U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: **ACTION**: Review and Concurrence, Equivalent Level of Safety

Date: December 13, 2002

From: Manager, Boston Aircraft Certification Office

Reply to Attn. of:

To: Manager, Rotorcraft Directorate, ASW-100

Sikorsky S-92A Helicopter Type Certification Project TC0309BO-R

Background

FAR 29.177 requires that the static directional stability be positive with throttle and collective controls held constant at the trim conditions specified in FAR 29.175(a), (b), and (c). The sideslip angle must increase steadily with directional control deflection for sideslip angles up to +/- 10° from trim with the collective control and airspeed held fixed. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.

The Notice of Proposed Rulemaking (NPRM) (Ref: Encl letter forwarding NPRM from ARAC to FAA, dated February 20, 2002), Performance and Handling Qualities for Rotorcraft, has recently been proposed to revise FAR 29.177 to change the demonstration criteria. The proposals provide a definition of the sideslip envelope over which the directional stability characteristics of rotorcraft are evaluated, and allow for a minimal amount of negative stability around each trim point. Sideslip angles must increase with steadily increasing directional control deflection for sideslip angles up to the lesser of:

- ±25 degrees from trim at a speed of 15 knots less than the speed for minimum rate of descent varying linearly to ±10 degrees from trim at Vne
- The limit sideslip angle defined under § 29.351
- A sideslip angle selected by the applicant which corresponds to a side force of at least 0.1g, or
- The sideslip angle attained by maximum directional control input.

Manufacturers and FAA certification compliance flight tests have shown that the aircraft does not fully comply with the requirements of the current §29.177 or the NPRM requirements during the following autorotation demonstration points:

1. Autorotation at 80 KIAS, Right Sideslip – 22,000 lbs/aft c.g.
2. Autorotation at 80 KIAS, Right Sideslip – 26,150 lbs/aft c.g.
3. Autorotation at 100 KIAS, Right Sideslip – 22,000 lbs/aft c.g.
4. Autorotation at 100 KIAS, Right Sideslip – 26,150 lbs/aft c.g
5. Autorotation at 100 KIAS, Right Sideslip – 22,000 lbs/fwd c.g
6. Autorotation at 100 KIAS, Right Sideslip – 26,150 lbs/fwd c.g

At these flight conditions directional control deflection becomes neutral before reaching the required sideslip angle. Dive Vne –10 KIAS points were also marginally positive.

Sikorsky believed that the S-92A flying qualities would meet the intent of the rule by providing sufficient side force cues to the pilot when approaching sideslip limits. Additionally, the direction and magnitude of lateral cyclic and roll attitude are commensurate with the change in sideslip and are not effected by the neutral directional control characteristics. Therefore, Sikorsky requested that an equivalent level of safety finding be granted.

FAA agreed with the concept of granting a finding of equivalent safety in lieu of literal compliance with the static directional stability requirements for the listed flight conditions. Compliance with the static directional stability was based upon a qualitative evaluation of the sideforce cues at the regulatory (or NPRM) sideslip limits as well as a quantitative and qualitative evaluation of roll attitudes and lateral cyclic inputs at those limit conditions during FAA flight tests.

FAA S-92A equivalent safety evaluations did not reveal any unsafe characteristics regarding static directional stability characteristics. Evaluations were conducted in right sideslip at 80 and 100 KIAS autorotation and Vne-10 KIAS in the minimum dispatch configuration (1 AP and 1 PSAS <120 KIAS, 1 AP and 2 PSAS > 120 KIAS) with worst-case weight/cg conditions (26,150 lbs and 360.8 in cg) and assessed for Day/VFR operations. The neutral pedal gradients that occur in right sideslip during autorotations and near Vne were accompanied by sufficient sideforce cues just prior to reaching sideslip limits. Additionally, sufficient roll cues into the sideslip were present and noticeable. These two cues were more pronounced for high-speed flight than in autorotation. The most significant mitigating factor for this neutral static directional characteristic, however, was the visual cue. Evaluation in both calm air and dynamic maneuvers in disturbed air conditions revealed that the structural sideslip envelope was well outside the relative (to trim) envelope for any resulting sideslip condition.

The Boston Aircraft Certification Office recommends the Rotorcraft Directorate approve this Equivalent Level of Safety finding for 29.177 in accordance with 21.21(b)(1).

Robert G. Mann

Concur

Signature: _____
Manager, Rotorcraft Standard Staff, ASW-110

Date: _____

Concur

Signature: _____
Manager, Rotorcraft Directorate, ASW-100

Date: _____

Encl

cc:

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