LEONARDO

HELICOPTERS DIVISION

TECHNICAL INFORMATION LETTER

TIL N° **T-189-24-001**

DATE: **January 24, 2024**

REV.: **/**

To: Leonardo Helicopters products
Owners / Operators / Service Centres

SUBJECT: **GE CT7 / T700 Engine Power Turbine (PT) Torque Reference Tube Malfunction**

Helicopters Affected: AW149/AW189

Dear Customer,

Hereby, Leonardo Helicopters (LH) would like to inform you regarding the All Operators Wire (AOW) CT7-AOW-2024-001 issued by General Electric (GE) dealing with a failure which occurred on a GE CT7-2E1 Engine installed on an AW149 and three other T700 Engines.

The investigation is currently ongoing in collaboration with GE to determine the root cause of the failure.

AOW CT7-AOW-2024-001 highlights that no actions are currently foreseen at engine level. In case that actions on the CT7-2E1 Engines installed on the AW149/89 in-service fleet will be deemed necessary in the future, LH will share details and instructions through the usual communication channels.

LH would like to take this opportunity to share with our Customers and Operators some additional details reported in Annex A regarding how engine malfunctions should be addressed in accordance with applicable operational instructions and common practices.

Should you need any additional information, please do not hesitate to refer to your usual contact within LH Engineering Support team.

Yours Sincerely,

Marco D'Adamo
Leonardo Helicopters
Customer Support, Services & Training
Head of Product Support Engineering

Annex A

Background:

During an investigation prompted by an event in service, GE has notified LH that other failures (potentially similar) were previously identified on three GE T700 engines (not installed on LH products) during factory testing after the replacement of the PT Torque Reference Tube.

In all three cases, upon removal of the Engine C-sump cover, the aft insert of the PT Torque Reference Tube was found to be circumferentially loose and could be rotated by hand due to the failure of a brazed joint. All T700 / CT7 Engine PT Torque Reference Tubes are manufactured using the same braze process.

The failure of the PT Torque Reference Tube may result in:

- Incorrect Engine Torque (TQ) indication.
- Incorrect Engine Power Turbine Speed (NP) indication.

Discussion:

The GE CT7-2E1 engine control system uses multiple inputs to control engine load-sharing. During normal All Engines Operative (AEO) conditions, the Full Authority Digital Engine Control (FADEC) will maintain 102% Main Rotor Speed (NR) with matched TQ values. In addition to governing NR, the FADEC provides Engine Gas Generator Speed (NG), TQ, and Inter Turbine Temperature (ITT) limit protection. When AEO, TQ is simultaneously limited based on the Total Torque applied and each engine's individual TQ. While the FADEC has been designed to provide maximum performance under a wide array of individual sensor and mechanical failures, there may be compound failures that result in unusual engine indications, and/or performance, with associated impact on NR and power available.

Depending on the kind of failure, identifying the affected engine may not be straightforward, particularly if engine parameters (NG, TQ, ITT) are varying and not consistent with the other engine.

In the event of a significant torque split or engine parameter variations it is important to consider each engine's NG, TQ and ITT, and how they compare to nominal or cross engine values. This comparison should be used to help confirm, and/or identify, the malfunctioning engine and whether the displayed information is considered valid or not.

Operational Considerations:

In a normal operational scenario the FADEC is able to limit NR variations between 100% and 104%. Engine parameter variations may result in NR variations outside the normal range following fast and large collective applications.

Diagnosing Non-normal Engine Behavior:

Engine performance degrades over time (in a scale of hundreds of hours) during normal operations, but abnormal events can also create sudden changes in engine performance. Some sudden changes may not be easily detected. A Foreign Object Debris (FOD) event may result in small changes in the Engine Power Assurance Check (EPAC) ITT margin and an engine may sound different. Changes may also be detectable by regular comparison of engine ITT in steady cruise flight.

Sudden changes in EPAC ITT margin can be caused by:

- FOD
- Mechanical failure or malfunction of an engine component; compressor, turbine, fuel management unit, or another component.
- Ng, TQ, ITT, or NP Sensor failure or malfunction - Following a loss of TQ signal the load sharing function (if selected) will match ITT to balance engine power.

Therefore pilots should be familiar with nominal engine parameter ranges for their aircraft configuration, mission Gross Weight (GW) and ambient conditions. Engine parameters are usually in agreements in terms of range and trend (high/increasing TQ usually go along with high/increasing ITT and NG values).

Being familiar with the relationship between these normal values and being able to recognize a significant variance is an important factor in diagnosing non-normal engine behavior.

Best Practices:

Normal Operations

Monitor for variation in engine parameters and/or EPAC ITT margin.

Non-normal operations

In the event of low or high NR, normal pilot action to manage the transient condition would be to correct collective position to maintain NR in the green band.

In case of inconsistent cockpit indications, significant torque split or engine parameter variation are observed, to identify the affected engine it is essential to identify inconsistencies between the engine parameters (NG, TQ, ITT), e.g. an engine that indicates high TQ but has low NG/ITT.

In order to confirm which of the engines is affected by the failure, selecting the engine to Ground Idle may verify the un-affected engine as behaving as expected. If confirmed the affected engine may then be shutdown (i.e. selected to OFF).

Note: If engine parameter and rotor variations do not affect continued safe flight, consideration should be given to landing prior to any attempt to diagnose the affected engine.

In power critical scenarios, drooping NR slightly (1%) below the current FADEC TQ governing limit will ensure that the engine is operating at its current limit and delivering maximum power to the Main Gearbox (MGB). In One Engine Inoperative (OEI) situations where power available is less than power required, it may be necessary to intentionally droop the NR as low as 90% to achieve the power required to maintain level flight.

If the engine control system is malfunctioning consideration should be given to flying at a “SAFE OEI FLIGHT” condition with a suitable airspeed (120 KIAS max) to ensure safe flight following an engine failure or if an inflight shutdown is required.

Electrical load management may also help during engine power critical scenarios:

- Select APU – ON and APU GEN – ON for emergency AC power, if required.
- IPS and Air Conditioning – OFF, if possible, to reduce power required.