



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

Background:

FAR Section 29.1305(a)(24) requires that an individual indicator, warning or caution device be provided for each of the following parameters if exceeding the applicable APU limits for either gas temperature, oil pressure or turbine rotor speed can be hazardous. The S-92A design incorporates only one annunciator which will be activated if any of the above limits plus the APU electrical control unit over current limit are exceeded. Exceedance of any of the above four parameter limits on the ground will result in auto shut-down of the APU. In flight the APU will auto shut-down only if there is a turbine rotor overspeed.

If it is determined that exceeding any of the APU parameters, other than rotor speed, would be hazardous, we do not believe that a single indicator would meet the intent of FAR 29.1305(a)(24). This position is taken in light of the fact that the S-92 auxiliary power unit is deemed essential equipment for meeting the requirements of Part 29. Individual indicators or warning devices would provide comprehensive information to the flight crew for managing degraded operations of the APU during any rotorcraft operating conditions. With a single indicator, the flightcrew may not be provided sufficient information to react appropriately during all flight scenarios including rotorcraft emergency operating conditions.

Sikorsky proposed one cockpit warning that will illuminate upon exceedance of any one (or more) of these three parameters and bases this on the premise that pilot action is the same for any of these conditions. Provided below is background information addressing system description and usage.

The S-92A APU installation is configured to provide two means of power extraction; shaft power to drive a 35 KVA generator and customer bleed air for engine starting and bleed air heating. The intended usage of APU power differs for on-ground and in-flight. On ground the APU will provide bleed air for aircraft heating and engine starting. With the engines not running the APU will provide aircraft electrical generated power. In-flight the APU is intended for backup electrical power in the event of failure of all electrical generating systems and in-flight engine restart in the event of a dual engine flame-out. Although the minimum required in-flight APU usage is for “dual generator out” or “dual engine out restart” the rotorcraft flight manual (RFM) may specify APU start after a one engine or one generator out occurrence.

The APU control system includes protection features that will operate differently in flight than on the ground. For on ground operation the APU will automatically shutdown upon exceedance of turbine speed, turbine gas temperature, or (over/under) oil pressure with no pilot action required. In flight, however, the APU will automatically shutdown only upon turbine overspeed. In flight the remaining exceedances (gas temperature, or oil over/under pressure) will illuminate a single cockpit warning.

It was the Sikorsky position that the single warning, indicating exceedance of turbine gas temperature or oil over/under pressure achieves the intent of and is in compliance with 29.1305(a)(24). The pilot action following the warning will be identical for either of the faults. Sikorsky pilots have indicated that multiple separate exceedance indicators would not change the decision logic and in fact may distract the pilots in a potential high workload situation. For example, if such an exceedance was to occur in flight and one generator (or one engine) was operational the pilot could shutdown the APU. If however, the situation were more critical (i.e.: if both primary generators had failed or if one engine had failed and a second engine failure appeared eminent) the pilot could elect to continue APU operation regardless of the exceedance or the level of such.

The FAA required;

Sikorsky to provide the FAA with the probability of failures that would lead to an emergency condition requiring the APU in flight and a subsequent APU exceedance,

Sikorsky to review all exceedances and failures to determine if all exceedances and failures that would trigger an “APU FAULT” message would require the same crew action in an emergency condition and to address separately those that do not,

Sikorsky to review the failure modes following continued operation of the APU with an “APU FAULT” indication to determine the effects of such a scenario and,

Sikorsky to provide the flight crew with clear directions to take following an “APU FAULT” indication as part of the RFM Emergency Procedures.

The following items have been adequately addressed;

The failure modes following continued operation of the APU should the pilot elect to continue APU operation with an exceedance, to determine the effects of such a scenario.

All exceedances and failures to determine if all exceedances and failures that would trigger an "APU FAULT" message would require the same crew action in an emergency condition.

The probability of failures that would lead to an emergency condition requiring the APU in flight and a subsequent APU exceedance.

Clear directions to Flight Crew to take following an "APU FAULT" indication as part of the RFM Emergency Procedures.

The Boston Aircraft Certification Office recommends the Rotorcraft Directorate approve this Equivalent Level of Safety finding for 29.1305(a)(24). in accordance with 21.21(b)(1).

Robert G. Mann

Concur

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Signature: _____

Signature:

Manager, Rotorcraft Standard Staff, ASW-110
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Manager, Rotorcraft Directorate, ASW-

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