ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround

Safety Risk Management Document with Hazards

SBS-187, Rev 0.1

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January 3, 2022

Approved by:

PAUL DOUGLAS ARBUCKLE Digitally signed by PAUL DOUGLAS ARBUCKLE
Date: 2022.01.19 18:03:32 -05'00'

Doug Arbuckle, Chief Scientist & International Lead
Surveillance Services, PMO, ATO

Date

Federal Aviation Administration
800 Independence Ave, SW
Washington, DC 20591

Revision History for
ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround
Safety Risk Management Document
SBS-187, Rev. 01

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Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

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SRM Document Signature:

Submitted by:

PAUL DOUGLAS ARBUCKLE Digitally signed by PAUL DOUGLAS ARBUCKLE
Date: 2022.01.19 18:04:45 -05'00'

Doug Arbuckle, Chief Scientist & International Lead
Surveillance Services, PMO, ATO

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Signature:

Approved by:

DANIEL S. HICOK

Digitally signed by DANIEL S. HICOK
Date: 2022.02.16 10:57:43 -05'00'

Daniel S. Hicok, Director, Surveillance Services (AJM-4)

Date: _____

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

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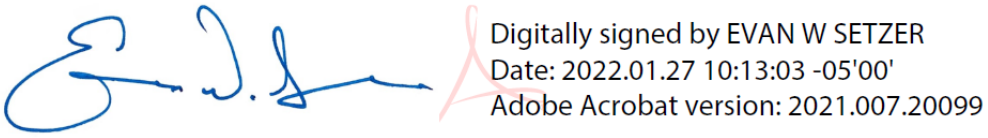
SRM Document Signature:

Approved by: 

Evan Setzer, Group Manager (A), Surveillance and Broadcast Services (SBS, AJM-42)

Date: _____

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Revision Date: January 3, 2022

SRM Document Signature:

Approved by:

AUBREY WIGGINS Digitally signed by AUBREY WIGGINS
Date: 2022.02.02 17:46:29 -05'00'

Aubrey Wiggins, Program Manager, SBS Applications and Investments Team (AJM-423)

Date: _____

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Signature:

Approved by:
Natasha A. Durkins
Digitally signed by Natasha A. Durkins
Date: 2022.02.01 12:55:46 -05'00'

Natasha Durkins, Director, Policy (AJV-P)

Date: _____

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Signature:

Approved by:
NATKING R ESTEVEZ
Digitally signed by NATKING R ESTEVEZ
Date: 2022.02.01 10:54:59 -05'00'

Natking Estevez, Manager (A), Standards and Procedures (AJV-P3)

Date: _____

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
SRM Document Revision Number: SBS-187, Rev. 01
SRM Document Revision Date: January 3, 2022

SRM Document Signature:

Approved by:
WENDY L O CONNOR
Digitally signed by WENDY L O CONNOR
Date: 2022.02.22 13:17:20 -05'00'

Wendy O'Connor, Director (A), Operational Planning and Integration (AJT-3)

Date: 02/22/2022

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Signature:

Approved by:
JON M STOWE
Digitally signed by JON M STOWE
Date: 2022.02.22 12:14:17 -05'00'

Jon Stowe, Group Manager (A), Operations Integration (AJT-31)

Date: 2/22/22

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Revision Date: January 3, 2022

SRM Document Signature:

Risk Accepted by:

JEFFREY S SZCZYGIELSKI

Digitally signed by JEFFREY S SZCZYGIELSKI
Date: 2022.02.28 13:05:28 -05'00'

Jeffrey Szczygielski, Director, Operational Policy and Implementation (AJT-2)

Date: 2/28/2022

Title: ADS-B In Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM Document

Initiator: Doug Arbuckle, Chief Scientist & International Lead
Initiator's Organization: Surveillance Services, PMO, ATO
Initiator's Phone Number: (757) 864-4072

Submission Date: January 3, 2022
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SRM Document Signature:

Approved by:
GREGORY A PRAY
Digitally signed by GREGORY A PRAY
Date: 2022.03.28 15:20:40 -04'00'

Kimberly Pyle, Director, Policy and Performance (AJI-3)

Date: _____

EXECUTIVE SUMMARY

On July 15, 2021, Federal Aviation Administration (FAA) participants and designated Subject Matter Experts (SMEs) convened with American Airlines pilots and operational experts, as well as the National Air Traffic Controllers Association (NATCA) and Professional Aviation Safety Specialists (PASS), for a Safety Risk Management (SRM) Panel. This panel was conducted in support of the Automatic Dependent Surveillance-Broadcast In (ADS-B In) Retrofit Spacing Evaluation (AIRS Eval) A321 Workaround SRM System Hazard Analysis initiated by AJM-4.

The panel evaluated an ADS-B In Capability Indicator Workaround for the Standard Terminal Automation Replacement System (STARS) and En Route Automation Modernization (ERAM) automation systems. The proposed workaround would be used until the STARS and ERAM platforms receive automation upgrades to provide controllers with an ADS-B In Capability Indicator in the data block on the controller display. This Workaround, as proposed, would apply to American Airlines A321ceo and A321neo aircraft that are equipped with SafeRoute+®.

American Airlines is in the process of equipping their entire A321 fleet, which consists of A321ceo (current engine option) and A321neo (new engine option) aircraft, with the avionics needed to support the ADS-B In operations. The flight deck applications were developed by Aviation Communication & Surveillance Systems (ACSS) and are known as SafeRoute+®, which is the ACSS ADS-B In avionics certified by the FAA for installation on A321ceo and A321neo aircraft.

All flight crews of these aircraft would be trained to perform the approved ADS-B In operations and to file flight plans with the FAA using an “A321” International Civil Aviation Organization (ICAO) aircraft type designator. Conversely, American Airlines A321ceo and A321neo aircraft not equipped with SafeRoute+® will be filed using the “A21N” ICAO aircraft type designator. This Workaround enables the evaluation of both Cockpit Display of Traffic Information (CDTI)-Assisted Separation (CAS) and Initial-Interval Management (I-IM) ADS-B In operations as part of the AIRS Eval

The SRM Panel reviewed the proposed change and identified three low-risk hazards that could occur as a result of the A321 Workaround. These hazards are shown below in Table 1-1 – *A321 Workaround SRM Panel Hazards*. Two of these hazards are related to the Automated Terminal Proximity Alert (ATPA) within STARS, which is used to prevent compression errors for aircraft on final approach. ATPA is a tool that automatically provides controllers the distance between aircraft flying in-line instrument approaches. The A321ceo and A321neo aircraft have slight differences in their approach speeds modeled within the system. The first hazard, ***A321–H01*** – *Nuisance ATPA Alert*, was assessed with an initial and predicted residual risk of low (5B). ***A321–H02*** – *Late ATPA Alert,* was also identified and assessed as having an initial and predicted residual risk of low (5B). A third hazard was also identified, ***A321–H03*** – *Mismatch between STARS aircraft type indication and aircraft type observed visually*. This hazard was also assessed as having a predicted and residual risk of low (5C). The

initial and predicted residual risk for these hazards are shown in Table 1-1 and depicted on the risk matrix in Table 1-2 below.

Table 1-1: A321 Workaround SRM Panel Hazards

Hazard ID	*Hazard Description*	*Initial Risk Level*	*Predicted Residual Risk Level*
A321-H01	*Nuisance ATPA Alert*	*(5B) – Low*	*(5B) - Low*
A321-H02	*Late ATPA Alert*	*(5B) – Low*	*(5B) – Low*
A321-H03	*Mismatch between STARS aircraft type indication and aircraft type observed visually*	*(5C) – Low*	*(5C) – Low*

Table 1-2: A321 Workaround Hazard Risk Matrix

Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A					
Probable B	A321-H01 A321-H02				
Remote C	A321-H03				
Extremely Remote D					
Extremely Improbable E					

In addition to the hazards identified by the SRM Panel, the panelists also explored a concern with aircraft using an alternative type designator. The concern is that using an

ICAO aircraft type designator outside of its intended aircraft type could impact the voluntary and mandatory safety reports submitted by controllers. Also, the data collection may be affected, as it uses filed flight plan data for the aircraft type. Safety reporting systems that could be affected include the Mandatory Occurrence Report (MOR), Preliminary Aviation Risk Identification and Assessment (ARIA) Reports (PARs), the Air Traffic Safety Action Program (ATSAP), and the NASA Aviation Safety Reporting System (ASRS). Performance data that could be impacted include System Wide Information Management (SWIM) and the Performance Data Analysis and Reporting System (PDARS).

The SRM Panel did not ultimately consider the A321 Workaround to have a hazard relating to potential data corruption for events involving American Airlines A321 aircraft participating in the operational evaluation. The panel determined this concern could be addressed with a memo to affected stakeholders that contains a description of the A321 Workaround, a list of all American Airlines A321ceo aircraft with registration numbers and ICAO codes, and the period of time that the A321 Workaround will be used.

The panel also considered hazards related to wake turbulence differences between the A321ceo and A321neo aircraft types. The FAA's NextGen office (ANG-C51), with support from the Department of Transportation's (DOT) Volpe Center and wake turbulence subject matter experts (SMEs), provided input to the SRM Panel regarding wake turbulence for both the A321ceo and A321neo aircraft types. Although wake turbulence generated by these two aircraft types are not identical, the two aircraft are placed in the same wake turbulence category and do not affect wake turbulence separations applied by controllers. The panel reviewed this information and determined that the proposed A321 Workaround has no impact on wake turbulence risks in the National Airspace System (NAS).

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1 Introduction

1.1 Background

The FAA, American Airlines, and ACSS are participating in the ADS-B In Retrofit Spacing (AIRS) Evaluation project. This evaluation is a multi-year project that will be conducted to evaluate ADS-B In operations during revenue service on the American Airlines A321 fleet. American Airlines is in the process of equipping their entire A321 fleet, which consists of A321ceo (current engine option) and A321neo (new engine option) aircraft, with the avionics needed to support the ADS-B In operations. The flight deck avionics were developed by ACSS and are known as SafeRoute+®. Installation of this equipment in the American Airlines A321 fleet is expected to take up to five years and is expected to be completed in 2025. In total, 318 aircraft will be equipped, of which 218 are A321ceos and 100 are A321neos.

The AIRS Evaluation of CDTI Assisted Separation (CAS) is scheduled to be begin at the Dallas-Fort Worth Terminal Radar Approach Control (D10) key site in calendar year (CY) 2022. The AIRS Evaluation of Initial-Interval Management (I-IM) is scheduled to begin at the Albuquerque Air Route Traffic Control Center (ZAB) key site in CY 2022. Prior to the deployment of CAS or I-IM, a safety analysis will be performed for each application in accordance with the FAA Safety Management System (SMS).

CAS and I-IM operations[1] will be initiated by the controller and require knowledge of aircraft ADS-B In capability. The current lack of an ADS-B In Capability Indicator within STARS and ERAM impairs controller identification of which aircraft are ADS-B In equipped and have regulatory approval to perform these operations. The proposed interim solution is for both A321ceo aircraft equipped with SafeRoute+® and all A321neo aircraft equipped with SafeRoute+® to use the “A321” ICAO aircraft type designator. This aircraft type designator is currently only used for A321ceo aircraft. The proposed workaround will be used until the ADS-B In Capability Indicator is added to the aircraft data block in forthcoming STARS and ERAM upgrades. In addition, the SRM Panel proposes that the “A21N” ICAO aircraft type designator be used to indicate A321ceo and A321neo aircraft that are not equipped with SafeRoute+®. Currently, the “A21N” ICAO type designator is only used for A321neo aircraft. Detailed information on this effort is contained within ***Appendix E*** *– ADS-B In Retrofit Spacing (AIRS) ADS-B In Capability Indicator Workaround*.

1.2 Purpose

This document chronicles the results of the SRM Panel assessment of the proposed use of the A321 Workaround for A321ceo and A321neo aircraft equipped with SafeRoute+® ADS-B In avionics to determine its safety impact and identify risk. The A321 Workaround will enable the operational evaluation of CAS and I-IM ADS-B In operations, conducted at their respective key facilities. Participating American Airlines

[1] CDTI-Assisted Separation (CAS) and Initial Interval Management (I-IM) are new operations in the NAS which will be addressed in future SRM activities.

A321ceo and A321neo aircraft equipped with SafeRoute+® and filed using the “A321” ICAO type designator will provide a means for controllers to determine the aircraft’s ADS-B In capability prior to the availability of the ADS-B In Capability Indicator within STARS and ERAM platforms.

This panel was convened to evaluate the risk of using the A321 Workaround so that CAS and I-IM operations could be conducted prior to implementation of the ADS-B In Capability Indicator in air traffic control (ATC) automation systems. The panel concluded that the Workaround is safe to use in the operational evaluation of CAS and I-IM operations, as part of the AIRS Evaluation. Safety assessments have not been conducted for CAS and I-IM prior to the A321 Workaround. However, SRM Panels will be conducted prior to implementing these ADS-B In operational evaluations. Similarly, additional SRM Panels will be convened prior to any NAS-wide implementation of I-IM or CAS operations.

1.3 Assumptions

The SRM Panel made the following assumptions for this analysis:

A. American Airlines will have internal means to:
    i. Differentiate between the equipped A321ceo and equipped A321neo, both of which will file using an “A321” ICAO aircraft type designator.
    ii. Differentiate between the unequipped A321ceo and unequipped A321neo, both of which will file using an “A21N” ICAO aircraft type designator.
        - This is important to ensure an A321ceo does not get assigned to a long-range route that only the A321neo is capable of flying.
B. American Airlines is responsible for coordinating with foreign Air Navigation Service Providers (ANSPs) that could be affected by filing aircraft with a different aircraft type designation.
    i. American Airlines currently flies the A321ceo and A321neo to Canada, Mexico, the Caribbean, Columbia, and Venezuela.
C. All American Airlines A321ceo and A321neo flight crews flying equipped aircraft will be trained to perform the CAS/I-IM operation prior to use of the A321 Workaround for CAS and/or I-IM.
D. Based on analysis supporting this Workaround, the A321 and A21N aircraft type designators materially represent the same type aircraft when used in flight planning for this Workaround.

2 Description of Change

5M Model

The 5M Model is used to capture the information needed to describe the system and aid in hazard identification. The 5M Model, as seen in Figure 2-1, uses a Venn diagram to describe the system, depict the interrelationships among its five elements, and bound the system to permit an analysis of only the elements being changed.

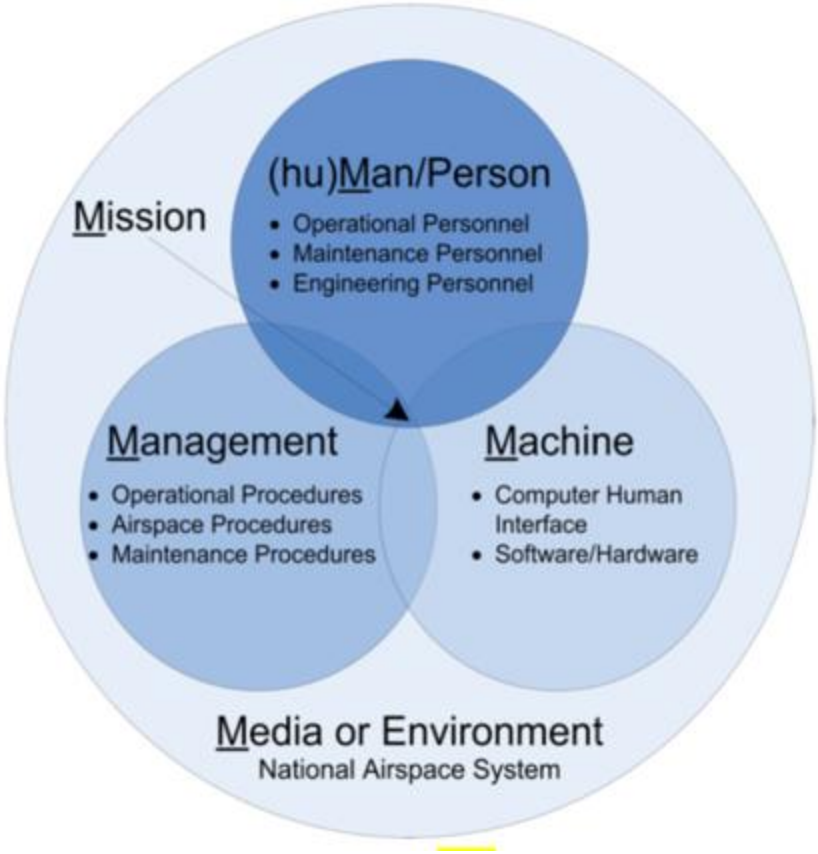

Figure 2-1: 5M Model

The components of the 5M Model are as follows:

- **Mission:** The clearly defined and detailed purpose of the NAS change proposal or system/operation being assessed.
- **(hu)Man/Person:** The human operators, maintainers, and affected stakeholders.
- **Machine:** The equipment used in the system, including hardware, firmware, software, human-to-system interfaces, system-to-system interfaces, and avionics.
- **Management:** The procedures and policies that govern the system's behavior.
- **Media:** The environment in which the system is operated and maintained.

Mission

The system mission is the safe provision of air traffic services and to integrate ADS-B In capabilities into current operations. The SRM Panel's mission is to assess the safety impacts, if any, of using the A321 Workaround as a means to identify American Airlines A321ceo and A321neo aircraft as being ADS-B In equipped, prior to the Capability Indicator being integrated within future STARS and ERAM upgrades.

(hu)Man

The (hu)Man element includes American Airlines operational personnel, the dispatchers who file the flight plans, the pilots trained in CAS and I-IM operations who are operating SafeRoute+® equipped A321ceo and A321neo aircraft, and air traffic controllers providing the provision of air traffic services.

The To-Be scope of the analysis associated with the A321 Workaround includes the dispatchers, the American Airlines pilots operating A321ceo and A321neo aircraft equipped with SafeRoute+® avionics, the ADS-B infrastructure, the STARS and ERAM automation systems, air traffic controllers providing air traffic services, and pilot-controller communications.

Machine

The machine element includes A321ceo and A321neo aircraft equipped with SafeRoute+®, the STARS and ERAM automation systems, and ATC communications between controllers and pilots. This also includes cooperative surveillance updates received on aircraft position which is sent to automation.

The machine component also includes the aircraft type designator defining the aircraft equipped with ACSS ADS-B In SafeRoute+® avionics. American Airlines will have internal means to differentiate between the equipped A321ceo and equipped A321neo, using the “A321” ICAO aircraft type designator for all equipped aircraft, regardless of engine type. Similarly, American Airlines will have internal means to differentiate between the unequipped A321ceo and unequipped A321neo, using the “A321” ICAO aircraft type designator for all equipped aircraft, regardless of engine type

Management

The management element contains the operational procedures covering the operational evaluation and conducting CAS and I-IM operations. The A321 Workaround process, as proposed, would be transparent to American Airlines crews operating the A321ceo and A321neo aircraft used in the operational evaluation. Flight crews participating in the operational evaluation will receive training, be aware of both their aircraft type (A321ceo or A321neo), and flight plan filing as they are today. Training materials for CAS and I-IM operations would be disseminated by American Airlines management to the impacted flight crews and would also be included within their recurrent training program. Further, air traffic controllers throughout the NAS will receive notification of the operational evaluation and the usage of the A321 ICAO type designator for participating A321ceo and A321neo aircraft. Formal training will be provided to air traffic controllers at the key sites.

FAA Order JO 7360.1E, *Aircraft Type Designators*, was referenced as the authoritative source document for ICAO type designations.

Media

The media element for the A321 wWorkaround is the Terminal and En Route environments and will include only ADS-B In equipped American Airlines aircraft.

Proposed Change

Given the current lack of an automated ADS-B In Capability Indicator within STARS and ERAM, there is no obvious means for controllers to identify which aircraft have the ADS-B In capabilities to initiate the CAS and I-IM operations. While the dispatcher could indicate an aircraft's ADS-B In capability within the remarks field of the flight plan, there is no assurance this would be observed by controllers, which could result in a lack of controller awareness regarding when these operations could be utilized.

The proposed change would involve American Airlines dispatchers filing A321ceo and A321neo aircraft with ADS-B In capability using an "A321" ICAO type designator. This designator would serve as a means to signify the aircraft's ADS-B In capability to perform CAS and I-IM operations in an operational evaluation. Conversely, American Airlines A321ceo and A321neo aircraft do not have ADS-B In capability will be filed using an "A21N" type designator. This will serve as a means to signify the aircraft is not capable of performing CAS and I-IM operations in an operational evaluation.

The objective of this proposed change is to provide near-term benefits for airspace users while the FAA completes the necessary automation upgrades to automatically identify an aircraft's ADS-B In capability within the data block. Using the "A321" ICAO type designator signifies the aircraft's capability to perform CAS and I-IM operations, making this scenario possible in the interim until the ADS-B In Capability Indicator can be displayed by STARS and ERAM.

This analysis focused on American Airlines A321ceo and A321neo aircraft that have ADS-B In capability being filed using the "A321" ICAO type designator to show their capability to perform CAS and I-IM operations. This workaround will be used during the evaluation period until either the ADS-B In Capability Indicators are incorporated into STARS or ERAM, or until all A321ceos and A321neos are equipped with SafeRoute+®.

3 Safety Risk Management Panel (SRM Panel)

The SRM Panel convened on July 15, 2021, to perform a thorough analysis of the mission statement. SMEs from across the FAA were invited to leverage their operational experience, and experts in the SRM process were present to maintain its integrity. Table 3-1 lists the panel participants.

Table 3-1: SRM Panel Participants

Organization	Title	Email	Role	SMS Trained
AAL	Dispatcher	Lee.Roper@aa.com	SME	Yes
AAL	Tech Pilot/AAL Mgmt	david.surridge@aa.com	SME	Yes
AAL APA	Pilot	rbabcock@alliedpilots.org	SME	Yes
AJV-1	ICAO Representative	keith.dutch@faa.gov	Panel Member	Yes
FAA	Chief Wake Scientist	edward.johnson@faa.gov	SME	Yes
FAA/AFS-400	Pilot	paul.vonhoene@faa.gov	Panel Member	Yes
FAA/AJT	ATC SME	mark.s.schumacher@faa.gov	Panel Member	Yes
FAA/NATCA	IM Rep/Terminal	imterminalnatca@gmail.com	Panel Member	Yes
FAA/NATCA	Procedures Rep	jmurdock@natca.net	Panel Member	Yes
FAA/NATCA	IM Rep/EnRoute	imnatca@gmail.com	Panel Member	Yes
AAL APA	Pilot	btownsend@alliedpilots.org	SME	Yes
FAA/AJT-2	ATC SME	kelvin.l.courtney@faa.gov	SME	Yes
FAA/AJV-P3	ATC SME	dilip.satheesan@faa.gov	SME	Yes
AAL	Flight Planning	desmond.keany@aa.com	SME	Yes
AAL	Pilot	Roddy.Guthrie@aa.com	SME	Yes
FAA/SBS	Avionics SME	rick.ridenour@L3Harris.com	SME	Yes
FAA/SBS	Chief Scientist and Intl. Lead	doug.arbuckle@faa.gov	Panel Member	Yes
FAA/SBS	Interval Management SME	brenda.ctr.perez@faa.gov	SME	Yes
FAA/SBS	SRM SME	rbradely@regulus-group.com	SME	Yes
FAA/SBS	Facilitator	rburton@regulus-group.com	Facilitator	Yes
FAA/SBS	AIRS Safety POC	christine.haissig@ix.netcom.com	SME	Yes
FAA/SBS	Co-Facilitator	aharris@regulus-group.com	Co-Facilitator	Yes
FAA/SBS	AIRS Safety POC	Kenneth.M.Jones@bluemountainaero.com	SME	Yes
FAA/SBS	Ops SME	jkirk@systems-enginuity.com	SME	Yes
FAA/SBS	ATC SME	jminck@regulus-group.com	SME	Yes
FAA/SBS	ATC SME	jesparrow@blmtgrp.com	Panel Member	Yes
FAA/AJT3	Wake SME	raul.zamora-jr@faa.gov	SME	Yes

4 Hazard and Risk Analysis

4.1 Analysis Methodology

A working group comprised of representative stakeholders from the panel participants convened in advance of the SRM Panel to brainstorm on potential issues that could result in a hazard to the NAS, due to implementation of the proposed A321 Workaround. This activity resulted in the following preliminary hazard list (PHL):

i. A321ceo and A321neo aircraft may be modeled differently within automation.

ii. Automated Terminal Proximity Alert (ATPA) in STARS alerting may be impacted.

iii. Using a non-standard aircraft type designator in the flight plan may cause unintended consequences.

iv. Fire rescue uses airplane-specific responses.

v. FAA performance monitoring, data collection, and analysis may be impacted.

vi. Mandatory Occurrence Report (MOR) and reporting requirements may be impacted.

vii. ANSPs may be impacted.

The panel discussed the merits of the proposed change, considered the PHL, and determined the first two items related to two hazards which were identified: *A321-H01 – Nuisance ATPA Alert* and *A321-H02 – Late ATPA Alert*. These hazards were adopted upon receiving confirmation from a STARS SME that an initial six-knot difference in landing speed modeling exists between the A321ceo and the A321neo aircraft within STARS. The panel learned that the A321ceo is modeled with a landing speed of 140 knots, whereas the A321neo is modeled with a landing speed of 134 knots. The ATPA functionality is found in STARS and serves to reduce compression errors. The panel learned that the aircraft modeling differences were limited to ATPA functionality and there are no additional hazards related to aircraft modeling within automation. As a note, ATPA functionality is also deployed at select Microprocessor En Route Automated Radar Tracking System (MicroEARTS) sites, including Honolulu, Hawaii, and operates identically to STARS.

The third item on the PHL concerning the usage of a non-standard aircraft type designator in the flight plan having unintended consequences also resulted in the identification of the hazard *A321-H03 – Mismatch between STARS aircraft type indication and aircraft type observed visually.* For example, a tower controller in a tower cab being located very close to the runway could recognize that an American Airlines (AAL) A321ceo does not match an “A21N” ICAO type designator or an AAL A321neo does not match an “A321” ICAO type designator, given the different engine nacelles and door locations. This may cause a controller to query the flight crew on why they are not filing the correct ICAO type designator and increase controller and flight crew workload.

The panel also referred to a presentation made by an FAA Aircraft Rescue and Firefighting (ARFF) specialist to determine whether the A321 Workaround could pose a risk for an incident where an aircraft is not filed using its actual aircraft type designator. This issue was thoroughly discussed, and the determination was made that there is no ARFF-related hazard attributed to the A321 Workaround.

The panel discussed potential impacts to FAA performance monitoring and data analyses that might be corrupted through filing an ICAO type designator other than the actual aircraft type. The panel identified the following systems that may be impacted:

i. Mandatory Occurrence Report (MOR)
ii. Air Traffic Safety Action Program (ATSAP)
iii. NASA Aviation Safety Reporting System (ASRS)
iv. System Wide Information Management (SWIM)
v. Performance Data Analysis and Reporting System (PDARS)

The SRM Panel did not consider this a hazard and determined this concern could be addressed by providing key stakeholders with a list of American Airline A321ceo aircraft when the Workaround commences. Stakeholders also have the option to use the FAA Civil Aircraft Registry to verify aircraft type information and the Aviation System Performance Metrics (ASPM) database to correlate a flight’s identification with an aircraft type.

The panel also considered hazards related to wake turbulence differences between the A321ceo and A321neo aircraft types. NextGen office (ANG-C51), with support from the DOT Volpe Center and wake turbulence subject matter experts, applied approved standard methodologies to develop wake turbulence separation recommendations for both the A321ceo and A321neo aircraft types.

Wake turbulence generated by these two aircraft types is similar, but not identical. The approach speeds are different and the A321neo wake turbulence strength is initially stronger due to the increased weight of the aircraft. However, the differences in wake characteristics are not sufficient to result in the two aircraft being placed in different wake turbulence categories or classes. In all FAA wake turbulence separation systems, the two aircraft are placed in the same wake turbulence category or class. Therefore, the wake turbulence separations applied by controllers are not affected by the proposed A321 Workaround for the AIRS Evaluation. The panel reviewed this information and determined that the proposed A321 Workaround has no impact on wake turbulence risks in the NAS.

4.1 Risk Determination

In order to determine the risk associated with each hazard effect, both the severity and the likelihood of occurrence were assessed. The analysis process was executed in accordance with the April 2019 Air Traffic Organization (ATO) Safety Management System (SMS) Manual and the guidance for severity and likelihood definitions.

5 Analysis Results

The results of the SRM Panel's safety analysis are provided in Table 5-1 and are described in detail in the following sub-sections. Details of the Hazard Analysis Worksheet (HAW) can be viewed in Appendix B, while the monitoring plan can be reviewed in Appendix C.

Table 5-1: A321 Workaround Hazard Summary

Hazard ID	*Hazard Description*	*Initial Risk Level*	*Predicted Residual Risk Level*
A321-H01	*Nuisance ATPA Alert*	*(5B) – Low*	*(5B) - Low*
A321-H02	*Late ATPA Alert*	*(5B) – Low*	*(5B) – Low*
A321-H03	*Mismatch between STARS aircraft type indication and aircraft type observed visually*	*(5C) – Low*	*(5C) – Low*

5.1 A321-H01 – Nuisance ATPA Alert

The panel identified that the A321ceo and A321neo aircraft may be modeled differently within STARS and ERAM. It subsequently confirmed that the A321ceo landing speed is modeled at the expected speed of 140 knots in ATPA, which is used to mitigate compression on the final approach and is part of STARS. The 140 knot expected speed for medium aircraft compares to a landing speed of 134 knots for A321neo aircraft. Pilot and SME input provided that actual landing speed was highly dependent on landing weight, as the ATPA default parameters are used for initial approach modeling by the ATPA algorithm. Given this differential in speed, the panel discussed the potential for ATPA alerting to be impacted based on the difference between the actual aircraft type and the altered ICAO aircraft type designator. The panel discussed the potential for nuisance alerts as a result of the A321 workaround.

Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A					
Probable B	A321-H01				
Remote C					
Extremely Remote D					
Extremely Improbable E					

Figure 5-1: Hazard Matrix A321-H01

5.1.1 Initial Risk Assessment (A321-H01)

The panel performed an assessment for this hazard and considered that ATPA, as designed, adapts for the varying approach speeds of the arriving aircraft. However, implementing the A321 Workaround could result in an increase in nuisance alerts, which cause a distraction but require no action by the controller. This could result in a slight increase in ATC workload, depending on the traffic complexity. According to the ATO SMS Manual, a slight increase in controller workload corresponds to a Minimal (5) severity. The panel assigned a Probable (B) likelihood, based on SME input using the

qualitative guidance contained in the ATO SMS Manual. This results in a Low Initial Risk Level for this hazard of 5B and is represented as such in Figure 5-1.

5.1.2 Predicted Residual Risk Assessment (A321-H01)

A321-H01 Severity:

The panel discussed controller training at the key sites and promoting national awareness of the A321 Workaround, identifying both of these activities as safety requirements. Although these safety requirements are not required by the ATO SMS Manual for hazards with a Low Initial Risk Level, the panel determined they would promote awareness of this hazard and collectively agreed the severity would not change, assigning a Minimal (5) severity.

A321-H01 Likelihood:

The likelihood was established using the qualitative guidance contained in the ATO SMS Manual. The likelihood rationale has been revised to reflect the panel discussion, during which NATCA tower controllers familiar with ATPA alerts qualitatively estimated that the likelihood of this hazard would be less than once per week and equal to or more than once per three months, assigning a likelihood of Probable (B).

5.2 A321-H02 – Late ATPA Alert

Given the noted difference in how A321ceo and A321neo aircraft are modeled within STARS and ERAM, the panel also discussed the potential for ATPA to provide late alerts, due to the usage of ICAO type indicators which are different from the actual aircraft type. This concern was considered a hazard and the panel assessed its potential impact to operations.

Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A					
Probable B	A321-H02				
Remote C					
Extremely Remote D					
Extremely Improbable E					

Figure 5-2: Hazard Matrix A321-H02

5.2.1 Initial Risk Assessment (A321-H02)

The panel performed an assessment for this hazard and noted that ATPA, as designed, adapts for the varying approach speeds of the arriving aircraft. However, implementing the A321 Workaround could result in an increase in late alerts during compression, causing the controller to initiate a go-around. This could result in a slight increase in ATC workload, depending on the traffic complexity. According to the ATO SMS Manual, a slight increase in controller workload corresponds to a Minimal (5) severity. The panel assigned a Probable (B) likelihood based on SME input using the qualitative guidance contained in the ATO SMS Manual which results in a Low Initial Risk Level for this hazard of 5B and is represented as such in Figure 5-2.

5.2.2 Predicted Residual Risk Assessment (A321-H02)

A321-H02 Severity: The panel discussed controller training at the key sites and promoting national awareness of the A321 Workaround for the AIRS evaluation. The panel concluded these activities are required to mitigate the hazard. Although these safety requirements are not required by the ATO SMS Manual for hazards with a Low Initial Risk Level, the panel determined they would promote awareness of this hazard, assigning a Minimal (5) severity.

A321-H02 Likelihood: The likelihood was established using the qualitative guidance contained in the ATO SMS Manual. The likelihood rationale has been revised to reflect the panel discussion, during which NATCA tower controllers familiar with ATPA alerts qualitatively estimated that the likelihood of this hazard would be less than once per week and equal to or more than once per three months, assigning a likelihood of Probable (B).

5.3 A321-H03 – Mismatch between STARS aircraft type indication and aircraft type observed visually

The panel noted the potential for a tower controller to notice an A321ceo should not have an “A21N” ICAO type indicator in their flight plan, given the aircraft has smaller engine nacelles than the A321neo. This could result in the controller querying the flight crew on their type of aircraft not matching what appeared in the flight plan. This exchange could result in an increase in workload to tower controllers, should they have to verify the actual aircraft type.

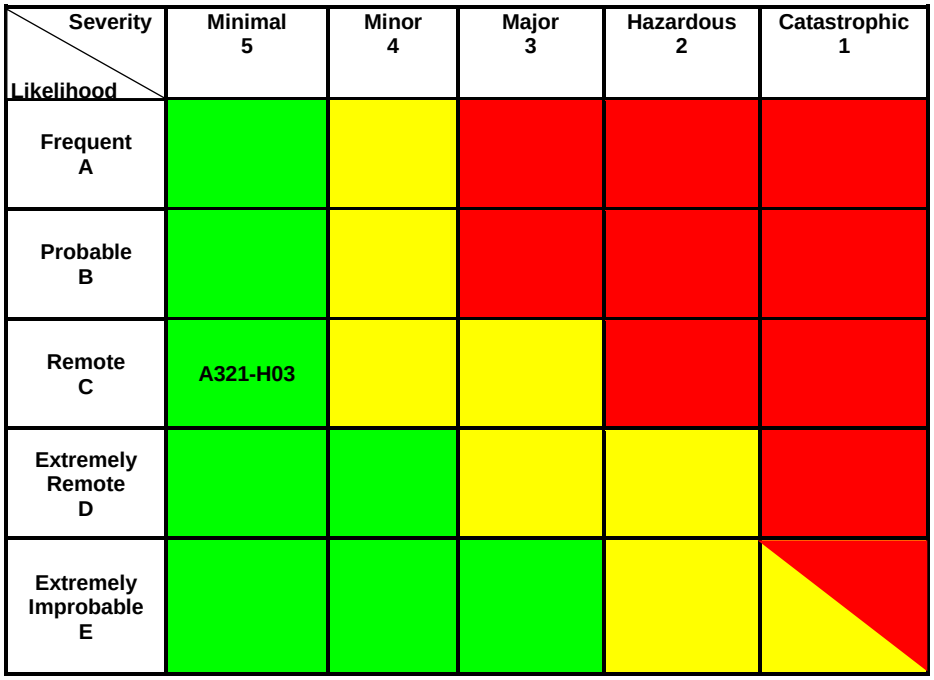

Figure 5-3: Hazard Matrix A321-H03

5.3.1 Initial Risk Assessment (A321-H03)

The panel performed an assessment for this hazard and noted the hazard could occur – especially at facilities where a tower is located very close to a runway. Philadelphia International Airport was referenced as an example of a tower where a controller could more easily identify a mismatch in the specific aircraft type from what was filed in the flight plan. This could result in a slight increase in ATC workload, depending on the traffic complexity. According to the ATO SMS Manual, a slight increase in controller workload corresponds to a Minimal (5) severity. The panel assigned a Remote (C) likelihood based on SME input, using the qualitative guidance contained in the ATO SMS Manual, which results in a Low Initial Risk Level for this hazard of 5C and is represented as such in Figure 5-3.

5.3.2 Predicted Residual Risk Assessment (A321-H03)

A321-H03 Severity: The panel discussed informational bulletins and other materials that would be distributed to the controller workforce regarding the A321 operational evaluation and identified this as a safety requirement. Although this safety requirement is not required by the ATO SMS Manual for hazards with a Low Initial Risk Level, the panel determined it would promote awareness of the A321 Workaround, the AIRS evaluation, and the potential for this hazard. Collectively, they assigned a Minimal (5) severity. It was also noted that awareness of the A321 Workaround usage would increase over time.

A321-H03 Likelihood: The likelihood was established using the qualitative guidance contained in the ATO SMS Manual. The panel agreed that implementing the above

requirements would promote awareness for this hazard, assigning a likelihood of Remote (C).

5.4 Summary of Hazard Requirements

The three hazards identified by the panel were all assessed as having low initial and predicted residual risk. Although these hazards did not require mitigation, per ATO SMS guidance, the panel developed safety requirements in the interest of preventing or decreasing their rate of occurrence.

5.4.1 A321-H01 – Nuisance ATPA Alert

Prior to conducting the operational evaluations, controllers will receive training within their facilities on CAS and I-IM operations, the usage of the A321 Workaround, and the possibility of nuisance ATPA alerts. On a national level, an informational bulletin on these operations will be distributed to the controller workforce containing detailed information on the operational evaluation, the key site involved, the usage of the A321 Workaround, and the hazards that could result. Further materials will be distributed to the controller workforce, as required, to provide updates on the operational evaluations.

5.4.2 A321-H02 – Late ATPA Alert

Prior to conducting the operational evaluations, controllers will receive training within their facilities on CAS and I-IM operations, the usage of the A321 Workaround, and the possibility of late ATPA alerts. On a national level, an informational bulletin on these operations will be distributed to the controller workforce containing detailed information on the operational evaluation, the key site involved, the usage of the A321 Workaround, and the hazards that could result. Further materials will be distributed to the controller workforce, as required, to provide updates on the operational evaluation.

5.4.3 A321-H03 – Mismatch between STARS aircraft type indication and aircraft type observed visually

Controllers within the key facilities would receive training on CAS and I-IM operations and the usage of the A321 Workaround. On a national level, controllers will also receive an informational bulletin containing detailed information on the operational evaluation and that some American Airlines aircraft filed with an “A321” ICAO aircraft type indicator may actually be an A321neo. American Airlines will also include information on the A321 Workaround within the training and internal communications received by the impacted flight crews.

5.5 Hazard Tracking and Monitoring

Once usage of the A321 Workaround commences at the key sites, the requirements developed by the SRM Panel, and the related metrics, must be reviewed periodically to ensure they remain effective in keeping risk at or below acceptable levels. This section

outlines the methodology for hazard tracking and monitoring to ensure the risk mitigations remain effective.

The Surveillance and Broadcast Services (SBS) Applications and Investments Team (AJM-243) will record and track the three identified hazards, as well as any newly identified hazards, along with their associated risk mitigations within the ATO's Safety Management Tracking System (SMTS). The SMTS record for the A321 Workaround will be updated on a quarterly basis for the duration of its usage in the NAS.

The following activities will be conducted to ensure the mitigations remain effective:

1. **Sub-Group Review of A321 Hazard Performance**
   A sub-group composed of SMEs and NATCA representatives from the Interval Management stakeholders will review any issues or concerns relating to the performance of the operational evaluation. Further, controller feedback will be solicited on any adverse impacts relating to the hazards or any new hazards that are identified. The specific activities for the identified hazards are outlined below.

2. **A321–H01 – Nuisance ATPA Alert**
   After extensive discussion by the panel members, it was determined that a sub-group of SMEs and NATCA representatives from the Interval Management stakeholders will review ATPA nuisance alerts to assess the A321 Workaround impact. Further review will be conducted in coordination with AJT and NATCA to determine any impacts to facilities and to develop further mitigations, as required, to ensure risk remains at or below acceptable levels.

3. **A321–H02 – Late ATPA Alert**
   The sub-group of SMEs and NATCA representatives from the Interval Management stakeholders will also review data on late ATPA alerts to assess the A321 Workaround impact. Further review will be conducted in coordination with AJT and NATCA to determine any impacts to facilities and to develop further mitigations, as required, to ensure risk remains at or below acceptable levels.

4. **A321–H03 – Mismatch between STARS aircraft type indication and aircraft type observed visually**
   The sub-group of SMEs and NATCA representatives from the Interval Management stakeholders will also review available data to quantify events where a controller had increased workload due to noting an A321ceo should not have an "A21N" ICAO aircraft type indicator and verified the actual aircraft type with the flight crew. The rate of these reports will be tracked for the duration of the operation evaluation. Further review will be conducted in coordination with AJT and NATCA to determine any impacts to facilities and to develop further mitigations, as required, to ensure risk remains at or below acceptable levels.

APPENDIX A – Acronyms

Acronym List

ACSS – Aviation Communication & Surveillance Systems
ADS-B In – Automatic Dependent Surveillance-Broadcast In
AIRS Evaluation – ADS-B In Retrofit Spacing Evaluation
ANSP – Air Navigation Service Provider
ASRS – NASA Aviation Safety Reporting System
ATC – Air Traffic Control
ATO – Air Traffic Organization
ATPA – Automated Terminal Proximity Alert
ATSAP – Air Traffic Safety Action Program
CAS – CDTI-Assisted Separation
CDTI – Cockpit Display of Traffic Information
ERAM – En Route Automation Modernization
HAW – Hazard Analysis Worksheet
ICAO – International Civil Aviation Organization
I-IM – Initial Interval Management
MOR – Mandatory Occurrence Reporting
NATCA – National Air Traffic Controllers Association
PASS – Professional Aviation Safety Specialists
PDARS – Performance Analysis Data and Reporting System
PHL – Preliminary Hazard List
SBS – Surveillance and Broadcast Services
SME – Subject Matter Expert
SMS – Safety Management System
SRM – Safety Risk Management
STARS – Standard Terminal Automation Replacement System
SWIM – System Wide Information Management

APPENDIX B – Hazard Analysis Worksheets

Hazard Name	Hazard Description	Cause	System State	Existing Controls	Existing Control Justification	Effect	Severity	Severity Rationale	Likelihood	Likelihood Rationale	Initial Risk	Safety Requirements	Organization Responsible for Implementing Safety Requirements	Predicted Residual Risk	Safety Performance Targets
A321-H01	Nuisance ATPA Alert	Incorrect aircraft type is modeled in ATPA and aircraft speeds for A321ceo and A321neo approach speeds differ by six knots	Push Period	ATPA	STARS samples aircraft speeds and adapts	Slight increase in controller workload	5 -Minimal	Nuisance ATPA alerts could cause a distraction but require no action	B - Probable	NATCA tower controllers familiar with ATPA alerts qualitatively estimated that the likelihood of this hazard would be less than once per week and equal to or more than once per three months.	5B- Low	Controller training at CAS and I-IM operational sites and National awareness of the A321 Workaround shall take place	AJT/AJM AA	5B -Low	No increase above the current rate of ATPA nuisance alerts.

Hazard Name	Hazard Description	Cause	System State	Existing Controls	Existing Control Justification	Effect	Severity	Severity Rationale	Likelihood	Likelihood Rationale	Initial Risk	Safety Requirements	Organization Responsible for Implementing Safety Requirements	Predicted Residual Risk	Safety Performance Targets
A321-H02	Late ATPA Alert	Incorrect aircraft type is modeled in ATPA and aircraft speeds for A321ceo and A321neo approach speeds differ by six knots	Push period	ATPA	STARS samples aircraft speeds and adapts	Slight increase in controller workload	5- Minimal	Late ATPA alerts could cause compression and require controller to initiate a go-around	B - Probable	NATCA tower controllers familiar with ATPA alerts qualitatively estimated that the likelihood of this hazard would be less than once per week and equal to or more than once per three months.	5B - Low	Controller training at CAS and I-IM operational sites and national awareness of the A321 Workaround shall take place	AJT/AJM AA	5B- Low	No increase above the current rate of late ATPA alerts.

Hazard Name	Hazard Description	Cause	System State	Existing Controls	Existing Control Justification	Effect	Severity	Severity Rationale	Likelihood	Likelihood Rationale	Initial Risk	Safety Requirements	Organization Responsible for Implementing Safety Requirements	Predicted Residual Risk	Safety Performance Targets
A321-H03	Mismatch between the STARS aircraft type indication and the aircraft type observed visually	A321 Workaround	Push Period	Controllers are aware that flight plans can contain incorrect flight plan data	Controller scan of surface movements	Distraction resulting in a potential slight increase in controller workload	5- Minimal	Controller noticing an aircraft type other than as filed may cause them to query the flight crew on their flight plan	C- Remote	Could realistically occur less than once within a three-month period and equal to or more than once per three-year period	Low	Informational Bulletin in controller binder and other materials shall be provided *Awareness would increase over time* AAL A321 pilots shall be made aware that a A321ceo could be filed in the flight plan using an “A21N” ICAO aircraft type indicator rather than an “A321” ICAO aircraft type indicator	AJT/AJM	C - Remote	No increase above the current rate of occurrence.

APPENDIX C – Monitoring Plan

Hazard Name	Hazard Description	Initial Risk	Safety Requirements	Organization Responsible for Implementing Safety Requirements	Monitoring Activities	Frequency	Duration	Monitoring POC	Safety Performance Targets
A321-H01	Nuisance ATPA Alert	5B - Low	Controller training at the key sites National awareness of the A321 Workaround and CAS and I-IM operational evaluations	AJT/AJM AA	1) AJT/AJM to coordinate with NATCA during quarterly Article 114 meetings that include the monitoring POCs as well as En Route and Terminal automation leads (the meeting is held monthly with quarterly in-person meetings). 2) Determine impact to facilities and develop further mitigations, if required	1) Quarterly 2) Quarterly	1) Duration of operational evaluation 2) Duration of operational evaluation	AJT/AJM	No increase above the current rate of ATPA nuisance alerts.
A321-H02	Late ATPA Alert	5B - Low	Controller training at the key sites National awareness of the A321 Workaround and CAS and I-IM operational evaluations	AJT/AJM	1) AJT/AJM to coordinate with NATCA during quarterly Article 114 meetings that include the monitoring POCs as well as En Route and Terminal automation leads (the meeting is held monthly with quarterly in-person meetings). 2) Determine impact to facilities and develop further mitigations, if required	1) Quarterly 2) Quarterly	1) Duration of operational evaluation 2) Duration of operational evaluation	AJT/AJM	No increase above the current rate of late ATPA alerts.

Hazard Name	Hazard Description	Initial Risk	Safety Requirements	Organization Responsible for Implementing Safety Requirements	Monitoring Activities	Frequency	Duration	Monitoring POC	Safety Performance Targets
A321-H03	Mismatch between STARS aircraft type indication and aircraft type observed visually	5B - Low	Controller training at the key sites National awareness of the A321 Workaround and operational evaluations AAL A321 pilot awareness that a A321ceo could be filed in the flight plan using an “A21N” ICAO aircraft type indicator rather than an “A321” ICAO aircraft type indicator.	AJT/AJM	1) Monitor instances where ATC reacted to an A321ceo being filed as A21N and queried flight crew on flight plan accuracy 2) Track rate of reports during the operational evaluation period 3) Determine impact to facilities and develop further mitigations, if required 4) AJT/AJM to coordinate with NATCA during quarterly Article 114 meetings that include the monitoring POCs as well as En Route and Terminal automation leads (the meeting is held monthly with quarterly in-person meetings).	1) Quarterly 2) Quarterly 3) Quarterly 4) Quarterly	1) Duration of operational evaluation 2) Duration of operational evaluation 3) Duration of operational evaluation 4) Duration of operational evaluation	AJT/AJM	No increase above the current rate of occurrence.

APPENDIX D – References

1. FAA, *ATO Safety Management System Manual*, April 2019
2. FAA Order JO 7360.1E, *Aircraft Type Designators*

APPENDIX E – A321 Workaround Description

ADS-B In Retrofit Spacing (AIRS) ADS-B In Capability Indicator Workaround Using the A321 Type Designator

Rev 2.0

September 9, 2021

Federal Aviation Administration
American Airlines
Aviation Communication & Surveillance Systems, LLC
NextGen Project

Record of Revisions

Revision	Date	Description of Change
1	6/24/2021	Version 1 released to the A321 Workaround Safety Risk Management Panel members in advance of July 15, 2021 Safety Risk Management Panel meeting.
2	9/9/2021	Version 2 will be provided as an Appendix to the A321 Workaround Safety Risk Management Document. It reflects changes to the A321 Workaround that were decided upon just prior to the A321 Workaround Safety Panel on July 15, 2021. Namely, the American Airlines A321neo aircraft that are equipped with SafeRoute+® will also be filed as A321 during the CDTI-Assisted Separation and Initial Interval Management operational evaluations. The description of how American Airlines will be implementing the A321 Workaround was also updated.

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1 INTRODUCTION

1.1 ADS-B In Retrofit Spacing Evaluation Project

The Federal Aviation Administration (FAA), American Airlines, and ACSS are participating in a project known as the Automatic Dependent Surveillance-Broadcast (ADS-B) In Retrofit Spacing Evaluation (AIRS Eval). The AIRS project is a multi-year effort where three ADS-B In operations will be evaluated during revenue service on the American Airlines A321 fleet. The ADS-B In operations are CDTI-Assisted Visual Separation (CAVS), CDTI-Assisted Separation (CAS) and Initial-Interval Management (I-IM). American Airlines is in the process of equipping their entire A321 fleet, which consists of A321ceo (current engine option) and A321neo (new engine option) aircraft, with the avionics needed to support the ADS-B In operations. The flight deck applications were developed by ACSS and are known as SafeRoute+®. The installation of this equipment in the American Airlines A321 fleet is expected to take up to five years and be completed in October 2024. In total, 318 aircraft will be equipped, of which 218 are A321ceos and 100 are A321neos.

The AIRS Eval schedule as of late-June 2021 is shown in Figure 1. CAVS operations do not require any involvement of air traffic control (ATC) and started in May 2021. I-IM operations are planned to begin in June 2022, with CAS operations planned to begin in August 2022. Both the CAS and I-IM operations will start before the ADS-B In Capability Indicator is available in STARS or ERAM. The operations will also start before SafeRoute+® installation on the A321 fleet is completed.

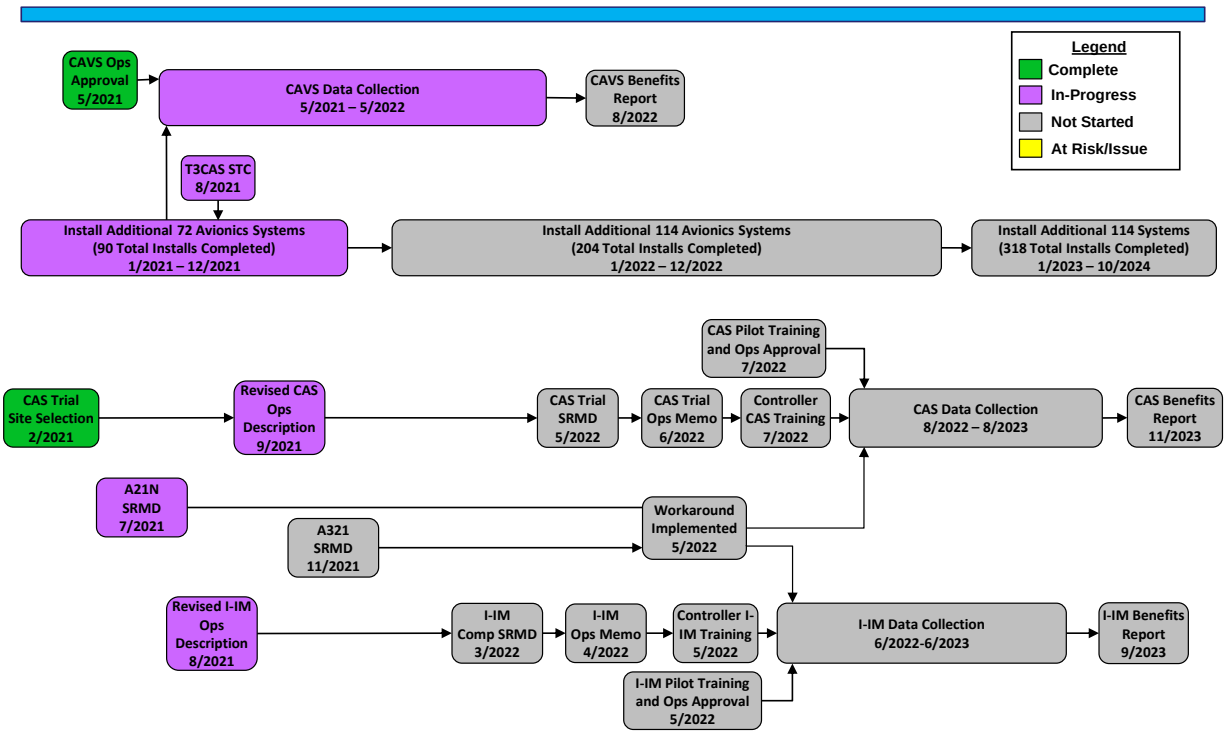

Figure 1. ADS-B In Retrofit Spacing Evaluation Project Plan (June 2021)

Current installation plans project that the A321ceo fleet will be equipped by the end of 2023 (see the black line on Figure 2), the new A321neo fleet will be equipped by March 2025 (see the blue line on Figure 2) and the A321neos that require a retrofit will be equipped by August 2024 (see the orange line on Figure 2).

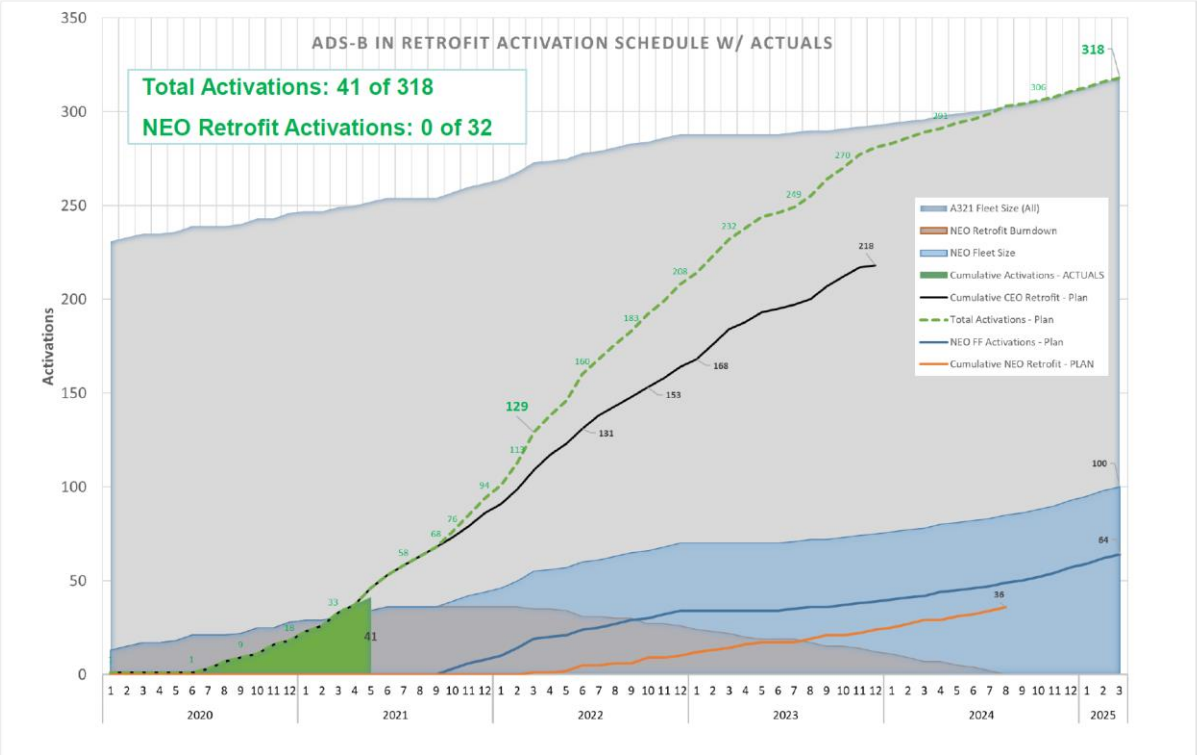

Figure 2. ADS-B In Retrofit Spacing Evaluation Avionics Installation Plan (May19, 2021)

1.2 ADS-B In Capability Indicator and the Need for a Workaround

The CAS and I-IM operations are initiated by the controller. For both operations, the controller needs to know which American Airlines (AAL) A321 aircraft are able to perform CAS or I-IM in order to issue a CAS or I-IM clearance. The ability to perform CAS or I-IM includes the installation of the SafeRoute+® avionics, trained flight crew, trained controllers, airline operational approval, and air traffic control facility operational approval. Although American Airlines will eventually equip their entire A321 fleet with SafeRoute+®, both the CAS and I-IM operational evaluations are planned to start prior to full equipage with SafeRoute+®.

Currently, the Standard Terminal Automation Replacement System (STARS) automation platform used by terminal controllers and the En Route Automation Modernization (ERAM) automation platform used by en route controllers both do not provide an indication of which aircraft have the capability to perform an ADS-B In operation. The FAA has planned automation upgrades for both STARS and ERAM that include providing the controller with what is known as the ADS-B Capability Indicator, which will provide controllers with the ability to know which aircraft and flight crews can perform ADS-B In operations. The planned

upgrades will happen after the AIRS operational evaluations are completed, which is why a workaround is needed.

2 A321 WORKAROUND

2.1 Overview

The FAA and American Airlines have assessed many alternatives to inform controllers which American Airlines A321 aircraft are capable of performing CAS or I-IM prior to the deployment of the ADS-B Capability Indicator in ERAM and STARS. Capable in this context means an aircraft with a trained flight crew and installed equipment. Design goals for a workaround are that it can be implemented by American Airlines and the FAA, will support the AIRS Eval timeline, will work operationally for the pilots and controllers, and has a high probability of being successful in operation. The workaround that has been identified is called the A321 Aircraft Type Designator Workaround or A321 Workaround.

The A321 Workaround works as follows: Once either CAS or I-IM operational evaluations begin, A321 aircraft that are capable of performing CAS or I-IM will be filed with the A321 aircraft type designator, while A321 aircraft that are not capable of performing CAS or I-IM will be filed with the A21N aircraft type designator. Specifically:

- American will file flight plans for the A321ceo aircraft that are not equipped with SafeRoute+® using the A21N aircraft type designator.
- American will file flight plans for the A321neo aircraft that are equipped with SafeRoute+® using the A321 type designator.
- The remaining A321ceo (equipped with SafeRoute+®) and A321neo (not equipped with SafeRoute+®) will be filed with the usual aircraft type designator (no change).

All American Airlines A321 flight crew will be trained to perform CAS and I-IM prior to the start of the operational evaluations. The FAA will train terminal controllers participating in the CAS evaluation to know that aircraft filed as an AAL A321 are capable of performing CAS operations. Likewise, the FAA will train en route controllers participating in the I-IM evaluation to know that aircraft filed as an AAL A321 are capable of performing I-IM. In addition, controllers throughout the National Airspace System (NAS) will need to be aware that some American Airlines aircraft with the type designator A21N could actually be A321ceo aircraft and some American Airlines aircraft with the type designator A321 could actually be A321neo aircraft.

The A321 Workaround will end if any of the following happens:

- American Airlines and the FAA are no longer participating in the CAS or I-IM operational evaluations, which are each expected to last one year.
- All of the AAL A321ceo and AAL A321neo aircraft are equipped with SafeRoute+®.
- STARS and ERAM have deployed the ADS-B In Capability Indicators.

Note that the A321 Workaround will apply to the entire AAL A321 fleet, not just the A321 aircraft that are being flown through the I-IM operational evaluation site (Albuquerque ARTCC (ZAB)), or the CAS operational evaluation site (Dallas TRACON (D10)). American Airlines flies the A321 fleet within the lower 48 states, as well as to Alaska, Hawaii, Canada, Mexico and to destinations in the Caribbean and South America. Therefore, tower controllers at other facilities could notice a difference between the aircraft designator on their displays (e.g., AAL A21N) and what they observe outside the window (e.g., an AAL A321ceo), since the A321neo

has a larger engine diameter than the A321ceo. See Section 2.3, Major Assumptions, for a discussion of how foreign Air Navigation Service Providers (ANSPs) will be handled.

2.2 Comparison of the A321ceo and A321neo

The A321ceo and A321neo are both A321 aircraft. The A321ceo has the current engine option. The A321neo has the new engine option and are the new A321 aircraft being delivered to American Airlines. The new engine option provides a significant increase in operating range for the A321neo, increasing the typical range from 3200 nautical miles (nm) to 4000 nm. It also makes the A321neo about 50% quieter than the A321ceo. All A321 models are certified at Stage 3 or better, as defined in 14 CFR part 36. In 2018, there were 398 A321 aircraft in the U.S. commercial aircraft inventory, which represented 5.4% of the total inventory of 7356 aircraft. Approximately half of those were operated by American Airlines.

The A321ceo and A321neo are virtually identical except for the engines (Table 1). They have the same length, wingspan, height, and fuselage. The engine nacelles are larger for the A321neo, since the neo engine is a different shape with a larger diameter. The A321ceo and A321neo have the same cargo capacity, operating ceiling, and cruise speed. The maximum takeoff weight and maximum payload are slightly higher for the A321neo. The seating configurations for the A321ceo and A321neo are also different. The maximum passenger capacity for the AAL A321neo is 196, compared to 187 for the AAL A321ceo.

Figure 3 shows one version of an AAL A321ceo. This aircraft has sharklets. Some AAL A321ceo have sharklets and some do not; the AAL A321neo typically has sharklets. Note that the AAL A321ceo depicted has a door forward of the engine nacelle. The AAL A321neos do not have this door (Figure 4).

The reason that the A321neo has a different aircraft type designator than the A321ceo is because the A31neo is significantly quieter. An airport operator in Europe requested a new aircraft type indicator from ICAO to be able to distinguish the much quieter A321neo from the A321ceo. The need for a different type designator was not driven by different performance or wake characteristics. Per FAA Order JO 7360.1E, the A321ceo and A321neo have the same Medium weight category, the same RECAT wake categories, and the Same Runway Spacing. They also have the same Land and Hold Short Operations (LAHSO) category. The FAA Wake Program Office has collected data comparing the A321neo and A321ceo wake characteristics. While there are differences in the wake of each, those differences are not sufficient to require the aircraft to be placed in different wake categories.

Table 1. Comparison of A321ceo and A321neo

Variant	A321ceo	A321neo
Cockpit crew	2	
Seats	AAL 187	AAL 196
Length	146 feet	
Wingspan	117 feet 5 inches	
Wing	1318 square feet area. 25 degree sweep	
Height	38.6 feet	
Fuselage	13.0 by 13.6 feet width x height, 12.1 feet wide cabin	
Max takeoff weight	206,000 lb.	213,800 lb.
Max payload	56,000 lb.	56,200 lb.
Empty weight	107,000 lb.	110,500 lb.
Fuel capacity	6,350 – 7,930 US gallons	6,261 – 8,700 US gallons
Engines (x2)	CFM56-5B, 68.3 inch fan IAE V2500A5, 63.5 inch fan	CFM International LEAP-1A, 78 inch fan
Max thrust	30,000 – 33,000 lbf	33,100 lbf
Speed	Cruise Mach 0.78, Max Mach 0.82	
Ceiling	39,100 – 39,800 feet	
Typical range	3,200 nm	4,000 nm

Figure 3. AAL A321ceo Aircraft

Figure 4. AAL A321neo Aircraft

2.3 Major Assumptions

The A321 Workaround described in Section 2.1 includes a number of key assumptions.

1. *American Airlines will have an internal means to differentiate between the A321ceo aircraft that are filed as A21N (as part of the workaround) and the real A321neo aircraft. AAL will also have an internal means to differentiate between the A321neo aircraft that are filed as A321 and the real A321ceo aircraft.* Since the A321neo has a longer range and a different seating configuration than the A321ceo, it must be treated differently than the A321ceo for airline scheduling, reservations, and other purposes.
2. *American Airlines will coordinate with foreign ANSPs that could be affected by AAL filing an A321ceo aircraft as an A21N or an A321neo aircraft as an A321.* American Airlines flies the A321 internationally to Canada, Mexico, the Caribbean, and South America, so ANSPs as well as the FAA could be affected by the A321 Workaround. American Airlines is responsible for notifying the foreign ANSPs where they operate the A321 fleet about the A321 Workaround and for obtaining any necessary approvals.
3. *American Airlines will coordinate, as appropriate, with their pilots and dispatchers to make them aware of the A321 Workaround*.
4. *All American Airlines A321 flight crew will be trained to perform the CAS operation prior to the use of the A321 Workaround for CAS operations.*
5. *All American Airlines A321 flight crew will be trained to perform the I-IM operation prior to the use of the A321 Workaround for I-IM operations.*
6. *American Airlines will provide the FAA with the date on which they start using the A321 Workaround and the date they stop using the A321 Workaround for the CAS and I-IM operational evaluations.*
7. *The FAA will compile a list of the A321ceo aircraft in the American Airlines fleet. The list will include the registration numbers of the aircraft (N number).*
8. *The FAA will make all controllers in the NAS aware of the A321 Workaround.*
9. *The FAA will make organizations that do safety reporting, performance monitoring, and data analysis with flight plan data aware of the A321 Workaround.*

2.4 American Airlines Implementation of the A321 Workaround

American Airlines is implementing the A321 Workaround with automation that only affects the information that is sent in the flight plan to the FAA. Internally, American Airlines sees the correct A321 aircraft type designations. American Airlines will have a table with the tail numbers of all A321 aircraft with a mapping to the aircraft type designator that should be put into the flight plan that is filed with the FAA

- Equipped A321ceo → file as A321 (no change)
- Equipped A321neo → file as A321
- Unequipped A321ceo → file as A21N
- Unequipped A321neo → file as A21N (no change)

The American Airlines table with the tail numbers and aircraft type designation for the flight plan will be updated as A321ceo aircraft and A321neo aircraft are retrofitted with SafeRoute+® and as new A321neo aircraft are added to the fleet. New A321neo aircraft delivered after October 2021 will include SafeRoute+® before they are deployed.

Pilots and dispatchers will be made aware that the A321 Workaround is being implemented, but neither will need to be involved with modifying the flight plan information sent to the FAA.

2.5 Authorization of the A321 Workaround

American Airlines will be authorized to perform CAS operations through a CAS Operational Specification (OpSpec) and will be authorized to perform I-IM operations through an I-IM OpSpec. The CAS OpSpec is expected to reference this document (or an updated version) as a description of the A321 Workaround. The I-IM OpSpec is expected to reference this document (or an updated version) as a description of the A321 Workaround. The signed A321 Workaround Safety Risk Management Document will be considered authorization to use the A321 Workaround in each operational evaluation.

2.6 Controller Use of the A321 Workaround

2.6.1 Tower Controllers and Standard Terminal Automation Replacement System (STARS) for CAS Operations

The primary method for determining the aircraft type, for both the terminal radar controller and tower local controller, is through the STARS data block. The type designator is displayed on the second line of the STARS data block and is time-shared with the aircraft ground speed. It is also time-shared with the scratch pad entry, if present. The A321 Workaround will not change the method of display, but will simply indicate an A321 type designation for an equipped A321ceo or an equipped A321neo and an A21N type designation for an unequipped A321ceo or unequipped A321neo. Dallas TRACON controllers will be trained that an AAL A321 can perform CAS operations.

A graphical depiction of the type designator in the STARS data block is contained in Figure 5.

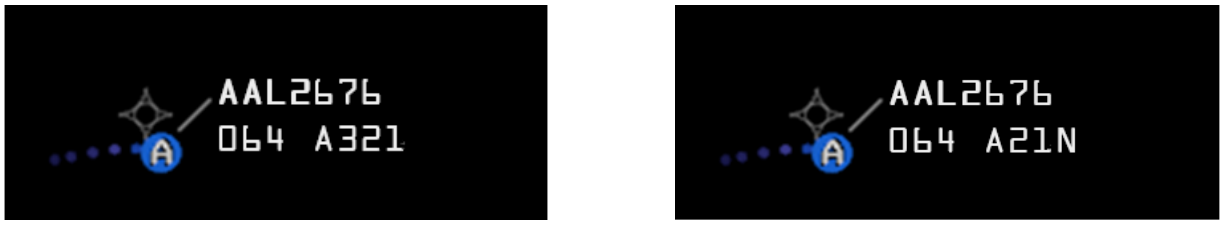

Figure 5. Aircraft Type Depiction in STARS

2.6.2 En Route Controllers and En Route Automation Modernization (ERAM) for I-IM Operations

The primary method for determining the aircraft type for the en route radar controller is through the ERAM data block. The type designator, along with the equipment suffix, is displayed on the fourth line of the ERAM data block and may time-share with other information. The fourth line of the data block can be toggled on or off and its use is not mandatory. When the fourth line of the data block is toggled off, the controller can use the En Route Decision Support Tool (EDST) to ascertain the aircraft type. The A321 Workaround will not change the method of display, but will simply indicate an A321 type designation for an equipped A321ceo or an equipped A321neo and an A21N type designation for an unequipped A321ceo or unequipped A321neo. Albuquerque ARTCC controllers will be trained that an AAL A321 can perform I-IM operations.

A graphical depiction of the type designator in the ERAM data block is contained in Figure 6.

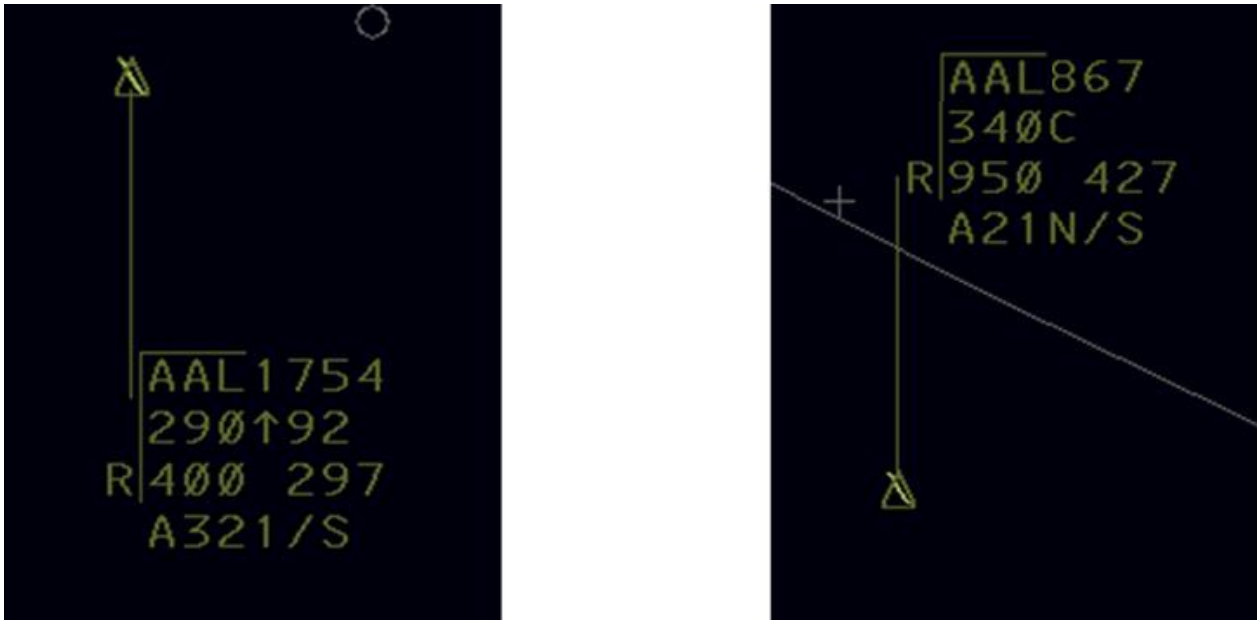

Figure 6. A321 and A21N Depictions in ERAM

2.7 NAS-Wide Impact of the A321 Workaround

2.7.1 NAS-Wide Controllers

Once the CAS operational evaluation starts, all AAL A321ceo that are not equipped with SafeRoute+® will be filed as A21N. In addition, all AAL A321neo that are equipped with SafeRoute+® will be filed as A321. This will also be the case when the I-IM operational evaluation starts. The filing is independent of the departure or arrival airport, so air traffic controllers throughout the NAS will see some AAL A321ceo aircraft designated as A21N and some AAL A321neo aircraft designated as A321. Since the engines on the A321ceo and A321neo are a different diameter, it is possible for a tower controller to notice a mismatch between the aircraft type designation depicted on their automation and their out-the-window view. This could occur, for example, when an aircraft is taxiing. In addition, the need could arise to notify airports that ATC may not know if an AAL aircraft is an A321ceo or A321neo, especially in a divert or emergency situation.

Controllers that are not involved with the CAS and I-IM operational evaluations will need to be informed about the A321 Workaround so they know that the AAL A21N aircraft they are working may be an AAL A321ceo and that the AAL A321 aircraft they are working may be an AAL A321neo.

2.7.2 Aircraft Rescue and Firefighting Services

In the event of an aircraft emergency, the controller communicates key information about the aircraft to the airport Aircraft Rescue and Firefighting (ARFF) service. This information includes the souls on board, fuel, and aircraft type. Controllers try to be as specific as possible on the aircraft type (e.g., B737-500 and B737-900), but all the checklist says is to pass along the aircraft type; it is not a requirement to differentiate among specific series.

The rescue and firefighting response to a specific aircraft type depends on the length of the aircraft and the type of fuel. Since the A321ceo and A321neo are the same length with the same type of fuel, the number of vehicles and extinguishing agents required are the same. The door and seating configuration differences between the AAL A321ceos and AAL A321neos will not drive the firefighting response either. There are multiple door and seating configurations among the airline A321 fleets and firefighters are prepared for all possibilities. As such, the A321 Workaround should not impact Aircraft Rescue and Firefighting services.

2.7.3 Land and Hold Short Operations (LAHSO)

The A321neo and A321ceo have the same group code for Land and Hold Short Operations (LAHSO).

2.7.4 Noise Abatement

The A321ceo and A321neo meet Stage 3 noise requirements in 14 CFR part 36; however, the A321neo is significantly quieter than the A321ceo. The FAA does not route the A321ceo any differently than the A321neo for noise abatement. However, local airport authorities could treat the A321ceo and A321neo differently with respect to noise. American Airlines has determined that there are no local airport authorities in the United States that have noise restrictions that

affect the scheduling of the AAL A321ceos or AAL A321neos. As such, the A321 Workaround should not lead to an incorrect noise abatement procedure being applied in the U.S.

2.7.5 FAA Ground Automation Systems

One issue to consider with the A321 Workaround is whether the FAA ground automation systems treat the A321ceo and A321neo the same for any performance modeling/trajectory prediction or wake separation. STARS, ERAM, MicroEARTS and the Time-Based Flow Management (TBFM) system are considered in the following subsections.

2.7.5.1 Standard Terminal Automation Replacement System (STARS)

The Automated Terminal Proximity Alert (ATPA) is the only STARS automation component that uses aircraft type. ATPA is used to help prevent compression errors on final approach. It uses both wake turbulence and radar spacing, depending on what applies. As such, a site-specific adaptation maps the aircraft types to a wake category. The weight and wake categories for the A321ceo and A321neo are the same, per FAA Order JO 7360.1E Aircraft Type Designators, so there should be no differences in how the aircraft are treated in ATPA/STARS, with respect to weight and wake.

The A321ceo and A321neo are adapted differently in ATPA for another reason. The A321 has an exception in ATPA to account for the faster approaches speed identified by data collection in the NAS. An A321ceo is expected, in ATPA, to perform faster on final approach (6 knots), as compared to the A21neo. This difference between the A321ceo and A321neo speeds on final is fairly small and could be due to how the aircraft operate. If the A321neo is typically deployed on long haul flights, for example, it may be landing with less weight on average than the typical A321ceo operating domestic flights. Another reason for the difference in the observed approach speeds could be how operators specify which flap settings to use on final approach.

2.7.5.2 MicroEARTS

MicroEARTS is in use in Alaska, Guam, Puerto Rico, Hawaii, and the FAA William J. Hughes Technical Center in Atlantic City, New Jersey. AAL can operate the A321ceo to Alaska, Puerto Rico, and Hawaii. The Automated Terminal Proximity Alert (ATPA) is the only MicroEARTS automation component that differentiates between an A321ceo and an A321neo, and ATPA is only deployed in MicroEARTS at Honolulu, Hawaii. See Section 2.7.5.1 for a discussion of how ATPA approach speeds are customized differently for the A321ceo and the A321neo.

2.7.5.3 En Route Automation Modernization (ERAM)

ERAM uses aircraft models to generate expected four-dimensional trajectories for conflict prediction. The conflict prediction includes aircraft-to-aircraft conflicts and aircraft-to-restricted airspace conflicts. The adaptation uses one A321 model for the A321neo and all variations of the A312ceo. As such, there should be no issues for ERAM with the A321 Workaround.

2.7.5.4 Time-Based Flow Management (TBFM)

TBFM uses aircraft models for four-dimensional trajectory prediction. There are a set of aircraft performance models in the TBFM source code. A site-specific adaptation maps the various ICAO codes to the aircraft performance models available in the source code, as well as to a wake

category. Looking at the adaptation for the Denver airspace, both the A321 and A21N codes are mapped to the "EA32" performance model. In fact, the A318, A319, A19N, A320, A20N, A322, A339, C919, and MC23 are all mapped to the EA32 performance model. Technically, a facility could map to the A21N to a different performance model, but that does not seem likely. Assuming the DEN adaption is representative, TBFM should not be impacted by the A321 Workaround.

2.7.6 Safety Reporting

There are a number of safety reporting systems in place to capture incidents such as loss of separation, flight too close to terrain, wake events, and other potential safety issues. Some of these systems are mandatory and others are voluntary. Controllers that provide safety reports could include the wrong aircraft type for an American Airlines A321ceo or A321neo, due to the A321 Workaround. Automated reporting systems that get aircraft type from the flight plan information could also report the wrong aircraft type for an American Airlines A321ceo or A321neo due to the A321 Workaround. The following sections discuss the safety reporting systems that could be affected.

2.7.6.1 Mandatory Occurrence Reporting (MOR) and Aviation Risk Identification and Assessment (ARIA) Safety Reporting

Mandatory Occurrence Reports (MOR) must be filed when certain safety-related events happen, such as the loss of separation in air or on the ground, flight too close to terrain, a wake event, or an aircraft landing on a taxiway. Pilots, controllers, the general public, and others can file these reports. The forms used to submit an MOR include the aircraft identification and aircraft type/suffix. Controllers that provide safety reports could include the wrong aircraft type for the AAL A321ceo due to the A321 Workaround. MORs are input into the Comprehensive Electronic Data Analysis and Reporting (CEDAR) tool and reviewed by ATO safety.

The Aviation Risk Identification and Assessment (ARIA) tool generates safety reports that are known as Preliminary ARIA Reports (PARS). PARS are reviewed by Quality Assurance and qualifying operations are input to CEDAR. The ARIA Reports that are input into CEDAR could include the wrong aircraft type for the AAL A321ceo, if aircraft type is obtained from the filed flight plan in ERAM. As such, American Airlines A321ceo aircraft participating the in the AIRS operational evaluations could be misidentified as A321neo in CEDAR.

The information in CEDAR is reviewed by ATO safety. The FAA AIRS Eval will make ATO Safety aware of the A321 Workaround and provide the registration numbers for the American Airlines A321ceo aircraft. ATO Safety can use the registration numbers of the AAL A321ceo in conjunction with other data sources, such as the ADS-B Performance Monitor, to correlate individual flights with the aircraft registration numbers to ensure the correct aircraft type.

Currently the Wake RECAT program is collecting all MOR data for a six-month period when Consolidate Wake Turbulence is implemented at a facility. The FAA AIRS Eval will also make the FAA Wake Office aware of the A321 Workaround and the need to verify the aircraft type for MORs that include an AAL A21N aircraft type or an AAL A321 aircraft type.

2.7.6.2 Air Traffic Safety Action Program (ATSAP)

The Air Traffic Safety Action Program (ATSAP) has established a system for controllers and other employees to voluntarily identify and report safety and operational concerns. The intent is to identify and report all events that could or did lead to a breakdown in safety, or an increased risk to air traffic operations.

It is possible that a controller submitting a report to ATSAP could misidentify an A321ceo as an A321neo or vice versa due to the A321 Workaround. The FAA AIRS project will make the FAA ATSAP aware of the A321 Workaround so that they understand that a safety report during the time period of the A321 Workaround is in effect could misidentify an American Airlines A321ceo as an A321neo, or vice versa. ATSAP can use the registration numbers of the AAL A321ceo in conjunction with other data sources, such as the ADS-B Performance Monitor, to correlate individual flights with the aircraft registration numbers to ensure the correct aircraft type.

2.7.6.3 Aviation Safety Reporting System (ASRS)

The FAA Aviation Safety Reporting Program (ASRP) uses the National Aeronautics and Space Administration (NASA) as a third party to receive and process Aviation Safety Reports. NASA's Aviation Safety Reporting System (ASRS) includes a means for cooperative safety reporting from pilots, controllers, flight attendants, maintenance personnel, dispatchers, and other users of the NAS. Based on information obtained from this program, the FAA will take corrective action, as necessary, to remedy defects or deficiencies in the NAS. The reports may also provide data for improving the current system and planning for a future system.

The forms that are submitted to describe safety incidents include the aircraft type. Whether aircraft type includes just make or model or the series is up to the submitter. The ASRS searchable database does not include series. All of the A321 aircraft types, for example, are searched for as A321.

It is possible that a controller submitting a report to the ASRS could misidentify an A321ceo as an A321neo or vice versa due to the A321 Workaround. The FAA AIRS project will make the FAA ASRP aware of the A321 Workaround so that they understand that a safety report during the time the A321 Workaround is in effect could misidentify an American Airlines A321ceo as an A321neo or vice versa. The FAA ASRP can use the registration numbers of the AAL A321ceo in conjunction with other data sources, such as the ADS-B Performance Monitor (APM), to correlate individual flights with the aircraft registration numbers to ensure the correct aircraft type.

2.7.7 FAA Performance Monitoring and Data Analysis

2.7.7.1 ADS-B Performance Monitoring

FAA ADS-B performance monitoring matches the ICAO aircraft address in each ADS-B message with the corresponding FAA Civil Aviation Registry information for all U.S.-registered and Canadian-registered aircraft. For U.S.- and Canadian-registered aircraft, FAA ADS-B performance monitoring makes no use of flight plan aircraft type indicator information.

For aircraft registered outside the U.S. and Canada, as determined by their ICAO address from ADS-B data, the FAA ADS-B performance monitor "scrapes" the aircraft type indicator from Instrument Flight Rule (IFR) flight plan data and stores it in the APM as associated with that ICAO aircraft address (this is a recent enhancement, implemented in 2020).

The A321 Workaround proposed for the AIRS Eval applies only to the American Airlines A321 fleet, which is registered in the U.S., so the A321 Workaround will have no effect on the ADS-B Performance Monitor.

2.7.7.2 AIRS Benefits Analysis

The FAA is performing a benefits analysis on the I-IM and CAS operations as part of the AIRS project. The FAA will have access to the AAL A321 tail numbers and can determine the correct aircraft type designator using the ADS-B Performance Monitor or other data sources. Therefore, the AIRS benefits analysis will not be affected by the A321 Workaround.

2.7.7.3 FAA Wake Studies

The FAA wake program is currently collecting aircraft wake turbulence data at multiple sites using Light Detection and Ranging (LIDAR) systems. LIDARS are currently in use at San Francisco International Airport (multiple units) and John F. Kennedy International Airport. This data is correlated with aircraft type data and MET data to build databases of wake behavior in all operational conditions. The databases support safety assessments of new separation systems and/or proposed operational procedures, etc. The A321neo is of interest to the wake office since it is a new aircraft and it is important that the wake turbulence is characterized at operationally relevant in-trail distances. The A321neo wake database will not be reliable if it contains data that is actually correlated with the A321ceo aircraft. The A321 Workaround could corrupt the A321neo wake database if the A21N aircraft type is obtained from the flight plan and not checked for correctness.

The FAA AIRS project will make the FAA Wake Office aware of the dates of the A321 Workaround and provide the registration numbers of the A321ceo. The FAA Wake Office can use the registration numbers in conjunction with other data sources, such as the ADS-B Performance Monitor, to correlate the aircraft registration numbers with individual flights to verify the correct aircraft type for any AAL A321ceo or AAL A321neo aircraft.

2.7.7.4 Reduced Vertical Separation Minima (RVSM) and the North American Approval Registry and Monitoring Organization (NAARMO)

The North American Approval Registry and Monitoring Organization (NAARMO) located at the FAA William J. Hughes Technical Center in Atlantic City, New Jersey is responsible for monitoring aircraft height-keeping performance in support of Reduced Vertical Separation Minima (RVSM). NAARMO uses ADS-B height monitoring for ADS-B Out equipped aircraft, an Aircraft Geometric Height Measurement Element for aircraft with Mode S transponders, and a GPS-based Monitoring Unit (GMU) for individual flights. The aircraft are tracked by their ICAO 24-bit address and aircraft registration number. NAARMO also does matching between the as-flown monitoring data and the flight plan. It is possible that some RVSM data would be rejected due to the aircraft type mismatch with A321ceo aircraft that are filed as A21N or A312neo aircraft that are filed as A321. The FAA AIRS project will make the FAA Wake Office aware of

the dates of the A321 Workaround and provide the registration numbers of the A321ceo to minimize the chance that RVSM monitoring data will be rejected.