we revised the proposed regulatory text in this NPRM from ARAC's recommendation to clarify certain provisions, we have confirmed that the substance and intent are the same. We therefore consider this proposal to be fully harmonized with the JAA's because the rules would have the same effect.

The following comments represent those received informally from the FGS working group members at the Toulouse meeting.

FAA Response to Comment on the Term ''Rare Normal Condition,'' Proposed Paragraph (e): One FGS working group member disagreed with a statement included in the proposed preamble language that the term ''rare normal condition'' is intended to make a distinction regarding the severity of the environmental and operational conditions encountered, not the probability of encountering those conditions. The commenter asserted that the HWG did imply to infer probability when discussing ''rare normal'' conditions.

FAA Disposition of Comment: The FAA disagrees with this comment. ''Rare normal conditions'' cannot imply anything about the probability of encountering those conditions for the following reasons. Some icing conditions (possibly severe) may be encountered on a regular basis, perhaps daily. This is especially true, for example, given a specific daily operation in some extreme weather conditions (for example, northern latitudes in stormy conditions in autumn or winter). Therefore, in the probabilistic sense of the word, it may not be ''rare'' to encounter these severe conditions.

The real concern is that the Flight Guidance System must be able to handle these adverse environmental conditions according to the proposed regulations whenever they occur, regardless of how often they occur. Proposed paragraphs (d) and (e) would make a distinction based on the severity of the condition encountered, not the probability of encountering that condition. Proposed paragraph (e) would allow some degradation of system performance for the more severe environmental conditions encountered than those allowed by paragraph (d). The probability of encountering those conditions is not an issue.

Changes: No change was made to the NPRM because of this comment.

FAA Response to Comment on the Proposed Preamble Discussion of Pilot Override: One FGS working group member disagreed with the discussion in the proposed preamble that states, ''An automatic autopilot disconnect due to a pilot override is a normal condition. The system is to be designed for this occurrence. It is not considered a non-normal event.'' The commenter strongly disagreed with the FAA statement that an override is a normal condition. The commenter expressed concern that the FAA and applicants would take this to mean that an override was a normal way to ''disengage an autopilot.''

FAA Disposition of Comment: The FAA disagrees with the main point of this comment. If a pilot override was classified as a non-normal event, proposed paragraph (e) would allow a significant transient to result because of the override. The override would be addressed with this proposed rule. Several accidents and incidents have occurred because of a pilot override of an engaged autopilot. This proposal would require a transient resulting from an override to be as benign as possible [in other words, to be covered by proposed paragraph (d)]. Classifying an override as a ''non-normal condition'' would be contrary to this intent.

One relevant point is that an override is not a ''condition.'' It is an action taken by the flightcrew. It may be in response to a system failure, a reflexive reaction by the pilot to avoid oncoming traffic, or even a desire to assist an engaged autopilot in leveling off or slowing down a descending airplane without first manually disengaging the

system. A ''condition,'' based on proposed § 25.1329 text and the proposed AC 25.1329–XX, is due to a system failure or adverse environmental circumstance, or (in the case of a normal condition) the lack of failures or adverse environmental circumstances. A pilot action is therefore not a ''condition.''

Changes: The FAA agrees that the proposed preamble wording should be revised. The revised NPRM would state that an override is a normal event rather than a normal condition, and make it clear that an override is not the usual or preferred method to disengage an engaged autopilot. We have revised the NPRM.

FAA Response to Comment on the Term ''Hazardous Conditions,'' Proposed Paragraph (g): One FGS working group member stated that the revision made to proposed paragraph (g) did not fully define flight guidance malfunction criteria, and that the term ''hazardous conditions'' is confusing. The commenter stated that this could be misconstrued as the AC 25.1309 definition of ''hazardous.'' The commenter suggests that proposed paragraph (g) should ''invoke the concept that the severity of the malfunction is inversely proportional to the probability of occurrence.'' This would relate flight guidance malfunctions to the following § 25.1309 standards:

- A malfunction, which exceeds structural limits, should be Extremely Improbable.
- A malfunction, which exceeds limit loads or results in serious or fatal injury to a relatively small number of occupants, should be Extremely Remote.
- A malfunction which results in physical distress, possibly including injuries should be Remote.

FAA Disposition of Comment: The commenter has two comments. First, the commenter finds the use of the term ''hazardous'' confusing. The FAA disagrees with this comment. The proposed use of hazardous in paragraph (g) is very similar to the use of hazardous in the current § 25.1329. Proposed paragraph (g) would invoke the concept of the § 25.1309 definition of hazardous.

Note: The only difference between current paragraph § 25.1329(f) and the ARAC recommendation is the removal of the language, ''within the range of system adjustments available to the human pilot.'' This language is removed because it is confusing and technically obsolete.

Second, the commenter states that proposed paragraph (g) should ''invoke the concept that the severity of the malfunction is inversely proportional to the probability of occurrence.'' The FAA does not consider this necessary. The autopilot system being certified under proposed § 25.1329(g) must also meet the requirements of § 25.1309. Therefore, this concept is already covered by that regulation and does not need to be repeated in proposed § 25.1329(g).

Changes: The FAA does not agree. No change will be made to proposed paragraph (g).

What Is the Effect of the Proposed Standard Relative to the Current Regulations?

The proposed rule expands the scope of § 25.1329 beyond autopilot systems to include requirements for flight director and autothrust. These functions are increasingly integrated into the same equipment. The fundamental principles for engagement, disengagement, and flightcrew awareness of changes in system operation, apply to each of the functions in a similar manner. The NTSB has recommended changes for enhanced flightcrew awareness of system operation and changes in airplane condition. Often, during FGS operation, the flightcrew is insufficiently aware of changes in attitude, airspeed, trim, and so forth that could adversely affect flight safety. This proposed rule and proposed advisory circular would increase the level of safety through improved system indications, annunciations, and speed protection. It would also encourage modern airplane flight deck standardization, which would also improve safety when flightcrew personnel pilot more than a single airplane type.

What Is the Effect of the Proposed Standard Relative to the Current Regulations?

The effect of the proposed change on current industry practice would be that:

- Operating differences between different airplane types would be minimized.
- Manufacturers would be required to assess system transients during disengagement of the autopilot systems.
- Flight guidance systems would be required to address the issue of speed protection.
- Certification standards for flight guidance systems for the U.S. and Europe would be harmonized.
- Other design enhancements would be incorporated to address system vulnerabilities that have been highlighted by several NTSB safety recommendations and FAA studies.

What Other Options Have Been Considered and Why Were They Not Selected?

The following is a discussion of major alternatives considered during the rulemaking activity, and the reasons each proposal was ultimately rejected.

- Envelope FAA and JAA requirements without adding new requirements.

Pro: Enveloping the FAA and JAA rules (adopting the more rigorous requirements of each) would have been a much simpler rulemaking task and an easier adjustment for industry. It would have harmonized the requirements and simplified bilateral validation programs.

Con: The existing requirements are out of date. They do not adequately address safety issues related to current designs and the anticipated direction of future designs. Service history and studies show that previous assumptions about flightcrew awareness of the airplane during autopilot operation are out of date as well. Flightcrew reliance on automated flight control systems has increased markedly since the current regulations were issued. The FAA Human Factors Team report, many NTSB safety recommendations, and other information (noted earlier in this document) point out the need to enhance flightcrew awareness of autopilot and guidance system operation. Newer designs enable functions that were not possible for automated systems when the current regulations were developed. They integrate the functions of many related systems and are far more complex than ''first or second generation'' systems based on analog technology. The newer designs also tend to be more complex from the crew's perspective, and vulnerable to flightcrew confusion over mode behavior and transitions. Standards cannot be effective if they simply address a particular avionics system; they need to address the functionality, regardless of which systems host the functionality. For reasons like these, the simple adoption of current requirements would not provide adequate safety standards.

- Define the scope of the rule to include all automatic control and guidance systems including FMS, yaw damping, integrated energy management, and so forth.

Pro: If mandated, a fully integrated system such as the one described above would provide increased safety because complex interactions between systems would be transparent to the flightcrew. All human-machine interfaces would be consistent among the various functions. All functionality would be totally

integrated and would not (if designed correctly) result in a situation where the individual system ''expectations'' conflicted with each other.

Con: This activity was considered out of the scope of the ARAC tasking, although such a system may be desirable for future development. Many of the functions listed are not considered part of a flight guidance system, and would therefore require coordination and agreement on appropriate language addressed in several other ARAC tasks. This would jeopardize completion of this rulemaking within a reasonable time. Also, the cost of such a system would most likely be prohibitive when applied to some of the smaller part 25 category aircraft.

• Require full flight envelope protection, that is, protections provided by the FGS, available in all flight phases and operational modes, that would not allow the airplane to exceed certain predefined speeds, pitch and bank angles, ''g'' maneuvers, and so forth, or would alert the pilot to that these limits were being exceeded.

Pro: Enhanced safety in all flight phases and flight guidance system modes.

Con: The cost/benefit return was not sufficient, because the primary focus in accidents and incidents is speed rather than full flight envelope. Therefore, the most cost-effective approach would be requiring speed protection only. Also, full flight envelope protection is more a function of design of the overall flight control system of the airplane, and not the flight guidance system.

• Require that speed protection always involve some form of automatic autothrust ''wakeup,'' that is, automatic autothrust system engagement from a disengaged state.

Pro: Enhance safety by having low speed protection thrust control engage automatically, even if the autothrust system is not currently active.

Con: Many airplanes are not equipped with an autothrust system, so those airplanes would not benefit from any regulation of this type. Also, many autothrust systems must be manually armed by manipulating a switch before the automatic function is allowed to become active. This is a necessary safeguard in some systems to prevent inadvertent activation when it could be hazardous (on the ground, for example). System designs that require the manual switch before the system can be activated would make the design of such a ''wake up'' feature very difficult and costly to implement. The ARAC decided that the proposed rule and AC adequately address low speed awareness and protection without requiring this feature.

Who Would Be Affected by the Proposed Change?

Avionics manufacturers would incur the added expense and time of designing and developing systems with extra features that would meet new proposed regulations (high and low speed protection, for example). Airplane manufacturers would be impacted as well. Operators could be affected by additional training requirements and the need to update equipment and documentation.

The proposed rule would apply to all new type certification (TC) programs. There would be added development costs incurred by both avionics and airplane manufacturers to meet these new regulations. When the NPRM is issued and the proposed requirements become known, the new features could be incorporated as part of the basic design.

The proposed rule, if applied to supplemental type certification (STC) or amended type certification (ATC) programs, would update previously certified airplanes and ATC programs. If the changes are ''cut-in'' to an existing production line, then new functionality of the airplane could be required (speed protection, for example) and therefore added costs could be incurred. These added costs would be dependent upon the configuration of the airplane being modified and the functionality of the system required to be installed in that airplane. The STC/ATC applicant could incur costs to modify the airplane, for example, to add additional sensors, and wiring. There would be increased costs associated with, for example, equipment, development, and flight test. Both the avionics vendor and the STC/ATC applicant would incur increased costs to cover extended development and certification of the modified airplane. The operator and airplane manufacturer could incur increased costs if part of a fleet is required to meet the latest regulations. The operator might elect to bring its entire fleet up to the latest standards for fleet commonality and training considerations.

Is Existing FAA Advisory Material Adequate?

No, the existing advisory material is not adequate. The existing advisory material would be made obsolete by this proposed rule. The ARAC developed a proposed harmonized advisory circular, proposed AC 25.1329–XX. Public comments concerning proposed AC 25.1329–XX are invited by separate notice published elsewhere in this issue of the **Federal Register**.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. We have determined that there are no new information collection requirements associated with this proposed rule.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed regulations.

What Regulatory Analyses and Assessments Has the FAA Conducted?

Regulatory Evaluation Summary, Regulatory Flexibility Determination, International Trade Impact Assessment, and Unfunded Mandates Assessment

This portion of the preamble summarizes the FAA's analysis of the economic impacts of this NPRM, consistent with various Federal directives and orders. Each Federal agency proposing a regulation must make a reasoned determination that the benefits justify the costs, and, separately, assess the effects on small entities, international trade, and whether or not the proposal imposes a Federal mandate resulting in a total expenditure of $100 million or more in any one year (an ''unfunded mandate assessment''). In conducting these analyses, the FAA has determined that the proposal:

(1) Has benefits that justify its costs;
(2) Is not a significant regulatory action;
(3) Would not have a significant impact on a substantial number of small entities;
(4) Is in compliance with the Trade Agreement Act; and
(5) Does not impose an unfunded mandate of $100 million or more, in any one year, on State, local, or tribal governments, or on the private sector.

The FAA has placed these analyses in the docket and summarized them below.

Total Costs and Benefits of This Rulemaking

Estimated discounted costs—

Small part 25 certificated airplanes (large business jets): $97 million.

New-production part 25 large transport category airplanes already meet the proposed requirements.

Estimated discounted benefits—

Small part 25 certificated airplanes (large business jets).

Qualitative Benefits Analysis—NPRM may avert four accidents with a value equivalent to discounted costs of $97 million.

Who Is Affected by This Rulemaking?

Manufacturers of small part 25 airplanes incur costs.

Occupants in affected airplanes receive safety benefits.

Assumptions and Standard Values

- Discount rate: 3%.
- Period of analysis: 2005–2040. Costs, 2005–2015 (one year of certification costs followed by ten years of production costs; there are no operating costs incurred as a result of the revisions). Benefits, 2007–2040 (based on 25-year operating lives of newly-certificated airplanes, all of which will be produced between 2006–2015).
- Value of statistical fatality avoided: $3 million.
- The proposed rule would significantly reduce occurrence of autopilot-related accidents in part 25 business jets.

Alternatives Considered

JAA/FAA harmonized standards were selected for this NPRM because of both the assessed improvements in operation of autopilot systems and the potential cost savings resulting from harmonization of FAA and JAA requirements.

Costs of This Rulemaking

Certification costs (non-recurring) equal $530,000 for each of four type-certifications. Recurring costs equal $52,000 for each airplane produced. Non-recurring and recurring costs total $116.520 million, or $96.554 million at present value. Present value costs are based on a 3% discount factor, which is allowed by the Office of Management and Budget where a study period covers 25 or more years; the combined costs-benefits period of analysis covers 36 years—2005 to 2040.

Benefits of This Rulemaking

The FAA has estimated the minimum levels of averted losses, in terms of avoided fatalities and airplane damage (each accident is valued at $40 million, *i.e.*, ten fatalities at $3 million each plus $10 million airplane replacement value) that would be necessary to offset the estimated compliance costs. The FAA has determined that the proposed rule would be cost-beneficial if four accidents were averted in the 34-year benefits period. There were four accidents or serious incidents involving business jets over a recent 20-year period (1983–2002); thus, over the future 34 years evaluated in this benefits' analysis, in the absence of a rule, one could expect nearly twice that number, or seven. Although it is not certain that the earlier events could have been prevented by the proposed autopilot changes (or, how many of any potential future accidents would, in fact, be catastrophic), the expected prevalence of more sophisticated autopilot systems in business jets, combined with the occurrence of serious accidents involving large transports (these provided the impetus for this rulemaking—see full regulatory evaluation), mandates regulatory action. For these reasons, the FAA finds this proposed rule to be cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) requires that agencies perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. The proposed rule would affect manufacturers of part 25 business jets produced under future new type-certificates. For manufacturers, a small entity is one with 1,500 or fewer employees. None of the part 25 manufacturers have 1,500 or fewer employees.

Based on the above, the FAA certifies that the proposed rule would not have a significant economic impact on a substantial number of small entities. The FAA invites comments on the estimated small entity impact from interested and affected parties.

International Trade Impact Assessment

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activities 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.

In accordance with the above statute, the FAA has assessed the potential effect of this proposed rule for airplanes produced under the affected FAR part. This rulemaking is consistent with the Trade Agreement Act since JAA and FAA international standards are the basis for this rulemaking.

Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (the Act) requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate in a proposed or final agency rule that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year. The FAA determines that this proposed rule does not contain a significant intergovernmental mandate.

What Other Assessments Has the FAA Conducted?

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action would not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, we determined that this notice of proposed rulemaking would not have federalism implications.

Plain English

Executive Order 12866 (58 FR 51735, Oct. 4, 1993) requires each agency to write regulations that are simple and easy to understand. We invite your comments on how to make these proposed regulations easier to understand, including answers to questions such as the following:

- Are the requirements in the proposed regulations clearly stated?
- Do the proposed regulations contain unnecessary technical language or jargon that interferes with their clarity?
- Would the regulations be easier to understand if they were divided into more (but shorter) sections?
- Is the description in the preamble helpful in understanding the proposed regulations?

Please send your comments to the address specified in the **ADDRESSES** section.

Environmental Analysis

FAA Order 1050.1D defines FAA actions that may be categorically excluded from preparation of a National Environmental Policy Act (NEPA) environmental impact statement. In accordance with FAA Order 1050.1D, appendix 4, paragraph 4(j), this proposed rulemaking action qualifies for a categorical exclusion.

Regulations That Significantly Affect Energy Supply, Distribution, or Use Impact

The FAA has analyzed this NPRM under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). We have determined that it is not a ''significant energy action'' under the executive order because it is not a ''significant regulatory action'' under Executive Order 12866, and it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements, Safety, Transportation.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend Part 25 of Chapter 1 of Title 14, Code of Federal Regulations, as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702 and 44704.

2. Revise § 25.1329 to read as follows:

§ 25.1329 Flight guidance system.

(a) Quick disengagement controls for the autopilot and autothrust functions must be provided for each pilot. The autopilot quick disengagement controls must be located on both control wheels (or equivalent). The autothrust quick disengagement controls must be located on the thrust control levers. Quick disengagement controls must be readily accessible to each pilot while operating the control wheel (or equivalent) and thrust control levers.

(b) The effects of a failure of the system to disengage the autopilot or autothrust functions when manually commanded by the pilot must be assessed in accordance with the requirements of § 25.1309.

(c) Engagement or switching of the flight guidance system, a mode, or a sensor must not cause a transient response of the airplane's flight path any greater than a minor transient. For purposes of this section, a minor transient is an abrupt change in the flight path of the airplane that would not significantly reduce airplane safety, and which involves flightcrew actions that are well within their capabilities involving a slight increase in flightcrew workload or some physical discomfort to passengers or cabin crew.

(d) Under normal conditions, the disengagement of any automatic control function of a flight guidance system must not cause a transient response of the airplane's flight path any greater than a minor transient.

(e) Under rare normal and non-normal conditions, disengagement of any automatic control function of a flight guidance system must not result in a transient any greater than a significant transient. Significant transients may lead to a significant reduction in safety margins, an increase in flightcrew workload, discomfort to the flightcrew, or physical distress to the passengers or cabin crew, including non-fatal injuries. Significant transients do not require, in order to remain within or recover to the normal flight envelope, any of the following:

(1) Exceptional piloting skill, alertness, or strength.

(2) Forces applied by the pilot which are greater than those specified in § 25.143(c).

(3) Accelerations or attitudes in the airplane that might result in further hazard to secured or non-secured occupants.

(f) The function and direction of motion of each command reference control, such as heading select or vertical speed, must be plainly indicated on, or adjacent to, each control if necessary to prevent inappropriate use or confusion.

(g) Under any condition of flight appropriate to its use, the flight guidance system must not produce hazardous loads on the airplane, nor create hazardous deviations in the flight path. This applies to both fault-free operation and in the event of a malfunction, and assumes that the pilot begins corrective action within a reasonable period of time.

(h) When the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the airplane experiences an excursion outside this range, the flight guidance system must not provide guidance or control to an unsafe speed.

(i) The flight guidance system functions, controls, indications, and alerts must be designed to minimize flightcrew errors and confusion concerning the behavior and operation of the flight guidance system. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and consistent manner. The indications must be visible to each pilot under all expected lighting conditions.

(j) Following disengagement of the autopilot, a warning (visual and auditory) must be provided to each pilot and be timely and distinct from all other cockpit warnings.

(k) Following disengagement of the autothrust function, a caution must be provided to each pilot.

(l) The autopilot must not create a potential hazard when the flightcrew applies an override force to the flight controls.

(m) During autothrust operation, it must be possible for the flightcrew to move the thrust levers without requiring excessive force. The autothrust must not create a potential hazard when the flightcrew applies an override force to the thrust levers.

§ 25.1335 [Removed].

3. Remove § 25.1335.

Issued in Renton, Washington, on July 28, 2004.

Ali Bahrami,

Manager, Transport Airplane Directorate, Aircraft Certification Service.

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