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WORKING PAPER

COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

STEERING GROUP MEETING

São Paulo, Brazil, 5 to 9 December 2022

Agenda Item 6: Emissions Technical (WG3)
Agenda Item 7: Noise Technical (WG1)

VIEWS OF THE UNITED STATES ON SUPERSONICS

(Presented by the United States of America)

SUMMARY

The United States has continuously supported development of civil supersonic environmental standards at CAEP as evidenced by its technical contributions in areas of Landing and Take Off (LTO) noise and engine emissions, en-route noise, and future CO_2 standards.

This paper provides the views of the United States on progress to-date at CAEP on these tasks and offers its views on next steps during CAEP13 cycle:

1. Supersonic exploratory study public release
2. Supersonic LTO noise Standard
3. En-route noise Standard
4. Supersonic LTO engine emissions

We continue to support this work within CAEP, and this paper offers some additional recommendations for CAEP to enable this technology in a harmonized and technically sound manner.

Action by the CAEP-SG is in paragraph 3.

1. INTRODUCTION

1.1 The United States has taken steps domestically to advance the development of civil supersonic airplanes as a priority on innovation in transportation. We strongly believe that international standards developed at ICAO are critical to the development of civil supersonic airplanes as they predominantly serve international travel.

1.2 At the close of the CAEP12 cycle, the exploratory study (e-study) for supersonic transport aircraft was completed, which provided an understanding of airport noise impacts resulting from the

introduction of supersonic aircraft. Upon a CAEP observer request for public sharing of the study, it received CAEP endorsement for public release.

1.3 Given the on-going development activity for supersonic airplanes and the goals to introduce them into the fleet in the near term, CAEP has recognized the critical need to finalize LTO noise Standard using Chapter 14 limits during the CAEP13 cycle. The manufacturers have requested this clarity so their designs comply with such standards in a global marketplace.

1.4 Looking beyond the first-generation supersonic airplanes, shaped signature, low-boom technology for the second-generation supersonic airplanes are expected to improve the business case and are being explored by manufacturers for future designs. As such, WG1 Supersonic Task Group (SSTG) N.05 tasks for en-route noise (low boom) Standard development continues to progress the long-term multi-CAEP effort. The United States continues to offer research addressing the technical planning, and investment of resources to deliver the scientific noise data for future Standard consideration by CAEP14.

1.5 From an emissions perspective, the current Annex 16, Volume II engine emissions standard for supersonic engines is outdated and must be revised to reflect more current engine designs that do not use afterburning technologies (see task E.16). In order to address the climate impact of supersonic airplanes, task E.17 looks to progress work regarding a CO_2 emissions metric system that could support future technology-based standard setting for supersonic aeroplane CO_2 emissions.

1.6 The United States supports CAEP's current tasks and associated timelines to enable introduction of civil supersonic airplanes.

2. SUPERSONIC ACTIVITIES

2.1 Supersonic e-study

2.1.1 The United States continues to support the publication of an updated e-study for public release and appreciates the challenges discussed in CAEP-SG/20221-WP/18 related to available options for release of an analysis without infringing on Aerion Corporation data rights permissions. Given the importance of making the e-study publically available, the United States supports the recommended proposal to reduce the number of airports assessed for the public version of the CAEP12 e-study report. This will address the 23 airports that were forecast to have commercial SST operations.

2.2 LTO Noise

2.2.1 The United States remains committed to support the LTO noise Standard development for supersonic airplanes in WG1 (task N.10). The United States recognizes the European Aviation Safety Agency (EASA) Advanced Notice of Proposed Amendment (A-NPA) on supersonic aircraft LTO noise, and we are encouraged that each agency shares a more common regulatory expectation and only few differences on noise that seem addressable.

2.2.2 Given the importance of international harmonization, the United States encourages all Member States to work within CAEP to finalize and complete the LTO noise Standard within the current CAEP13 cycle, as this will provide needed certainty to the supersonic airplane manufacturers.

2.2.3 The most recent WG1 meeting identified that a near complete Standard is necessary for preliminary Steering Group consideration by SG2023 in order to be available for decision at CAEP13. We note that the LTO noise subgroup developed a timetable to focus on resolving three key remaining technical

issues (1) Programmed Lapse Rate (PLR) balancing/thrust limitation; (2) reference takeoff speed and tolerance; and (3) Variable Noise Reduction Systems (VNRS) for approach condition, by SG2023. Given that most of the content of the noise standard proposals from the two independent national aviation authorities—FAA and EASA—share a common understanding, we support the WG1 goal to bring the 90% complete SARP by SG2023 and a completed version by SG2024.

2.2.4 In order to reach a common understanding on these three outstanding technical issues, the United States would like to provide the following input on each of those issues:

2.2.4.1 Programmed Lapse Rate (PLR) balancing/thrust limitation: The application of PLR which controls engine thrust levels was analyzed for the Supersonic Technology Concept Airplane (STCA) research vehicles to scientifically identify of the noise abatement/reduction from PLR implementation. The STCA modeling indicated a limited noise reduction benefit at sideline/lateral locations beyond an increasing range of % PLR, in which then the overflight noise location becomes burdened with the higher noise level. This indication of self-limiting response of PLR demonstrates that it would be most appropriate for the OEM to define the appropriate amount of that is beneficial as it relates to the whole aircraft design. Therefore, we find it unnecessary to include a PLR or thrust level limitation for VNRS take-off conditions using PLR in the LTO noise Standard.

2.2.4.2 Reference takeoff speed and speed range tolerance: Similarly, the STCA analyses served to demonstrate by simulation the flexibility of implementing a range of technologies that could accumulate to reduce noise, such as increased high-speed climb out that reduces noise from weaker turbulence combined with reduced duration. Added higher speed also creates more lift, allowing for a deeper piloted-initiated engine thrust cutback for added flyover level reduction. The subsonic aircraft procedure of constraining takeoff speed with a fixed tolerance range potentially constrains the possible speed variable design options where VNRS factors can be combined to benefit VNRS takeoff noise reduction. Therefore, the United States finds it unnecessary to invoke a single take-off speed tolerance range with a designated takeoff safety speed (V2) for the VNRS takeoff procedure. Therefore, we recommend that the takeoff reference true airspeed must be attained as soon as practicable after lift-off and not to exceed 250 knots.

2.2.4.3 Variable Noise Reduction Systems (VNRS) for approach condition: Arbitrarily restricting innovation regarding the use of VNRS during approach condition would potentially restrict opportunities for OEMs to reduce noise during day-to-day operations. We believe that the LTO noise Standard should allow the potential use of new technology supporting VNRS for approach conditions to further reduce aircraft noise of future designs.

2.2.5 The United States recognizes that both aviation regulatory proposals, ours and EASA's, served to reinforce the WG1's supersonic LTO noise Standard development (task N.10) effort with broad perspectives. While these efforts help the process, the United States highly favors a harmonized ICAO standardization prior to any finalized independent state rulemaking.

2.3 En-route Noise

2.3.1 In addition to LTO noise, the United States remains committed to support the en route noise (low boom) standard development for future supersonic airplanes (task N.05) and provides leadership for this task. We will maintain this commitment to ensure the en-route noise Standard development continues to make steady technical progress through CAEP13. In addition, the United States reassessed the subsequent CAEP14 technical planning to ensure the complex research schedule is achievable. As largely NASA led, the X-59 flight demonstrator airplane tests (that will quantify human response of shaped signature, low boom noise) remains on schedule to deliver such scientific data to WG1 by one year before the CAEP14 cycle ends.

2.3.2 The United States continues to make progress toward its goal of delivering to WG1 data on public response to sounds from aircraft designed to fly over land at supersonic speeds creating not a sonic boom, but a much quieter "thump" sound. As part of its planning for outreach associated with community testing, NASA recently adopted the mission name "Quesst" to replace "Low Boom Flight Demonstration." NASA is committed to completing a series of community tests and delivering the resulting data to WG1 one year prior to the CAEP 14 meeting. NASA continues to encourage engagement of the international community in planning and executing the community tests and has requested feedback from WG1 on the data deliverables and sufficiency considerations presented at WG1/3. States are also requested to consider collaborations or partnerships with the United States for conducting an X-59 community test outside the United States.

2.4 Emissions

2.4.1 Per the EASA A-NPA, the United States seeks a cooperative working relationship with EASA under the auspices of CAEP in developing appropriate CO_2 limits for supersonic aeroplanes that are based on vehicle technical data and analysis.

2.4.2 We note that WG3 has offered to this meeting a preliminary LTO cycle for the certification of supersonic engine emissions. This is a good step towards achieving the goal of updating Annex 16, Volume II Standards. The United States looks forward to seeing certification-like emissions measurements from modern supersonic engines, when they become available, to continue the standard setting process. The United States believes that possible emissions stringency options should be underpinned by emissions measurements, just like all of CAEP's past engine emissions standard settings.

2.5 Considerations

2.5.1 On both the noise and emissions front, the United States emphasizes the need to develop internationally harmonized environmental standards for civil supersonic airplanes. Harmonized standards will provide industry with the regulatory certainty to make investments in the development of these technologies.

3. ACTION BY THE CAEP-SG

3.1 The CAEP-SG is invited to:

a) agree that states should coordinate within CAEP to develop harmonized global environmental standards for Supersonic aircraft;

b) agree the Supersonic exploratory study be amended for public release as recommended in CAEP-SG/20221-WP/18;

c) note the proposed schedule to share a draft supersonic LTO noise Standard for SG2023 consideration, and provide feedback on the proposed interim deliverables for the LTO noise Standard; and,

d) encourage ICAO members to partner with NASA for a Quesst community test for wider global human response understanding of noise.

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