



U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

2200 South 216th Street
Des Moines, WA 98198-6547

May 13, 2021

In Reply

Refer To: 860-21-0268

Mr. Tom Galantowicz
ODA Lead Administrator
Regulatory Administration
The Boeing Company
P.O. Box 3707, M/C 081-53
Seattle, WA 98124-2207

Dear Mr. Galantowicz:

Subject: Boeing Model 777-9 Type Inspection Authorization (TIA) Readiness

References: (1) Boeing Letter RA-21-0402 "777-9 Common Core System (CCS) Applicant Proposal in support of 777-9 TIA," dated May 7, 2021
(2) FAA Letter 860-19-1081 "777-9 TIA Execution Plan," dated April 7, 2021
(3) FAA Letter 860-17-0556 "777-9 Plan for the Development Assurance Aspects of Certification," Revision C, dated October 31, 2017
(4) Boeing Letter RA-21-01067, "777-9, CCS Engineering Safety Assessment," dated April 12, 2021
(5) FAA letter 860-21-0286, "FAA Response to Boeing Submittal of 777-9 CCS Engineering Safety Assessment (ESA)," dated April 30, 2021

The purpose of this letter is to provide the Federal Aviation Administration (FAA) position and expectations for the upcoming Boeing Model 777-9 TIA.

The FAA Order 8110.4C states:

"The TIA is issued when examination of technical data required for type certification is completed or has reached a point where it appears the aircraft or component being examined is expected to meet the applicable regulations."

The FAA has received the reference (1) letter that submitted the CCS Applicant Proposal in support of Boeing Model 777-9 TIA. We noted in the reference (1) letter that the Organization Designation Authorization (ODA) Lead Administrator and Deputy Engineering-Unit Member (E-UM) Administrator acknowledge the CCS E-UM positions regarding incomplete software and Design Assurance Review (DAR) activities for the CCS, and that the CCS does not meet TIA readiness requirements. Despite these shortfalls

identified by the E-UMs, the ODA Unit believes the applicant position proposing that the program proceed with Phase 1 of the TIA warrants FAA consideration.

The CCS is a very complex and critical avionics system of the Boeing Model 777-9. It is an integrated modular avionics architecture that provides a set of shared computing, networking, and input/output resources to support the computing and system interface needs for multiple airplane systems. The CCS also provides the means for hosted functions of all criticalities to safely share the same physical resources. The CCS on the Boeing Model 777-9 is a significant change from the baseline 777-300ER. There are about 56-hosted functions using any resource within the CCS platform and interdependency of the CCS Hosted Functions and the CCS platform.

The FAA and Boeing have been discussing the TIA readiness of the Boeing Model 777-9 in numerous meetings over the past nine months. Based on our assessment, the FAA considers that the aircraft is not yet ready for TIA, even if it is a phased TIA of limited scope with a small number of certification flight test plans (CFTPs) proposed. The technical data required for type certification has not reached a point where it appears the aircraft type design is mature and can be expected to meet the applicable regulations.

The FAA position is based upon the following items:

1. Incomplete DAR Activities
 - The FAA has retained the Development Assurance compliance findings for the CCS (Reference 3). Boeing has yet to complete the DAR activities for the FAA to conduct compliance findings (DAR 2 and DAR 3). The FAA noted DAR 1 was conducted by Boeing with findings/actions, DAR 2 and DAR 3 are not complete.
 - Without finishing DAR activities, it is difficult for the FAA to determine if the system is mature and will provide only uncorrupted data for FAA certification testing. Completion of DAR activities provides confidence on the maturity of the CCS.
 - We communicated our requirement to complete DAR activities in our TIA expectation letter in reference (2).
 - We have also noticed that Boeing's DAR review dates have continuously slid over a year, which is also a concern for the FAA.
2. Lack of availability of Preliminary Safety Assessment for the FAA to review. Boeing does not meet own process (TIA Requirements for Boeing ODA Projects: D950-11761-1).
3. Lack of data to support the airplane level assessment (airplane level developmental assurance and airplane safety assessment) and system level integration.
4. The FAA retained development assurance compliance findings for common core system. We are unable to make compliance findings for retained development

assurance areas of the CCS based on the Plan for the Development Assurance Aspects of Certification as noted in reference (3).

5. Lack of sufficient data and artifacts to provide the FAA confidence in the ability to collect valid test data for the CFTPs that are planned to be conducted in this phased TIA and their relation to immaturity of the CCS.
6. A significant supplier finding for inadequate peer review of the safety analysis resulting in inconsistencies within and across safety reports and incorrect reuse of 787 data was noted by the FAA in Boeing's CCS Engineering Safety Assessment (reference 4). The assessment also stated that the data is not yet mature enough to show compliance, lists many open Problem Reports against safety documentation, assessments and requirements. The assessment identified many gaps.
7. Boeing has advised the FAA that there is an upcoming major software update with the software load of flight control 6.4.X and 6.5.X. The FAA understands that there are many significant problem report items that will be addressed by that version of the software load, including the software fix for the un-commanded pitch event that occurred on December 8, 2020. In addition, software load dates are continuously sliding and the FAA needs better visibility into the causes of the delays.
8. After the un-commanded pitch event, the FAA is yet to see how Boeing fully implements all the corrective actions identified by the root cause investigation, including system requirement development and tracing, robust verification process, supplier communication, systems integration validation and verification, and airplane level verification to ensure the "maturity" and safety/airworthiness of the aircraft. We are expecting Boeing to complete comprehensive validation, verification reviews and document the process improvements and lessons learned identified by the root cause investigation, and implement a robust process so similar escape will not happen in the future and this is not a systemic issue.
9. Boeing is proposing modifications that will involve firmware and hardware changes to the actuator controls electronics (ACE) of the Flight Control System. The European Union Aviation Safety Agency (EASA) has not yet agreed on a way forward on the Model 777-9. The FAA's concern is due to the addition of late change; Boeing needs to ensure the changes do not introduce new, inadvertent failures modes.
10. Stabilize the certification basis. Boeing informed the FAA more than a year ago regarding the plan for advancement certification basis to Title 14, Code of Federal Regulations, 25-146, which was pending due to this TIA discussion and potential impact on certification documents.

11. Design maturity is in question as design changes are on-going and potentially significant.

For example, the Stabilizer Design/Architecture for the 777-9 Relative to Removal of the STAB GREENBAND, Modified Indications during a failure of all Flight Control Modules and Modified Indications/new alert when airspeed protections are lost, Continuous Lateral Path, Extended Inertial Coasting and FLT DIR GUIDANCE, and a Mode Failure in Flight Director Only Mode.

Based on the information from Boeing, the Model 777-9 Amended Type Certification (ATC) date is realistically going to be mid to late 2023 (>2 years from now). The FAA anticipates a significant impact to the level of regression testing, change impact analysis, and the potential to increase the number of certification flight tests that will need to take place between TIA and ATC if we issue the TIA now. The additional activity will require the FAA to expend additional resources to review the changes and may reduce our resources to support other certification programs/activities, potentially with a higher priority.

The FAA requests the ODA Unit and the applicant to consider the items stated above, and close these gaps prior to submittal of a request for TIA issuance.

If you have any questions regarding this technical issue, please contact Mr. Tom Phan, Technical Program Manager, by telephone at [REDACTED] or by email at [REDACTED]. If you have any questions regarding the program, please contact Mr. Amod Koirala, Boeing Model 777-9 Program Manager, by telephone at [REDACTED] or by email at [REDACTED].

Sincerely,

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Ian Won
Aviation Safety
Acting Manager, BASOO Branch
Aircraft Certification Service