Exemption No. 11075

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
BURLINGTON, MA 01803-5229

In the matter of the petition of **ROLLS-ROYCE plc** for an exemption from § 33.27(f)(6) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2014-0609**

GRANT OF EXEMPTION

August 13, 2014, Rolls-Royce plc, ML-52, PO Box 31, Derby, DE24 8BJ, England, petitioned the Federal Aviation Administration (FAA) for an exemption from Title 14, Code of Federal Regulations (14 CFR) § 33.27(f)(6), Amendment 33-31.

The petitioner requests relief from the following regulation:

> **Section 33.27(f)(6), Amendment 33-31**, Turbine, compressor, fan, and turbosupercharger rotor overspeed.
>
> "(f) Failure of a shaft section may be excluded from consideration in determining the highest overspeed that would result from a complete loss of load on a turbine rotor if the applicant:
>
> (6) Does not exclude the entire shaft."

Petitioner Rolls-Royce requests the FAA grant the exemption based on two points. Petitioner's first point is that for each of the Trent XWB engine models it identifies, the petitioner has shown that the high-pressure (HP) turbine rotor burst speed is greater than 100 % rotor terminal speed resulting from HP shaft system failure. Petitioner's second point is that compliance with § 33.27 cannot be shown, absent an exemption from § 33.27(f)(6). The petitioner adds, however, that compliance can be shown without adversely affecting safety, if the exemption is granted.

Petitioner requests exemption from 14 C.F.R. § 33.27(f)(6) for the HP shaft system of the following Trent XWB engine models:

Model	Rating x 1000 lbs.
Trent XWB-84	84
Trent XWB-79B	79
Trent XWB-79	79
Trent XWB-75	75

Petitioner asserts that as demonstrated in its substantiating report, the level of safety afforded by compliance with § 33.27 for the HP shaft system will be unaffected by the granting of an exemption from § 33.27(f)(6). Petitioner also states that granting this exemption will promote and serve the public interest, and petitioner identified those benefits in its package.

Finally, petitioner also asserts that granting its exemption will have no adverse effect on safety and provided the following in support of that contention.

1. The HP shaft system design utilized across the Trent engine family differs significantly from conventional shaft systems. A Failure Mode and Effect Analysis determined that no known or potential environmental threats to the integrity of the HP shaft system components exist that could lead to a loss of load failure.

2. The special controls applied to the torque-transmitting components (i.e., the HP compressor rear drum and the HP turbine disc of the HP shaft system) are of a higher standard than those of many other shaft systems in the past.

3. The service experience of petitioner's three-shaft family of engines supports the theoretical assessment of points 1) and 2) above, and all incorporate the same design style for the HP shaft system as the engine models that are the subject of this petition. Operationally, over more than 250 million service flight hours have been recorded without failure of any reported HP shaft system torque path failures on the Trent family of engines. This performance translates to a failure rate of less than 2.8×10^{-9} failures per flight hour.

***Federal Register* Publication**

The FAA determined that publishing the petitioner's request for exemption in the Federal Register for public comment was necessary, per 14 CFR 11.87. A summary of the petition was published in the Federal Register on September 2, 2014 (79 FR 52104), for a 10 day period. The FAA received no comments. The complete petition is available at the Department of Transportation's Federal Docket Management System at http://regulations.gov under Docket No. FAA-2014-0609.

The FAA's Analysis

Our review of the petitioner's petition and supporting data indicates that what the petitioner seeks is not an exemption to § 33.27(f)(6), but to § 33.27(b)(3). Section § 33.27(b)(3) requires a rotor burst margin be greater than 5 % of rotor terminal speed. Section 33.27(f)(6) prohibits exclusion of the entire shaft system from failure consideration. Petitioner requested that the exemption from § 33.27(f)(6) be granted on the basis of its demonstration that for each of the listed engine models, the HP turbine rotor burst speed is greater than 100 % rotor terminal speed resulting from an HP shaft system failure. Based on what the petitioner requested and what the petitioner demonstrated in its supporting package, an exemption to § 33.27(f)(6) is not applicable. Rather, the petitioner's request is a petition for exemption to § 33.27(b)(3), and the requirement that rotor burst margin be greater than 5 % of rotor terminal speed. Therefore, we interpret petitioner's request as a request for exemption to § 33.27(b)(3).

We reviewed the data provided by petitioner and find that the HP turbine rotor burst speeds for the Trent XWB engine models are greater than 100 % rotor terminal speed resulting from an HP shaft system failure. Based on our finding and the compensating factors that the petitioner demonstrated through good service experience of similar three-shaft design systems and evaluation of all known failure modes, we conclude that an exemption to § 33.27(b)(3) for the Trent XWB-84, -79B, -79, and -75 engine models will have no adverse effect on safety.

The FAA's Decision

In consideration of the foregoing, and based on the FAA's interpretation of petitioner Rolls-Royce's exemption request, I find that a grant of exemption will not adversely affect the level of safety provided by the regulations and is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. §§ 106(f), 40113 and 44701, delegated to me by the Administrator, the petitioner, Rolls-Royce plc, is hereby granted an exemption to § 33.27(b)(3) for HP shaft system failure with the condition that the HP turbine rotor burst speed be greater than 100 % rotor terminal speed resulting from HP shaft system failure.

Issued in Burlington, Massachusetts, on October 3, 2014.

/s/ by Ann Mollica for

Colleen D'Alessandro
Assistant Manager, Engine and Propeller Directorate
Aircraft Certification Service