

NPRM 90-14

DEPARTMENT OF TRANSPORTATION**Federal Aviation Administration****14 CFR Part 135****[Docket No. 26202; Notice No. 90-14]****RIN 2120-AD29****Ground Proximity Warning Systems****AGENCY:** Federal Aviation Administration (FAA), DOT.**ACTION:** Notice of Proposed Rulemaking (NPRM).

SUMMARY: The FAA proposes to revise the operating rules for air taxi and commercial operators by requiring that all turbine-powered (rather than just turbojet) airplanes with ten or more seats be equipped with an approved ground proximity warning system. The proposed changes are needed because studies have shown that several controlled flight into terrain accidents involving turbo-propeller powered airplanes might have been avoided had the airplanes been equipped with a ground proximity warning system. This proposed rule is intended to reduce the risk of airplanes being flown into terrain with no apparent awareness by the crews that they are approaching the ground.

DATES: Comments must be received on or before July 23, 1990.

ADDRESSES: Comments on this notice should be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), room 915G, Docket No. 26202, 800 Independence Avenue SW., Washington, DC 20591. Comments must be marked Docket No. 26202. Comments may be examined in the Rules Docket between 8:30 a.m. and 5 p.m. on weekdays, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Mr. Philip Akers, Aircraft Certification Service, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-9571.

SUPPLEMENTARY INFORMATION:**Comments Invited**

Interested persons are invited to participate in the making of this proposed rule by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this notice are also invited. Substantive comments should be accompanied by cost estimates. Comments should identify the regulatory docket or notice

number and be submitted in triplicate to the Rules Docket address above. All communications received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. Persons wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must submit with those comments a preaddressed, stamped postcard on which the following statement is made: "Comments to Docket No. 26202." The postcard will be dated and time stamped and returned to the commenter. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerned with this rulemaking will be filed in the docket.

Availability of NPRM

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center (APA-230), 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267-3484. Requests must identify the notice number of this NPRM.

Persons interested in being placed on the mailing list for future NPRMs should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

Beginning in the 1970's, a number of studies conducted by the National Transportation Safety Board (NTSB), the United Kingdom's Civil Aviation Authority, and independent researchers looked into accidents that were classified as "Controlled Flight Into Terrain" (CFIT). In CFIT-type accidents, an airplane under the control of a fully qualified and certificated crew is flown into terrain (or water or obstacles) with no apparent awareness on the part of the crew of an impending disaster. In general, studies have shown that a ground proximity warning system (GPWS) would be a useful warning device to prevent CFIT accidents. (For detailed information on the studies, see "Investigation of Controlled Flight Into Terrain (CFIT)", Department of Transportation, Transportation Systems Center, March 1989 (hereafter referred to as "DOT-TSC study"). A copy of this study has been placed in the Rules Docket.)

Section 121.360 (Amendment 121-114, published in December 1974, 39 FR

44439) required all part 121 and some part 135 certificate holders to install GPWS's on large turbine-powered airplanes. The GPWS requirements were further refined by amendments in 1975 and 1976. (See 40 FR 19638, 42183, 50707, 55313, and 41 FR 35070.) No requirements for small turbine-powered airplanes operating under part 135 existed until October 1978, when § 135.153 was adopted. This regulation prohibited part 135 certificate holders from operating turbojet airplanes with 10 or more seats unless the airplanes were equipped with either GPWS's that met specific TSO requirements or alternative ground proximity advisory systems approved by the Director, Flight Standards Service.

The term "GPWS," as used in this document, means a warning system that could meet TSO-C92b or subsequent TSO's issued for GPWS. This is the type of system that operates only when there is an imminent potential hazard. The terms "ground proximity advisory system" and "advisory system" are used to refer to the type of alternative system authorized under present § 135.153(b), and refers to systems that usually provide routine altitude callouts, whether or not there is any imminent danger.

In 1978, the requirement for installing GPWS's or alternative ground proximity advisory systems in small turbojet airplanes operating under part 135 was considered necessary because of the complexity, size, speed, and flight performance characteristics of these airplanes. GPWS's or alternative approved advisory systems were therefore considered an essential element in helping the pilots of these planes to regain altitude quickly and avoid what could have been a CFIT-type accident.

Installation of GPWS's or alternate approved advisory systems was not originally required on turbo-propeller powered (turboprop) airplanes because, at the time, it was believed that the performance characteristics of turboprop airplanes made them less susceptible to CFIT accidents. Turboprop airplanes have a greater ability to respond quickly in situations where altitude control is inadvertently neglected, as compared to turbojet airplanes.

A 1981 study found that the use of GPWS's contributed to the prevention of CFIT accidents. (R. Porter and J. Loomis, "An Investigation of Reports of Controlled Flight Toward Terrain (CFTT).") The study reviewed CFIT-type incident reports from 1976-1980 and found that GPWS's and Minimum Safe

Altitude Warning (MSAW) equipment were "the initial recovery factor in some 18 serious incidents and were apparently the sole warning in 6 reported instances which otherwise would most probably have ended in disaster."

In October 1986, the NTSB published a study investigating the causes of three commuter air carrier accidents. One element explored in the study was the use of ground proximity warning devices. The NTSB pointed out that between 1975 and 1978, after FAA had required GPWS's for large turbine-powered airplanes operated under part 121, CFIT accidents decreased by 75 percent for part 121 operations.

The NTSB stated that it was "convinced that each of these (three) accidents could have been prevented if the flightcrew had been alerted to their proximity to the ground in sufficient time to have initiated missed approach procedures." The study went on to say that although the number of turboprop airplanes used for commuter purposes was increasing, thereby affecting a larger number of passengers, there was no regulation requiring that these airplanes be equipped with ground proximity warning systems or devices. The NTSB therefore recommended the following:

Amend 14 CFR 135.153 to require after a specified date the installation and use of ground proximity warning devices in all multiengine, turbine-powered fixed wing airplanes, certificated to carry 10 or more passengers.

In its report the NTSB stated that it "realizes that a full GPWS, such as those installed in large turbojet airplanes, may be prohibitively expensive to retrofit into part 135 type airplanes."

At the request of the FAA, an investigation into CFIT accidents involving turbine-powered airplanes operating under part 135 was conducted by the Department of Transportation-Transportation Systems Center [DOT-TSC]. The investigation, which was undertaken in response to the above NTSB recommendation, studied data from 41 CFIT accidents occurring between 1970 and 1988. Of the 41 accidents, complete accident investigation records were available for the 27 that occurred after 1977. These records showed that it was highly improbable that any of the pilots operating these airplanes received warning that impact was about to occur. Complete results of this investigation are contained in the DOT-TSC study.

Analysis of the accident investigation records reviewed in the DOT-TSC study

support the following conclusions: (1) A GPWS warning would not have been activated in four of the accidents; (2) a GPWS warning would have been activated but with questionable recovery in five of the accidents; and (3) a GPWS warning might have been activated with likely or probable recovery in 18 of the accidents. Thus, 66 percent of these accidents might have been avoided if the airplanes had GPWS's.

Besides pointing out the potential effectiveness of GPWS's, the DOT-TSC investigation presented data on the types of airplanes involved in all 41 accidents studied. Thirty-five of these accidents involved turboprop airplanes and six involved turbojet airplanes.

The DOT-TSC study evaluated a ground proximity warning system that would meet TSO-C92b and also evaluated two alternative ground proximity advisory systems of the type that could be approved under the present rule. This study found that in certain situations each of these systems provided essentially functionally-equivalent protection. The study pointed out that the three systems provide very different approaches to providing altitude awareness to the flight crew. The advisory systems use automatic altitude callouts which will always activate when the aircraft descends below 1,000 feet above ground level (AGL). On the other hand, a GPWS is designed to do the following:

1. Alert or warn only when necessary.
2. Provide maximum warning time while minimizing unwanted alarms.
3. Use command-type warnings.

This system is the only one of the three that can be called a ground proximity warning system (GPWS) and the only one that can meet applicable minimum performance standards for obtaining TSO design approval. The other two systems are accurately referred to as ground proximity advisory systems.

The DOT-TSC study found that in the most critical operational situation (excessive closure rate with terrain) there were significant performance differences between the TSO-approved GPWS and the alternative ground proximity advisory systems.

The DOT-TSC study also compared recent cost data on the three systems analyzed and found them to be comparable in their unit costs. That is, a full TSO-approved ground proximity warning system is no longer significantly more costly than the alternative advisory systems (\$20K for GPWS versus \$15K to \$19K for advisory systems). This fact is highly significant since as recently as 1986, the cost of a

full TSO-approved GPWS for smaller turbo-propeller powered airplanes would have been prohibitively expensive as the NTSB noted in its recommendation.

In view of the above cited studies and investigations and the FAA's past policy to increase ground proximity warning requirements consistent with technological and economic feasibility, it is appropriate to require ground proximity warning systems for all turbine-powered airplanes with 10 or more seats operating under part 135. The number of turbine-powered airplanes having a passenger configuration of 10 seats or more in operation today, as compared to 1978, has increased significantly. The traveling public today expects the same level of safety when required to transfer from a large air carrier airplane to a smaller turboprop airplane for travel to and from hub airports.

The Proposed Rule

Section 135.153 would be amended by changing the term "turbojet" to "turbine-powered" airplanes. This would expand the types of airplanes required to have ground proximity warning systems. Thus, both turbojet and turbo-propeller powered airplanes having a passenger configuration, excluding any pilot seat, of 10 seats or more would be required to have an approved GPWS. Equipment manufactured under TSO-C92b or subsequent TSO's issued for GPWS are considered approved GPWS.

As proposed, this amendment to § 135.153 would end on the rule's effective date the current option to install an FAA-approved ground proximity advisory system on turbojet airplanes. Certificate holders operating under part 135 with turbine-powered airplanes currently lacking ground proximity warning systems would be required to equip these airplanes with GPWS's within two years after the effective date of the rule. Certificate holders that operate turbojet airplanes with advisory systems that were approved and installed in accordance with § 135.153(b) before the effective date of the rule would be required to replace those systems within four years after the effective date. The FAA believes that only a few airplanes would be affected by this retrofit requirement since far fewer turbojet airplanes with 10 or more passenger seats are in operation under part 135 than were anticipated when § 135.153 was adopted.

The provisions of existing § 135.153(f) are included in proposed § 135.153(b)(3) for editorial purposes.

The justification for requiring GPWS's (as opposed to alternative advisory systems) on turbine-powered airplanes that have no existing warning systems is that the advisory systems generally provide routine warnings (i.e., automatic altitude callouts), rather than warnings that are provided only upon violation of defined flight profiles. Routine warnings may be easily overlooked by the flight crew as they attend to other duties. This, coupled with findings of some of the CFIT-related studies that show a lack of crew adherence to standard cockpit procedures and the incidence of crew stress and fatigue, could reduce effectiveness of the alternative advisory systems. GPWS's provide warning signals that are clear, specific, and non-routine, thereby giving the crew a better chance of making readjustments and avoiding possible disaster.

In addition, the costs of GPWS's are in the same range as the alternative advisory systems, therefore imposing little additional burden in terms of cost outlay for new installations.

Regulatory Evaluation

This regulatory evaluation analyzes the benefits and costs of the proposal. A more detailed analysis has been placed in the docket.

The proposed regulation would amend part 135 by expanding the requirement for GPWS's, now applicable only to turbojet airplanes with 10 or more passenger seats, to also include turboprop airplanes of similar seating capacity. This amendment would also require that only GPWS's, and not ground proximity "advisory" systems, be installed on airplanes that currently have no such system. However, airplanes that have previously approved advisory systems that were installed before the effective date would need to upgrade or replace these systems with a GPWS within 4 years from the effective date of the final rule.

Costs

At this time, only one avionics manufacturer plans to produce a GPWS that will meet the current FAA Technical Standard Order (TSO) for use in multiengine, fixed-wing, turbine-powered aircraft operating under part 135. The manufacturer provided FAA with its anticipated unit costs, as well as specification information about the warning system. Costs included \$12,000 for equipment, \$600 for wiring, connectors, etc., and \$2,000 for installation. Annual maintenance costs were estimated to be 5 percent of equipment costs, or about \$6,000 over 10 years (see *Investigation of Controlled Flight Into Terrain (CFIT)*, Department

of Transportation—Transportation Systems Center [DOT-TSC] March 1989).

In addition, the manufacturer provided cost data for suitable radio altimeters that must accompany the GPWS. The estimated cost per installation would be \$7,000, reflecting a \$5,000 cost for the radio altimeter and \$2,000 for installation.

As of December 1987, 695 part 135 turboprop airplanes were reported in operation (*FAA Statistical Handbook of Aviation—Calendar Year 1987*, Department of Transportation, FAA). A small percentage of these airplanes may already be equipped with an approved GPWS. For the purposes of this evaluation, FAA assumes that all 695 of these airplanes would be required to comply with the proposed regulation and would need to be equipped with a GPWS. Costs for equipment, materials, and installation for the GPWS, as reported by the manufacturer, total \$14,600. Thus, the total estimated costs to purchase and install GPWS's would be \$10.1 million ($\$14,600 \times 695$). Approximately 4 percent of the 695 airplanes operating under part 135, such as those operating in air taxi service, do not have 10 or more seats, and thus would not be affected by the proposed rule (according to the *Census of U.S. Civil Aircraft—1985*, Department of Transportation, FAA). Therefore, estimated costs are overstated to a small degree.

Not all of the 695 turboprop airplanes operating under part 135 would need to install radio altimeters. The DOT-TSC study determined that 38.8 percent of the airplanes that would be affected by this proposal currently have satisfactory radio altimeters on board. Thus, FAA estimates that 425 airplanes would be required to install these devices. At \$7,000 each, the total cost to purchase and install radio altimeters is nearly \$3 million. The total fleet cost for radio altimeters and GPWS is \$13.1 million ($\3 million + $\$10.1$ million). These costs would be incurred almost immediately after the rule becomes effective.

Maintenance costs were estimated to be \$600 per year over the 10-year life of the warning system. The total estimated 10-year cost to the fleet for maintenance is \$4.2 million (695 airplanes \times $\$600 \times 10$ years) which, when discounted at 10 percent annually over the 10-year life, is \$2.7 million.

Each additional pound of weight added to part 135 turboprop aircraft is estimated to result in 8.55 gallons of annual fuel consumption to fly the additional weight. Because jet fuel currently costs \$1.68 per gallon for part 135 commuters, the annual cost per

pound of additional weight is about \$14.36. The total additional weight per aircraft associated with the GPWS, altimeter, and wiring is estimated to be 4 pounds. Therefore, total annual weight penalty costs are estimated to be \$57.44 and \$39,921 per aircraft and fleet, respectively. Total discounted 10-year costs are expected to be \$261.165.

Therefore, fleet costs of the proposed rule include \$13.1 million in implementation costs, \$2.7 million for maintenance costs, and \$0.26 million in weight penalty costs, for a total of \$16.06 million.

Benefits

Twenty-seven accidents occurred in the 10-year period between 1978 and 1987 in which NTSB accident investigations revealed that it was highly improbable that the flight crew had any prior awareness of an impending impact with terrain. None of the airplanes involved in these accidents were equipped with a GPWS, and only one was equipped with an advisory system. The March 1989 DOT-TSC study of CFIT's scrutinized the circumstances of each of these accidents. The study determined that four of the accidents most likely would not have been prevented if a GPWS had been on board. In five other accidents the airplanes involved would have received a GPWS alert, but with questionable time provided for recovery, if such a system had been on board. The other 18 accidents involved airplanes that would have had a GPWS alert activated with sufficient time for recovery, if one had been in use at the time. The casualties in the 18 accidents that the study considered preventable with the use of a GPWS included 56 fatalities and 7 serious injuries.

The FAA assumes for the purpose of this analysis that similar casualties can be expected in the future if GPWS's are not installed on multiengine, fixed-wing, turboprop aircraft operating under part 135. For the purpose of quantifying benefits of this proposal, a minimum value of \$1M is used to statistically represent a human life, and \$59,000 is used to statistically represent a serious injury. In addition, the DOT-TSC study determined that the value of the average dollar loss for each of the 10 aircraft destroyed and the 6 aircraft substantially damaged was \$550,000 and \$180,000, respectively. Applying these values against the estimated potential losses provides an estimate of the total benefit of the proposal over a 10-year period. The savings in human casualties total \$56.4 million ($56 \times \1 million + $7 \times \$59,000$). The savings in destroyed

and substantially damaged airplanes total \$6.6 million ($10 \times \$550,000 + 6 \times \$180,000$). Total benefits amount to \$63 million, or \$40.7 million when discounted at 10 percent over the 10-year period.

Comparison of Benefits and Costs

The potential benefits of this proposal (\$40.7 million over 10 years) far exceed the estimated costs (\$16.06 million over 10 years). Unfortunately, there is no way to know how many accidents and deaths will actually be prevented if this proposal is adopted. However, it is clear that if this proposed regulation succeeds in preventing only 40 percent of the accidents predicted in this analysis, it will prove to be cost-beneficial.

International Trade Impact

The proposal, if adopted, would have little or no impact on trade for U.S. firms doing business overseas or foreign firms doing business in the U.S. The proposal affects only part 135 airplanes of U.S. registry, and the expected additional annual operating cost of \$2,311 (present value) per airplane (\$16.06 million for 695 aircraft over a 10-year period) should not create an economic disadvantage to either domestic operators or foreign carriers operating in the United States.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires agencies to review rules which may have a "significant economic impact on a substantial number of small entities."

The proposal would have an economic impact on entities regulated by part 135. The FAA's criteria for a "substantial number" is a number which is not less than 11 and which is more than one third of the small entities subject to the rule. For air carriers, a small entity has been defined as one who owns, but does not necessarily operate, nine aircraft or less. The FAA's criteria for a "significant impact" is at least \$3,700 per year for an unscheduled carrier, and \$51,800 or \$97,700 per year for a scheduled carrier depending on whether or not the fleet operated includes small airplanes (60 or fewer seats).

A carrier qualifying as an unscheduled small entity with at least two airplanes would incur a significant economic impact because the annual cost of \$4,622 for two airplanes exceeds the \$3,700 criteria used by the FAA. Such carriers represent approximately 37 percent of all small entities subject to

the rule. Therefore, as required by law, an initial regulatory flexibility analysis follows.

Initial Regulatory Flexibility Analysis

As required by section 603(b) and (c) of the Regulatory Flexibility Act, the following analysis deals with the proposed rule as it relates to small entities.

Why Agency Action Is Taken

The reasons for agency action are detailed in the preamble of the NPRM. Briefly, the proposal would improve safety by reducing controlled flight into terrain accidents involving turbo-propeller powered airplanes. The proposal addresses an NTSB recommendation and is supported by studies that suggest that installation of a ground proximity warning system would contribute to prevention of CFIT accidents.

Objective of and Legal Basis for the Rule

The objective of the proposal is to improve the operating safety of part 135 aircraft by preventing controlled flights into terrain. The objective is more thoroughly discussed in the preamble of the NPRM. The legal basis of the proposal is sections 313, 314, and 601 through 610 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354, 1355, and 1421 through 1430) and the Department of Transportation Act (49 U.S.C. 106(g)).

Description of the Small Entities Affected by the Rule

The small entities affected by the rule would be unscheduled carriers operating under part 135 of the Federal Aviation Regulations that have more than one aircraft, but less than nine. Such aircraft have 10 or more seats.

Compliance Requirement of the Proposed Rule

Compliance with the proposed rule would be mandatory for all operators of turbine-powered, multiengine, fixed-wing aircraft with 10 or more passenger seats that operate under part 135. Operators of turbojet aircraft that are currently using alternative warning systems approved by the FAA would be required to replace those systems within 4 years of the effective date of the rule.

Alternatives to the Proposal

As part of the rulemaking action, the FAA considered several alternative approaches to the problem addressed by this proposal.

Alternative One

Let the market decide. This alternative would allow the public to select an airline based on competitive factors including those of a safety nature. The airline would be free to choose whether it should install GPWS's as recommended. This is an alternative applicable to all safety regulations. In the view of the FAA, this alternative would not assure a safe U.S. air transportation system.

Alternative Two

Delay development of the proposal pending additional information which could be obtained during further government and industry reviews. This alternative is tentatively rejected. The current proposal is supported by adequate investigations and studies. Publication of the proposal in the *Federal Register* and solicitation of comments is the most effective method of developing a sound amendment.

Alternative Three

Reduce costs to the industry by reducing the safety requirements. Permit implementation of a warning system that has fewer than the five defined modes of protection provided in a "full-scale" GPWS. The FAA rejects this alternative because implementation of fewer than the full complement of five warning envelopes, as shown in the DOT-TSC study, would create only minimal cost savings. However, some of the benefits of the system would be lost.

Federalism Implications

The regulation proposed herein would not have substantial direct effects 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, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

This proposal is significant under Department of Transportation Policies and Procedures (44 FR 11034, February 26, 1979) and, if adopted, the FAA certifies that it may have a significant negative economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. The annual cost that would be imposed on part 135 operators to install a ground proximity warning system on turboprop airplanes would exceed \$3,700 per year for unscheduled

air carriers. The FAA has determined that this notice involves a rulemaking action that is not a major rule under Executive Order 12291. An initial regulatory evaluation of the proposal, including an Initial Regulatory Flexibility Analysis and International Trade Impact Analysis has been placed in the docket. A copy may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR Part 135

Ground proximity warning systems.

The Proposed Amendment

The Federal Aviation Administration proposes to amend part 135 of the Federal Aviation Regulations [14 CFR part 135] as follows:

PART 135—AIR TAXI OPERATORS AND COMMERCIAL OPERATORS

1. The authority citation for part 135 continues to read as follows:

Authority: 49 U.S.C 1354(a), 1355(a), 1421 through 1431, and 1502; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

2. Section 135.153 is revised to read as follows:

§ 135.153 Ground proximity warning system.

(a) Except as provided in paragraph (b) of this section, after (a date 2 years after effective date of this amendment), no person may operate a turbine-powered airplane having a passenger seating configuration, excluding any pilot seat, of 10 seats or more, unless it is equipped with an approved ground proximity warning system.

(b) Any airplane equipped before (insert effective date) with an alternative system that conveys warnings of excessive closure rates with the terrain and any deviations below glide slope by visual and audible means may continue to be operated with that system until (insert date four years after effective date) provided that—

(1) The system must have been approved by the Administrator;

(2) The system must have a means of alerting the pilot when a malfunction occurs in the system; and

(3) Procedures must have been established by the certificate holder to

ensure that the performance of the system can be appropriately monitored.

(c) For a system required by this section, the Airplane Flight Manual shall contain—

(1) Appropriate procedures for—

(i) The use of the equipment;

(ii) Proper flight crew action with respect to the equipment; and

(iii) Deactivation for planned abnormal and emergency conditions; and

(2) An outline of all input sources that must be operating.

(d) No person may deactivate a system required by this section except under procedures in the Airplane Flight Manual.

(e) Whenever a system required by this section is deactivated, an entry shall be made in the airplane maintenance record that includes the date and time of deactivation.

Issued in Washington, DC, on April 11, 1990.

Thomas E. McSweeney,

Acting Director, Aircraft Certification Service.

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