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:

The Bird Strike rule of 14 CFR Part 29.631 requires: "The rotorcraft must be designated to ensure capability of continued safe flight and landing (for Category A) or safe landing (for Category B) after impact with a 2.2-lb (1.0 kg) bird when the velocity of the rotorcraft (relative to the bird along the flight path of the rotorcraft) is equal to V_{NE} or V_H (whichever is the lesser) at altitudes up to 8,000 feet. Compliance must be shown by tests or by analysis based on tests carried out on sufficiently representative structures of similar design." Sikorsky has presented an analytical method to show compliance to the Bird Strike rule of 14 CFR Part 29.631 for certain components of the S-92 helicopter. However, the analytical approach does not use test data from "representative structure of similar design" as required from the rule. Therefore, Sikorsky will show that their analytical method is highly conservative through the use of their analysis based on tests on bird-impacted structure, so that it can be used on other components.

Applicable regulations:

14 CFR Part 29.631

Regulation(s) requiring an ELOS:

14 CFR Part 29.631

Description/Explanation of Compensating Method of Evaluation:

Sikorsky used a flat-plate analytical approach to calculate impact loads to compare to actual bird strike test data for the tail rotor blade to demonstrate that the flat-plate approach is highly conservative. They showed that other structural parts susceptible to bird strikes are similar to the tail rotor blade in the impact area and that they behave similarly during an impact event.

Conservative Load

A bird strike test was conducted on the tail rotor blade. The measured impact load was approximately 4.5 times higher than the load that would be predicted based on static balancing of loads. This indicated that the use of static analysis is highly unconservative. However, the flat plate analysis used by Sikorsky has been substantiated by bird impact on a rigid flat plate and, therefore, addresses the dynamics of the impact. Calculation of the bird strike loads for the tail rotor resulted in a load approximately 4 times higher than the measured load. This is considered to be highly conservative.

Structure of Similar Design

Sikorsky used the flat-plate analysis to evaluate other structural components that the Boston ACO did not consider to be of similar design. The main rotor pitch link was of primary concern. Sikorsky provided information to demonstrate that the pitch link could be considered to be of similar design from the viewpoint of the dynamic event. This information was:

- Comparison of the cross section of the bird impact area on the tail rotor blade and the main rotor pitch link. Both present a conic section of approximately the same distance across relative to the test bird.
- Comparison of results from a dynamic analysis of the bird strike event on the tail rotor blade and the main rotor blade showed that in both cases the structural component cleaved the bird into two parts. This cleaving greatly reduces the actual impact force on the component as compared to impacts in which the bird is not cleaved, such as impact with the windshield. The Sikorsky dynamic analysis was demonstrated previously by comparison to test results to provide a good simulation of the dynamic event.

Boston ACO Recommendation:

The Boston Aircraft Certification Office recommends that an Equivalent Level of Safety finding be approved for 14 CFR Part 29.631, in accordance with 14 CFR Part 21.21(b)(1), to allow use of the Sikorsky flat-plate analysis for the main rotor pitch link based on 1) the conservatism of the load prediction of the analysis, and 2) the similarity of both the dynamic event and impact area for the pitch link and the tail rotor blade that was tested.

Robert G. Mann

Concur

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

Date: _____

Concur

Signature:_____
Manager, Rotorcraft Directorate,
ASW-100

Date: _____

cc: 150/JL/RN/S.Miles (ASW-110)

File: TC0309BO-R Bird Strike (ELOS)
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