

# MEMORANDUM

**To:** Chief Engineer, Advanced Turbine Engine Program  
**From:** Dr. A. Patel, Propulsion Credibility Board  
**Date:** April 5, 2026  
**Re:** Model Risk Assessment — HPT Blade CHT for Cruise Creep-Life (COU2)

## 1. Purpose

Model risk assessment for the HPT blade CHT analysis applied to a new context of use: cruise steady-state creep-life prediction. This is distinct from COU1 (take-off transient screening, MRL 3) which was accepted on March 20, 2026.

## 2. Model Influence

CFD-predicted peak metal temperature at cruise is the primary quantitative input to blade creep-life calculation supporting the 25,000-hour service target. No independent parallel-path prediction exists at the required fidelity. The model output directly drives certification margin analysis and retirement-for-cause interval determination. Influence: **HIGH**.

## 3. Decision Consequence

Incorrect cruise peak temperature prediction propagates into creep damage calculations (exponential sensitivity via Larson-Miller). A 20K temperature error translates to roughly 2x change in predicted creep life. Blade life underprediction causes unnecessary early retirement (economic). Blade life overprediction risks in-service creep failure (safety-critical). Consequence: **HIGH**.

## 4. Model Risk Level

HIGH influence x HIGH consequence = **MRL 4** per NASA-STD-7009B risk matrix. This is one level higher than COU1 (MRL 3), reflecting the certification-facing nature of cruise life analysis versus the preliminary-screening nature of take-off comparison.

## 5. Required Activities at MRL 4

Per NASA-STD-7009B Table A-1, MRL 4 requires the following minimum credibility levels:

| Factor                                        | Required Level |
|-----------------------------------------------|----------------|
| Code Verification (MMS)                       | Level 3        |
| Discretization Error                          | Level 3        |
| Mesh Convergence at QoI Location              | Level 3        |
| Validation against Engine-Representative Data | Level 3        |
| Equivalency of Input Parameters to COU        | Level 3        |
| Relevance of Validation to COU                | Level 3        |

|                              |         |
|------------------------------|---------|
| Probabilistic UQ on Outputs  | Level 3 |
| Independent Technical Review | Level 3 |
| Data Pedigree Documentation  | Level 3 |

## 6. Principal Credibility Risk

**The central risk identified in this assessment is that the validation evidence package was designed for take-off operating point and may not transfer to cruise operating conditions.**

Specifically: cascade rig Reynolds number exceeds cruise engine Reynolds by 41 percent. This risk is to be evaluated against the required Level 3 evidence for Factors 2.1, 2.4, 3.1, 3.2, and 4.2 in the credibility assessment narrative.