Federal Aviation Administration

Memorandum

Date:	August 30, 2019
To:	Paula Martinez, Chairperson, FAA Safety Management System (SMS) Committee
From:	Safety Collaboration Team (SCT) Co-Chairs
Subject:	SRM Report for Jet Fuel Contamination with Diesel Exhaust Fluid (DEF) Safety Issue

The Safety Risk Management (SRM) Team met to conduct the hazard analysis of the Jet Fuel Contamination with Diesel Exhaust Fluid (DEF) safety issue on June 19–20, 2019. The SRM Team prepared the attached SRM Report, which reviews the safety risk assessment, including safety recommendations involved with this issue.

This assessment was conducted on behalf of the SCT. The SRM Team used the risk matrix and severity and likelihood definitions from Federal Aviation Administration (FAA) Order 8040.4B, *Safety Risk Management Policy*. The SRM Team identified a high initial risk associated with this safety issue. There is the potential to have a high residual risk, due to the common cause factor that the fuel system supplies all engines on the aircraft of failure, if joint efforts with the Environmental Protection Agency are unable to remove the hazard.

This issue spans several lines of business; therefore, the SCT Co-Chairs conducted a peer review of the safety risk assessment for completeness and accuracy and concurred with the analysis. This memorandum, with the accompanying signatures and the SRM Report, serves as acceptance of the SRM Report.

Signatures:

on behalf of 8/28/19

Eugene Huang, SCT Co-Chair
Manager, Safety Risk Management and Safety Assurance Branch
Aviation Safety Organization, AVP-310

Date

8/28/2019

Gregory Pray, SCT Co-Chair
Manager, Safety Engineering Team
Air Traffic Organization, AJI-314

Date

8/28/19

Chris J. Scott, SCT Co-Chair
Lead Safety Engineer, Enterprise Safety & Information Security
Office of NextGen, ANG-B3

Date

Safety Risk Assessment Report

Safety Assessment for Jet Fuel Contamination with Diesel Exhaust Fluid (DEF)

Version 1.0

August 30, 2019

Safety Risk Assessment Report Change Page

Action/Change Made to Report	Date	Version Number
Original Document	08/30/19	Version 1.0

Table of Contents

Executive Summary

Title: Jet Fuel Contamination with DEF

Initiator: Mark Rumizen

Initiator's Organization: AIR-20

Initiator's Phone Number: (781) 402-4609

Submission Date: August 30, 2019

Version Number/Revision Date: 1.0

Summary of Safety Issue: Between November 2017 and May 2019, there were three events of jet fuel contamination with diesel exhaust fluid (DEF). DEF is not a fuel additive; it is required by the Environmental Protection Agency (EPA) to be used on diesel trucks to reduce nitrogen oxide (NOx) emissions. When DEF is mixed with jet fuel, it forms crystals and clogs fuel filters and nozzles, leading to engine shut downs and other engine operability issues. All three events occurred when Fixed Based Operator (FBO) personnel inadvertently added DEF to the fuel truck anti-icing injection system reservoirs instead of fuel system icing inhibitor (FSII). In these three events, 15 civilian and 3 military aircraft were fueled with contaminated jet fuel, and 6 civilian and 3 military aircraft had to perform emergency landings.

This issue was presented to the Federal Aviation Administration (FAA) Safety Management System (SMS) Committee in April 2019. After the third event in May 2019, the FAA SMS Committee requested that the Safety Collaboration Team (SCT) expedite the formation of a Safety Risk Management (SRM) Team to perform a safety risk assessment on the DEF issue.

The SRM Team included representatives from: Aviation Safety (AVS), the Office of Airports (ARP); the Office of Security and Hazardous Materials Safety (ASH); and external stakeholders including the Aircraft Owners and Pilots Association (AOPA), the National Business Aviation Association (NBAA), the National Air Transportation Association (NATA), and Airports Council International – North America (ACI-NA). On June 19-20, 2019, the SRM Team met to:

- Perform an analysis of the hazards associated with jet fuel contamination with DEF throughout the National Airspace System (NAS) and
- Document the assessment and deliver it to the FAA SMS Committee.

Methodology for Moving Through SRM Process: The SRM Team performed their analysis under FAA Order 8040.4B, *Safety Risk Management Policy*. This order, published in May 2017, uses different severity and likelihood definitions for General Aviation (GA) versus commercial operations. To adhere to this methodology, the SRM Team evaluated safety risk to GA and commercial operations separately.

Hazards/Risk Assessment: The SRM Team identified one hazard associated with this issue: jet fuel contaminated with DEF. The Team evaluated the safety risk to GA and commercial operations separately. Additionally, the SRM Team decided on two credible effects that could result from an event of jet fuel contaminated with DEF: an emergency landing on-airport and a crash off-airport. With the two effects and two types of operations, the SRM Team evaluated

four sub-hazards for this safety assessment. The initial hazard identification is outlined in Table ES.1.

Table ES.1. Hazard Summary

Hazard	Hazard Description	Effect	Current Risk
DEF-01$_{EM-C}$	Commercial aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**HIGH (3B)**
DEF-01$_{EM-GA}$	GA aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**MEDIUM (3B)**
DEF-01$_{CR-C}$	Commercial aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**HIGH (1D)**
DEF-01$_{CR-GA}$	GA aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**HIGH (1D)[1]**

Table ES.2 identifies the safety recommendations identified by the SRM Team and the parties and organizations within the Agency that would be responsible for implementing each of them.

Note: These are recommendations, not requirements.

Table ES.2. Safety Recommendations

Safety Recommendation	Responsible Organization
1. Update Advisory Circular (AC) 150/5230-4B to incorporate fuel additive training, to include DEF and FSII handling.	AAS-300
2. Communicate risk level of jet fuel contamination with DEF to the EPA.	AVS-1
3. Request the EPA to issue permanent relief from emission control/system performance inducements (which require the use of DEF) for any non-road compression engine powered vehicles operating at/on airports.	Industry
4. Engage with National Association of State Aviation Officials (NASAO) on the risk of DEF to airports not certificated under Part 139 or receiving funds through the National Plan of Integrated Airport Systems (NPIAS).	Industry/AAS-100
5. Investigate adding dye to DEF to distinguish it from FSII or adding dye to FSII to distinguish it from DEF.	AIR-20
6. Investigate the creation of a required inspection item regarding DEF in the Program Tracking and Reporting Subsystem (PTRS) and Safety Assurance System (SAS).	AFS-900/AFS-300

[1] High risk, due to the common cause factor that the fuel system supplies all engines on the aircraft.

Safety Recommendation	Responsible Organization
7. Develop and publish an AC regarding incorporation of FSII as an operating limitation during aircraft and engine certification with a reference to potential DEF contamination.	AIR-20
8. Determine the best means to communicate information on jet fuel contamination with DEF to all pertinent parties.	AAS-300, AFS-300, AIR-20, AIR-6D1, and Industry
9. Update Safety Alert for Operators (SAFO) 18015 to include information from the latest DEF event and graphics/pictures.	AFS-300 and AIR-20
10. Coordinate with the FAA Safety Team (FAASTeam) to conduct outreach and awareness regarding jet fuel contamination with DEF.	AFS-800
11. Use information from this SRM Assessment to update DEF training.	Industry
12. Update AC 20-43C to include information on jet fuel contamination with DEF.	AFS-300
13. Coordinate with Type Certificate (TC) holders. Inform them of the jet fuel contamination with DEF issue and potential airplane effects. Recommend that they add appropriate cautionary statements to their Aircraft Flight Manuals (AFMs).	AIR-700, Aircraft Certification Office Branch (ACOB), AIR-6D1
14. Conduct research on DEF crystallization reaction mechanism and FSII bio stat capability.	ANG-E (Tech Center)
15. Expand communication and outreach to include manufacturers and suppliers, as well as aviation fuel, DEF, Ground Support Equipment (GSE), and mobile refuelers.	Industry

Background/Overview

Several aircraft have experienced engine shutdowns and other engine operability issues as a result of the contamination of jet fuel. The jet fuel contamination stems from the inadvertent filling of fuel truck anti-icing injection system reservoirs with diesel exhaust fluid (DEF) instead of fuel system icing inhibitor (FSII) by Fixed Base Operator (FBO) line personnel.

Based on fuel system designs, some aircraft require FSII to preclude engine operability issues in cold weather. Because of this requirement, airport refueling trucks have been equipped with FSII injection systems for many years. These systems require an FSII fluid reservoir mounted on the truck to supply the injecting system during aircraft refueling. However, in recent years newer refueling trucks have been introduced with a DEF reservoir in addition to the FSII reservoir. DEF is an additive used in selective catalytic reduction (SCR) systems installed on compression-ignition (diesel) trucks to reduce their nitrogen oxide (NOx) emissions. The Environmental Protection Agency (EPA) mandated the use of SCRs starting in 2010 for on-road trucks, but this mandate was extended to non-road diesel powered trucks (such as airport refuelers) beginning in 2014. Since that time, airport refueling trucks equipped with two fluid reservoirs to accommodate FSII and DEF have begun appearing at airports. This has created a new hazard to safety of flight.

Three instances have occurred in which multiple aircraft uplifted jet fuel contaminated with DEF, or uplifted jet fuel using refueling equipment that was exposed to DEF. The first event occurred in November 2017 at Eppley Air Field Airport, Omaha, Nebraska (OMA), affecting 13 aircraft; the second occurred in August 2018 at Miami-Opa Locka Executive Airport, Opa-Locka, Florida (OPF), affecting 14 aircraft; and the third occurred in May 2019 at Punta Gorda Airport in Punta Gorda, Florida (PGD), affecting 7 aircraft. The first two events are described in more detail in two Special Airworthiness Information Bulletins (SAIBs). SAIB HQ-18-08R2 was first published on December 26, 2017, and was updated on June 12, 2019 after the third event. SAIB HQ-18-28 was published on September 13, 2018. It should be noted that the SAIBs segregate the affected aircraft into two populations that reflect different risk exposure levels. The evidence from these events indicates that those aircraft not directly exposed to the contaminated fuel (listed in the second table of each SAIB) were exposed to negligible risk and therefore are not reflected in this risk assessment.

DEF Contamination Events

As DEF becomes more prevalent on airports due to EPA's mandated use of SCRs on non-road diesel powered trucks, this issue has become highly visible. In all three events, DEF was inadvertently added to the FSII container on the fuel truck by FBO personnel. DEF reacts with jet fuel and forms crystals, which clog the fuel filters and fuel nozzles leading to engine shutdown. In these three events, a total of 15 civilian aircraft and 3 military were fueled with contaminated jet fuel, and 6 civilian and 3 military aircraft had to perform emergency landings. Below, Figure 1 shows an auxiliary fuel tank with DEF deposits.

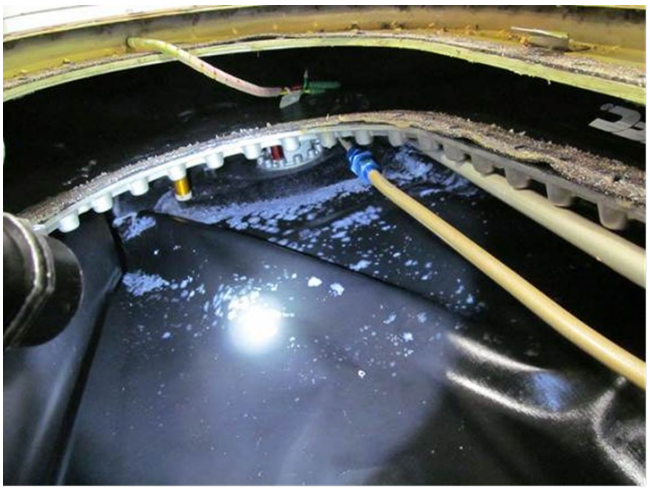

Figure 1. Auxiliary Fuel Tank with DEF Deposits

Figure 2 shows an engine fuel filter contaminated with DEF.

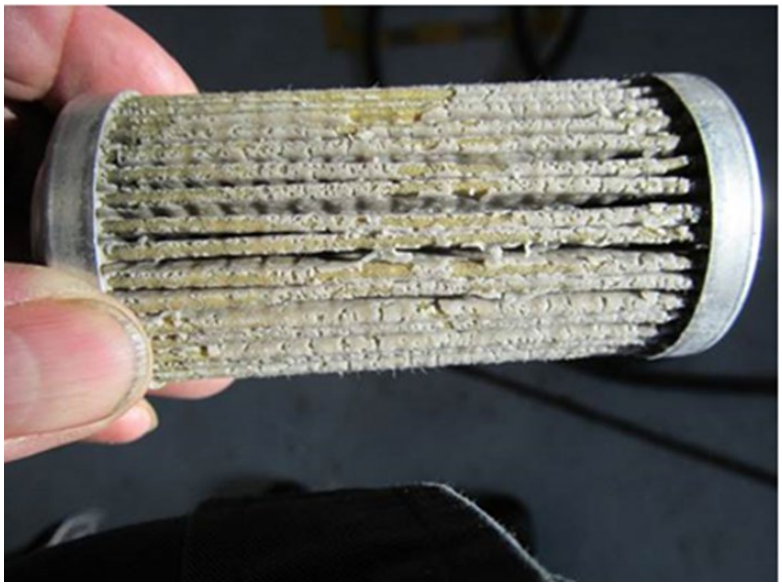

Figure 2. Engine Fuel Filter Contaminated with DEF

Eppley Field Airport in Omaha, Nebraska (OMA), November 18-21, 2017

During this event, the FSII reservoir on the refueling truck had been serviced with DEF, in lieu of FSII. Seven civilian aircraft, plus additional military aircraft, had jet fuel containing DEF directly injected into their fuel tanks, which yielded three civilian and two military aircraft emergency landings. An additional six aircraft were serviced with equipment that had been exposed to DEF. SAIB HQ-18-08R1 was issued on December 26, 2017 in response to this event.

Miami-Opa Locka Executive Airport in Miami, Florida (OPF), August 12-16, 2018

During this event, DEF was mixed into the refueling truck FSII reservoir during an off-truck leak repair. Five aircraft had jet fuel containing DEF directly injected into their fuel tanks, which yielded two aircraft emergency landings. An additional nine aircraft were refueled with equipment that had been exposed to DEF. In response to this event, the Federal Aviation

Administration (FAA) issued SAIB HQ-18-28 on September 13, 2018, Safety Alert for Operators (SAFO) 18015 on November 13, 2018, and the Office of Airports (ARP) Awareness & Guidance Letter was issued on October 29, 2018. Additionally, as a result of this event, the Industry Working Group was initiated and Airlines for America (A4A)/National Air Transportation Association (NATA) Bulletin 2018.4 was issued in December 2018.

Punta Gorda Airport in Punta Gorda, Florida (PGD), May 9, 2019

During this event, DEF was accidentally mixed into a 5-gallon FSII transfer container by the FBO lineman. Three aircraft were serviced from the "front meter," which is where the FSII injection line is. There were two in-flight incidents: one Citation 550 experienced an engine flameout at 35,000 feet, descended, experienced the second engine flameout at 8,000 feet on approach to Savannah International Airport (SAV), and landed with no injuries or damage; a second Citation 550 experienced an engine flameout at 36,000 feet, descended, and landed with one engine operative at Louisville International Airport (SDF) with no injuries or damage. Additionally, the third aircraft (an Eclipse 500) had DEF directly injected, but, it was not known until the aircraft had landed at its final destination. Post-flight inspection revealed that this aircraft's fuel system was contaminated with DEF and determined to be un-airworthy. Subsequent discussions with airport personnel at Punta Gorda showed that before this incident, they, including the FBO lineman, were aware of the DEF threat and had taken steps (implemented procedures and taken training) to preclude adding DEF into FSII tanks. The accidental mixing involved containers that looked similar. SAIB HQ-18-08R2 was issued on June 12, 2019, in response to this event.

Immediate Action in Response to the Punta Gorda Event

The latest event in Punta Gorda gave this issue high visibility and the Safety Collaboration Team (SCT) was tasked by the FAA Safety Management System (SMS) Committee with conducting an Agency-level analysis of this safety issue. A Safety Risk Management (SRM) Team of representatives from Aviation Safety (AVS); ARP; the Office of Security and Hazardous Materials Safety (ASH); and external stakeholders including the Aircraft Owners and Pilots Association (AOPA), the National Business Aviation Association (NBAA), NATA, and Airports Council International – North America (ACI-NA), met on June 19-20, 2019 to:

- Perform an analysis of the hazards associated with jet fuel contamination with DEF throughout the National Airspace System (NAS) and
- Document the assessment and deliver it to the FAA SMS Committee.

Safety Risk Management Planning & Methodology

The SRM Team met from June 19-20, 2019 in Washington, DC, to perform a thorough and objective assessment of the risk. Subject matter experts (SMEs) within the FAA and Industry were invited to provide their input. Table 1 details the experience of the SRM Team.

Table 1. SRM Team Members, Observers, and Facilitation Team

Team Member	Organization	Phone Number/Email	Experience	Role on Team
Mark Rumizen	FAA/AIR-600	781-238-7113 Mark.Rumizen@faa.gov	20 Years – Aviation Fuel in Aircraft Certification Service (AIR)	Team Member
Larry Reising	FAA/AIR-6D1	206-231-3244 Larry.Reising@faa.gov	32 years – Continued Operational Safety (COS)	Team Member
Arun Pankaj	FAA/AXH-002	202-267-1472 Arun.K.Pankaj@faa.gov	1 year – Hazardous Materials (HAZMAT)	Team Member
Clarence Garden	FAA/ARM-100	202-267-7489 Clarence.Garden@faa.gov	3 years – Rulemaking	Team Member
Dale Williams	FAA/AAS-300	202-267-4179 Dale.Williams@faa.gov	Airport Certification Safety Inspector	Team Member
Ryan Alfonso*	FAA/AFS-370	603-520-2480 Ryan.Alfonso@faa.gov	12 Years Aviation Safety/Maintenance FAA Airframe Powerplant Mechanic & Parachute Rigger Experienced Avionics Technician	Team Member
Mark Larsen	NBAA	202-737-4473 MLarsen@NBAA.org	Safety and Researching	Team Member
David Oord	AOPA	202-609-9719 David.Orord@AOPA.org	10 Years – Regulatory	Team Member
Mike France	NATA	MFrance@NATA.aero	18 Years – Fuel Handling/Regulatory	Team Member
Megan Eisenstein	NATA	202-774-1521 MEisenstein@NATA.aero	5 Years – Airport/FBO Issues	Team Member
Chris Oswald	ACI-NF	202-293-4539 COswald@airportscouncil.org	20 Years – Airport Safety Operations and Engineering	Team Member
Rune Duke	AOPA	202-509-9515 Rune.Duke@AOPA.org	SMS/Airports/Air Traffic Control (ATC)	Team Member
Mayowa Jenyo**	FAA/AVP-310	202-267-3307 Mayowa.Jenyo@faa.gov	13 Years – Systems Safety Engineering	Observer
Stephen Dickerson**	FAA/AVP-320	202-267-7808 Stephen.M.Dickerson@faa.gov	Operational Safety Investigator	Observer
Lesley Walcourt**	FAA/CTR/SCT	202-488-0975 x198 Lesley.Walcourt@veracity-eng.com	Systems Engineer 9 Years SMS Experience	Observer

Team Member	Organization	Phone Number/Email	Experience	Role on Team
Chris Pokorski	FAA/AVP-310	202-267-9266 Chris.Pokorski@faa.gov	30 years – United States (U.S.) Navy and FAA, Aviation Safety/Engineering Private Pilot SMS Practitioner and Trained Facilitator	Co-Facilitator
Gina Schlabach	FAA/CTR/AVP-310	317-213-4462 GSchlabach@qedllc.com	10+ years Aviation Safety Experience Commercial Pilot	Co-Facilitator
Michelle LaChance	FAA/CTR/AVP-310	301-653-9142 MLaChance@qedllc.com	6+ years technical writing/editing	Technical Writer

Note: The American Association of Airport Executives (AAAE) was invited to participate in the SRM Team but was unable to attend. They were provided an opportunity to review this report.

System Analysis/Description

5M Model

Scoping a safety analysis is essential to developing the most targeted, measurable safety recommendations possible. The 5M Model helps scope an analysis by illustrating the five integrated elements that are present in any system: mission, hu(Man)/person, machine, management, and media. A Venn diagram is used to depict the interrelationships among these five elements (see Figure 3).

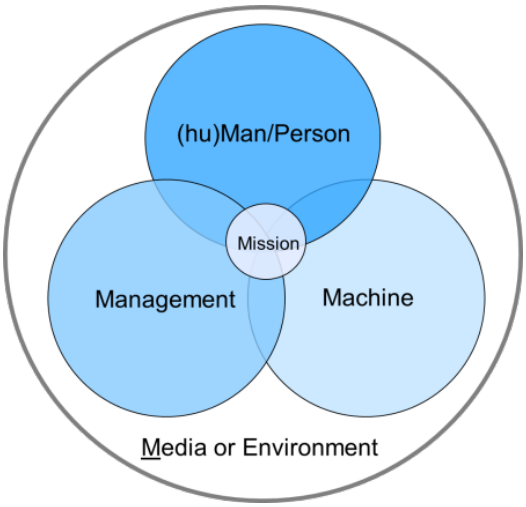

Figure 3. 5M Model Method

Table 2 shows the 5M Model Method for jet fuel contamination with DEF.

Table 2. 5M Model

5M Model Item and Definition	Description
Mission: Purpose of the NAS change proposal or system/operation being assessed, in detail.	The scope of this effort is to conduct a safety risk assessment of the hazards associated with inadvertent contamination of jet fuel with DEF.
huMan: Operators, maintainers, and affected stakeholders	• Flight crew • Fueling personnel (to include FSII/DEF storage and refueling of aircraft) • Airframe and/or Powerplant (A&P) mechanics • Original Equipment Manufacturers (OEMs) • FAA Aviation Safety Inspectors (ASIs) and Aviation Safety Engineers (ASEs)
Machine: Equipment used in the system that is related to the issue or change	• Aircraft (to include fuel systems and engines) • Fuel truck, including DEF reservoir • FSII injection system/reservoir • FSII & DEF storage
Management: Documents that are relevant to the issue or change	• SAIB HQ-18-08-R2 • SAIB HQ-18-28 • MIL-DTL-85470B, *Inhibitor, Icing, Fuel System, High Flash* • Title 40 of the Code of Federal Regulations (CFR) Part 1039—*Control Of Emissions From New And In-Use Nonroad Compression-Ignition Engines* • SAFO 18015, *Jet Fuel Contaminated with Diesel Exhaust Fluid (DEF)* • Air Transport Association (ATA) Specification 103, *Standard for Jet Fuel Quality Control at Airports* • ISO 22241-1:2019, *Diesel engines – NOx reduction agent AUS 32* • Aircraft certification requirements • Fueling vendor Standard Operating Procedures (SOPs) • Aircraft fueling SOPs • FSII and DEF storage policies/procedures • Fueling/vendor training • A4A/NATA Bulletin 2018.4, *DEF Contamination of Jet Fuel* • Advisory Circular (AC) 150/5230-4B, *Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports* • Airport Certification Manual (ACM)

5M Model Item and Definition	Description
	• ASTM D1655, *Standard Specification for Aviation Turbine Fuels* • ASTM D4171, *Standard Specification for Fuel System Icing Inhibitors* • 14 CFR Part 138.321, *Handling and storing of hazardous substances and materials* • 14 CFR 121.123, *Servicing maintenance facilities* • 14 CFR 121.135(b)(19), *Procedures for refueling aircraft, eliminating fuel contamination, protection from fire (including electrostatic protection), and supervising and protecting passengers during refueling* • 14 CFR 135.23(j), *Procedures for refueling aircraft, eliminating fuel contamination, protecting from fire (including electrostatic protection), and supervising and protecting passengers during refueling* • NATA's Operational Best Practice (OBP) Number 36, DEF Handling and Contamination Prevention
Media: Environment in which the system is operated and maintained	• Airport ramp fueling locations • DEF & FSII storage locations

Safety Risk Analysis & Assessment

Hazard Analysis Worksheet

During the safety risk analysis and assessment, the SRM Team utilized the Hazard Analysis Worksheet (HAW). The HAW includes cause, system state, controls, justification for the controls, effects, severity, likelihood, and current risk. The details of the HAW are further explained in this section, and the entire HAW can be found in Appendix A.

Scope of the Assessment

The SRM Team agreed that the scope was to conduct a safety risk assessment of the hazards associated with inadvertent contamination of jet fuel with DEF. They also agreed that the safety assessment was limited to discussion on jet fuel contamination only, since FSII is added to aviation gas (avgas) much less frequently than to jet fuel. In addition, the discussion was limited to DEF and FSII, and did not include other jet fuel additives.

Hazard Identification and Methodology

The SRM Team identified jet fuel contamination with DEF as the hazard. The SRM Team decided to split the hazard into two sub-hazards based on two effects that the Team identified: emergency landing (on airport) and crash (off airport). Furthermore, the SRM Team split these two sub-hazards into General Aviation (GA) and commercial operations, following the risk assessment methodology in FAA Order 8040.4B. It should be noted that FAA's and Industry's designations of GA and commercial operations differ; while the FAA categorizes Part 135 flight operations as commercial, Industry noted that they often categorize those operations as GA. The Team agreed to use both the GA and commercial risk designations in FAA Order 8040.4B. Table 3 below describes the sub-hazards identified.

Table 3. Hazard Summary

Hazard	Hazard Effect
$DEF\text{-}01_{EM\text{-}C}$	Commercial aircraft fueled with jet fuel contaminated with DEF performs an emergency landing on airport
$DEF\text{-}01_{EM\text{-}GA}$	GA aircraft fueled with jet fuel contaminated with DEF performs an emergency landing on airport
$DEF\text{-}01_{CR\text{-}C}$	Commercial aircraft fueled with jet fuel contaminated with DEF crashes off airport
$DEF\text{-}01_{CR\text{-}GA}$	GA aircraft fueled with jet fuel contaminated with DEF crashes off airport

Causes

The SRM Team identified a number of causes for jet fuel contamination with DEF. The Team agreed that a root cause is the EPA mandate for DEF on diesel engine vehicles, which led to the recent introduction and increasing use of DEF in the airport environment. In addition, the Team noted that the confusion in the identification and differences between DEF and FSII by fueling personnel as another cause. Lack of labels on containers, co-locating containers, non-standardized containers, inadvertent combining of DEF and FSII in one container, and the fact that DEF and FSII are clear liquids contribute to the confusion of DEF and FSII by fueling personnel.

There are varying applications of training and inadequate awareness regarding the dangers of jet fuel contamination with DEF. Additionally, there is inconsistent adoption of industry-wide standards and guidance for refueling at small airports.

The Team also noted that there are gaps in the regulatory oversight of airport refueling operations; the FAA has regulatory authority over certificated airports (which contract refueling companies), but does not have authority over the actual refueling operations themselves. The FAA also has oversight over airlines and other operators, who, in turn, are required to oversee their refueling operations.

System State

The presence of DEF on airports creates the hazard of jet fuel being contaminated by DEF. The hazard primarily applies to Part 91 and 135 operations. Any refueling trucks with FSII containers have the potential to be contaminated with DEF, and any aircraft that requires FSII also has the potential to be contaminated with DEF.

The SRM Team discussed that some aircraft operators believe that FSII prevents microbial contamination of jet fuel. Because of this, these aircraft operators may request that FSII be injected into their jet fuel even if the aircraft or anticipated operating conditions do not require it.

Controls

The SRM Team identified a variety of existing controls in regards to jet fuel contamination with DEF. A sample of the existing controls identified are listed below. Unless specified otherwise, these controls apply to both commercial and GA operations.

Table 4. Sample of Existing Controls

Control	Justification
14 CFR Part 121.123	Servicing maintenance facilities rule
14 CFR Part 121.135(b)(19)	Requirement to include fueling and fuel contamination prevention procedures in ground operations manual of Part 121 operators
14 CFR Part 135.23(j)	Requirement to include fueling and fuel contamination prevention procedures in ground operations manual of Part 135 operators
14 CFR Part 139.321	Handling and storage of hazardous substances and materials rule
AC 150/5230-4B	Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports, as well as standards for training of FBOs
SAIB HQ 18-08R2	SAIB issued after the first event in 2017; it was updated on June 10, 2019, to reflect new recommendations
SAIB HQ-18-28	SAIB issued after the second event in 2018

Control	Justification
SAFO 18015	SAFO advising aircraft operators, FBOs, repair stations, Flight Standards District Offices (FSDOs), and foreign civil aviation authorities on DEF
ACM	Manual for each airport that provides the requirements for refueling procedures and storage
ATA Specification 103	Industry-wide standard that includes fuel handling procedures for large airports
ARP Awareness & Guidance Letter (sent October 29, 2018)	Letter sent to airport sponsors regarding jet fuel contamination with DEF
NATA Safety1st Training and Best Practices	Education of FBOs on the dangers of DEF, misfueling, and OBP No. 36, DEF Handling and Contamination Prevention
A4A/NATA Bulletin 2018.4	Impacts and best practices for using and storing DEF and jet fuel additives

A comprehensive list of the existing controls and justifications for their inclusion can be found in Appendix B.

Effects

The SRM Team initially identified a preliminary list of effects for a jet fuel contaminated with DEF event that included engine failure, fuel system clog, crystals forming in the jet fuel, etc. After some discussion, the Team decided that the list should be narrowed down to two effects: an emergency landing on-airport and a crash off-airport.

Severity and Likelihood Determinations

The SRM Team discussed the severity and likelihood of the four sub-hazards.

When discussing emergency landings on-airport, the SRM Team agreed that the severity is **Major (3)** for both commercial and GA aircraft. They noted that an emergency landing on-airport of a commercial aircraft would cause physical distress or injuries to persons and substantial damage to the aircraft/vehicle. An emergency landing on-airport of a GA aircraft would cause physical discomfort to persons and slight damage to the aircraft/vehicle. In the three DEF contamination events, a total of 15 civilian and 3 military aircraft were fueled with contaminated jet fuel, and 6 civilian and 3 military aircraft had to perform emergency landings. Based on this data, the Team decided on the likelihood of **Probable (B)** for both DEF-$01_{EM\text{-}C}$ and DEF-$01_{EM\text{-}GA}$.

When discussing crashes off-airport, the SRM Team agreed that the severity is **Catastrophic (1)** for both commercial and GA aircraft. They noted that a commercial or a GA crash off-airport would result in multiple fatalities usually with the loss of the aircraft/vehicle. To date, there have been no crashes as a result of jet fuel contamination with DEF. However, the SRM Team felt that this was a very credible outcome given the most recent jet fuel contamination with DEF event, which led to a dual engine failure at altitude. The Team felt that the same scenario could

result in a crash. Therefore, the SRM Team decided on the likelihood of **High (D)** for both DEF-01_{CR-C} and DEF-01_{CR-GA}.

Current Risk

Table 5 briefly summarizes the current risk level.

Table 5. Current Risk

Hazard	Hazard Description	Effect	Current Risk
DEF-01_{EM-C}	Commercial aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**HIGH (3B)**
DEF-01_{EM-GA}	GA aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**MEDIUM (3B)**
DEF-01_{CR-C}	Commercial aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**HIGH (1D)**
DEF-01_{CR-GA}	GA aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**HIGH (1D)**[2]

Figure 4 and Figure 5 below show the corresponding risk levels for the four sub-hazards identified on the FAA Order 8040.4B risk matrices. These risk matrices distinguish between GA operations/small aircraft and rotorcraft, and commercial operations/large transport, respectively. Note that DEF-01_{CR-GA} is a high-risk hazard because it has a common cause factor due to the fact that the fuel system supplies all engines on the aircraft.

[2] High risk, due to the common cause factor that the fuel system supplies all engines on the aircraft.

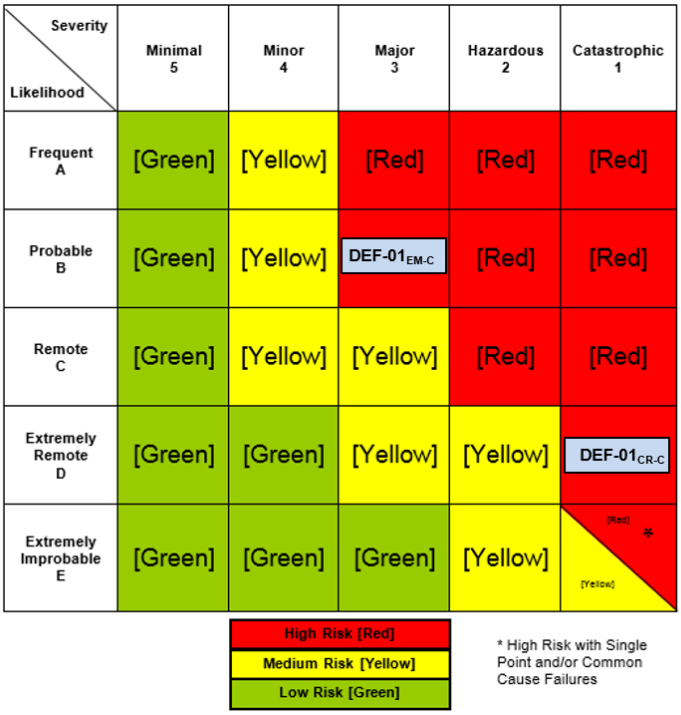

Figure 4. Current Risk for DEF-01$_{EM-C}$ and DEF-01$_{CR-C}$

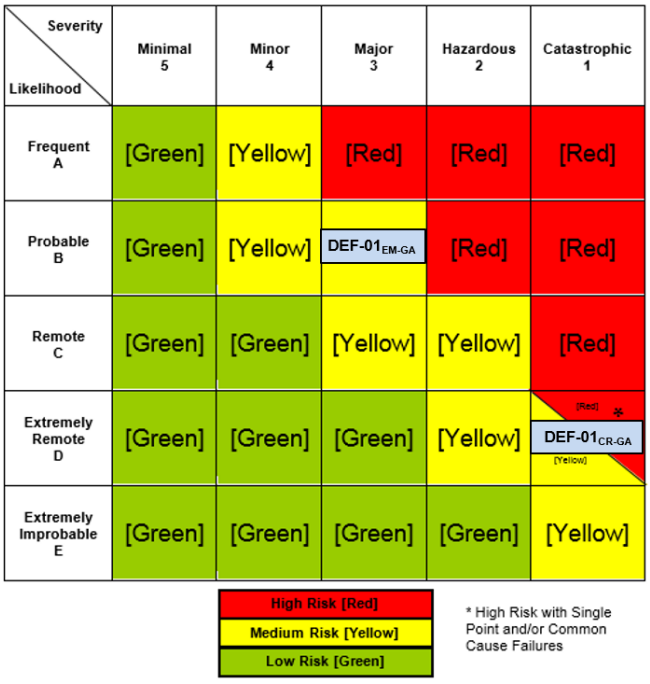

Figure 5. Current Risk for DEF-01$_{EM-GA}$ and DEF-01$_{CR-GA}$

Safety Recommendations

The SRM Team identified 15 safety recommendations to mitigate the risk of jet fuel contamination with DEF.

The SRM Team noted that if DEF was not present on airports, the hazard would be eliminated. To accomplish the removal of DEF at/on airports, the SRM Team identified two safety recommendations. One recommendation, to request the EPA to issue permanent relief from emission control/system performance inducements (which require the use of DEF) for any non-road compression engine powered vehicles operating at/on airports, is currently being undertaken by Industry. To bolster this request, the SRM Team recommended that the FAA (through the Associate Administrator Director of Aviation Safety [AVS-1]) communicate the high risk level of jet fuel contamination with DEF to the EPA. If these recommendations are followed through successfully and DEF is removed from airports, the hazard will be eliminated.

The SRM Team also discussed many avenues of outreach and awareness. While the FAA released two SAIBs, a SAFO, and sent out the ARP Awareness & Guidance Letter in response to the first two events, the SRM Team noted that these efforts have not been as effective as desired as the third event occurred after these actions were taken. To increase the effectiveness of communications, the SRM Team recommends that AAS-300, AFS-300, AIR-20, AIR-6D1, and Industry determine the best means of communicating the high level of risk associated with jet fuel contamination with DEF. Additionally, the SRM Team recommended that AFS-800 coordinate with the FAA Safety Team (FAASTeam) to conduct outreach and awareness. The SRM Team also identified more specific outreach and awareness recommendations, including developing and publishing an AC regarding the incorporation of FSII as an operating limitation with a reference to DEF contamination; updating AC 20-43C to include information on jet fuel contamination with DEF; and drafting and distributing a CertAlert that contains information that was in the ARP Awareness & Guidance Letter. After the SRM Team meeting, representatives from ARP determined that this was not the appropriate use of a CertAlert, thus the recommendation was removed from the list.

The SRM Team recognizes the importance of training fueling personnel on the dangers of jet fuel contamination with DEF. The Team identified two recommendations that apply to training: update AC 150/5230-4B to incorporate fuel additive training, including DEF and FSII handling, and to update Industry's DEF training based on the information from this safety assessment.

It was determined that further research is needed on DEF and FSII. Specifically, the SRM Team identified two recommendations. The first is to investigate dyeing DEF to distinguish it from FSII or dyeing FSII to distinguish it from DEF; however, the SRM Team recognizes the limitations and extensive time this recommendation could take. The second recommendation is to research DEF crystallization and FSII's bio stat capability. For the former, the SRM Team believes that more knowledge of the interaction between DEF and jet fuel could help in identifying any further mitigations. For the latter, the SRM Team discussed that many pilots request FSII, even though the aircraft or the anticipated operating conditions do not require it, because of an anecdotal belief that FSII prevents microbial contamination of the fuel system. An item of discussion during the SRM Team meeting was the difference between types of FSII, and the common "myths" that are believed by flight crews. DiEGME (diethylene glycol monomethyl ether) is the current chemical makeup of FSII, however, prior to 1994, the chemical makeup of FSII was EGMME (ethylene glycol monomethyl ether). Recent initial research indicates that DiEGME may not

prevent microbial contamination, thus it is not needed to retard the growth of microorganisms that could be potentially present in the jet fuel.

Upon review of this report, these recommendations need management approval. Should management not accept and implement the recommendations, then the SRM Team will need to reevaluate the recommended controls to more accurately assess the predicted residual risk. The full list of safety recommendations is displayed in Table 6 below.

Table 6. Safety Recommendations Summary

Safety Recommendation	Responsible Organization
1. Update AC 150/5230-4B to incorporate fuel additive training, to include DEF and FSII handling.	AAS-300
2. Communicate risk level of jet fuel contamination with DEF to the EPA.	AVS-1
3. Request the EPA to issue permanent relief from emission control/system performance inducements (which require the use of DEF) for any non-road compression engine powered vehicles operating at/on airports.	Industry
4. Engage with National Association of State Aviation Officials (NASAO) on the risk of DEF to airports not certificated under Part 139 or receiving funds through the National Plan of Integrated Airport Systems (NPIAS).	Industry/AAS-100
5. Investigate adding dye to DEF to distinguish it from FSII or adding dye to FSII to distinguish it from DEF.	AIR-20
6. Investigate the creation of a required inspection item regarding DEF in the Program Tracking and Reporting Subsystem (PTRS) and Safety Assurance System (SAS).	AFS-900/AFS-300
7. Develop and publish an AC regarding incorporation of FSII as an operating limitation during aircraft and engine certification with a reference to potential DEF contamination.	AIR-20
8. Determine the best means to communicate information on jet fuel contamination with DEF to all pertinent parties.	AAS-300, AFS-300, AIR-20, AIR-6D1, and Industry
9. Update SAFO 18015 to include information from the latest DEF event and graphics/pictures.	AFS-300 and AIR-20
10. Coordinate with the FAASTeam to conduct outreach and awareness regarding jet fuel contamination with DEF.	AFS-800
11. Use information from this SRM Assessment to update DEF training.	Industry
12. Update AC 20-43C to include information on jet fuel contamination with DEF.	AFS-300

Safety Recommendation	Responsible Organization
13. Coordinate with Type Certificate (TC) holders. Inform them of the jet fuel contamination with DEF issue and potential airplane effects. Recommend that they add appropriate cautionary statements to their Aircraft Flight Manuals (AFMs).	AIR-700, Aircraft Certification Office Branch (ACOB), AIR-6D1
14. Conduct research on DEF crystallization reaction mechanism and FSII bio stat capability.	ANG-E (Tech Center)
15. Expand communication and outreach to include manufacturers and suppliers, and aviation fuel, DEF, Ground Support Equipment (GSE), as well as mobile refuelers.	Industry

Predicted Residual Risk

The SRM Team discussed the residual risk to the NAS if all of the safety recommendations are implemented, except the two safety recommendations that apply to obtaining an exemption from the EPA. These two recommendations were excluded because if DEF is removed from all airports, the hazard will be eliminated.

Table 7 below briefly describes the predicted residual risk if all safety recommendations are followed through except for Safety Recommendations 2 and 3.

Table 7. Predicted Residual Risk

Hazard	Hazard Description	Effect	Predicted Residual Risk
DEF-01$_{EM-C}$	Commercial aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**MEDIUM (3D)**
DEF-01$_{EM-GA}$	GA aircraft fueled with jet fuel contaminated with DEF	Emergency landing on-airport	**LOW (3D)**
DEF-01$_{CR-C}$	Commercial aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**HIGH (1E)**[3]
DEF-01$_{CR-GA}$	GA aircraft fueled with jet fuel contaminated with DEF	Crash off-airport	**MEDIUM (1E)**

[3] High risk, due to the common cause factor that the fuel system supplies all engines on the aircraft.

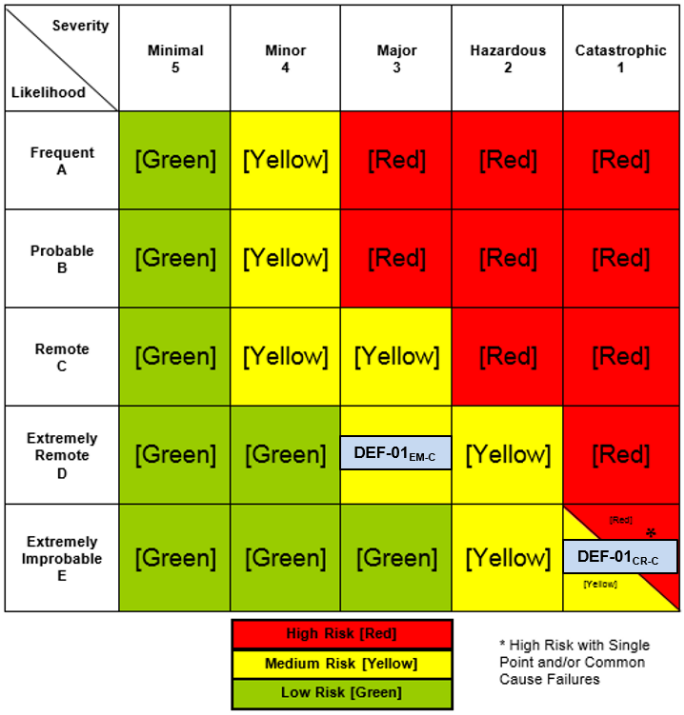

Figure 6. Predicted Residual Risk for DEF-01$_{EM-C}$ and DEF-01$_{CR-C}$

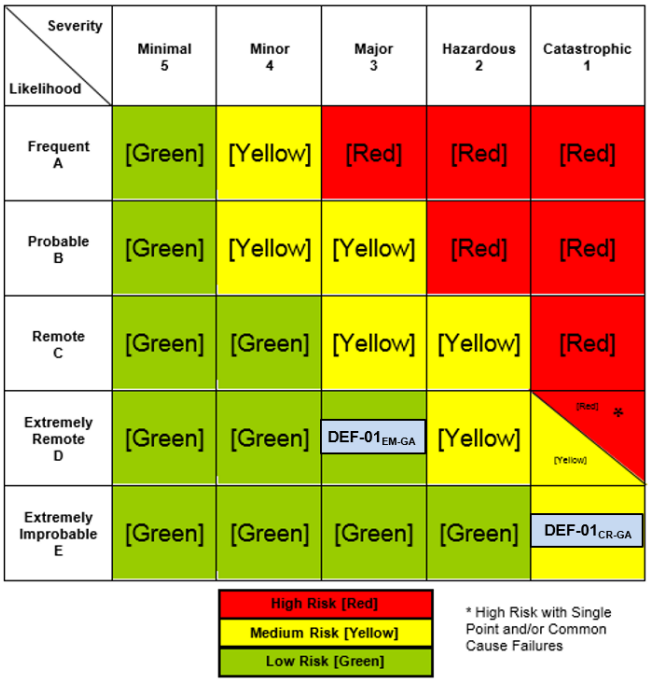

Figure 7. Predicted Residual Risk for DEF-01$_{EM-GA}$ and DEF-01$_{CR-GA}$

Tracking and Monitoring of Hazards

The Office of Accident Investigation and Prevention (AVP) will enter the hazard information into the FAA's Hazard Identification, Risk Management & Tracking (HIRMT) tool. AVP will work with the responsible organizations to document and track mitigation strategies and risk controls, per the monitoring plan requirements, to verify that the controls are effective and the predicted residual risk is realized. The Monitoring Plan for this assessment can be found in Appendix C, Monitoring Plan.

The SRM Team believes that implementation of recommendations listed in the previous section will help reduce the overall risk of jet fuel contamination with DEF events. The mitigations the SRM Team developed will help prevent an increase in the overall risk of the hazard in the future, with a goal of no more than one jet fuel contamination with DEF event every three years.

Given that the FAA management will need to approve the list of safety recommendations developed by the SRM Team, and that there will be on-going discussion between the FAA and the EPA, the SRM Team may need to reconvene and modify the tracking and monitoring of the hazards.

Appendix A—FAA Documents Related to the Assessment

Title 14 of the Code of Federal Regulations (CFR) Part 121.123, *Servicing maintenance facilities*

14 CFR Part 121.135(b)(19), *Procedures for refueling aircraft, eliminating fuel contamination, protection from fire (including electrostatic protection), and supervising and protecting passengers during refueling.*

14 CFR Part 135.23(j), *Procedures for refueling aircraft, eliminating fuel contamination, protecting from fire (including electrostatic protection), and supervising and protecting passengers during refueling*

14 CFR Part 139.321, *Handling and storing of hazardous substances and materials*

14 CFR Part 5, *Safety Management Systems*

40 CFR Part 1039, *Control of emissions from new and in-use nonroad compression-ignition engines*

Airlines for America (A4A)/National Air Transportation Association (NATA) Bulletin 2018.4, *DEF Contamination of Jet Fuel*

Advisory Circular (AC) 150/5230-4B, *Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports*

ASTM D1655, Standard Specification for Aviation Turbine Fuels

ASTM D4171, Standard Specification for Fuel System Icing Inhibitors

Air Transport Association (ATA) Specification 103, *Standard for Jet Fuel Quality Control at Airports*

ISO 22241-1:2019, *Diesel engines -- NOx reduction agent AUS 32*

MIL-DTL-85470B, *Inhibitor, Icing, Fuel System, High Flash*

Office of Airports (ARP) Awareness & Guidance Letter, sent October 29, 2018

Safety Alert for Operators (SAFO) 18015, *Jet Fuel Contaminated with Diesel Exhaust Fluid (DEF)*

Special Airworthiness Information Bulletins (SAIB) HQ-18-08R2, *Engine Fuel and Control – Operation with Contaminated Jet Fuel*

SAIB HQ-18-28, *Engine Fuel and Control – Operation with Contaminated Jet Fuel*

.

Appendix B—Hazard Analysis Worksheet

Hazard ID	Hazard Description	Cause	System State	Controls	Control Justification	Effect	Severity	Severity Rationale	Likelihood	Likelihood Rationale	Current Risk

DEF-1	Jet fuel contamination with diesel exhaust fluid (DEF)	- Recent introduction and increasing use of DEF in the airport environment
		- Confusion between DEF and fuel system icing inhibitor (FSII) containers by fueling personnel
		  ○ Lack of labelling of containers
		  ○ Co-locating container storage
		  ○ Non-standardized containers
		  ○ DEF and FSII are clear liquids
		- Inadvertent combining of DEF and FSII in one container
		- Inadequate training and awareness
		- High-turnover of refueling personnel
			- Primarily Part 91 and 135 operations
			- Presence of DEF at the airport
			- Refueling trucks with FSII containers
			- Aircraft that require FSII
			- Optional or perceived need to use FSII by aircraft operator
				1. Title 14 of the Code of Federal Regulations (CFR) Part 121.123
				2. 14 CFR Part 135.23(j)
				3. 14 CFR Part 121.135 (b) (19)
				4. 14 CFR Part 139.321
				5. 14 CFR Part 5 and Voluntary Safety Management System (SMS) Programs
				6. 40 CFR Part 1039
				7. Airlines for America (A4A)/National Air Transportation Association (NATA) Bulletin 2018.4
				8. Advisory Circular (AC) 150/5230-4B
				9. Aircraft fueling standard operating procedures (SOPs)
				10. Airport Certification Manual (ACM)
				11. Air Transport Association (ATA) Specification 103
					1. Servicing maintenance facilities rule
					2. Requirement to include fueling procedures in ground operations manual
					3. Requirement to include fueling procedures in ground operations manual
					4. Handling and storing of hazardous substances and materials
					5. SMS rule and Voluntary SMS programs
					6. EPA non-road diesel engines emissions control rule
					7. Impacts and best practices for using and storing DEF and jet fuel additives
					8. Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports, as well as standards for training of FBOs
					9. SOPs to avoid jet fuel contamination with DEF
					10. Provides requirements for refueling procedures and storage
					11. Industry-wide standard that includes fuel handling procedures for large airports
						Commercial
						
						Emergency landing (on-airport)
							Major (3)	Per FAA Order 8040.4B,
								- *Physical distress or injuries to persons*
								- *Substantial damage to aircraft/ vehicle*
									Probable (B)	In the three DEF contamination events, a total of 15 civilian and 3 military aircraft were fueled with contaminated jet fuel, and 6 civilian and 3 military aircraft had to perform emergency landings in the past 16 months. Based on this data, the Team decided on B, Probable.	High (3B)

						GA Emergency landing (on-airport)	Major (3)	Per FAA Order 8040.4B, - *-Physical discomfort to persons* - *-Slight damage to aircraft/ vehicle*	Probable (B)	In the three DEF contamination events, a total of 15 civilian and 3 military aircraft were fueled with contaminated jet fuel, and 6 civilian and 3 military aircraft had to perform emergency landings in the past 16 months. Based on this data, the Team decided on B, Probable.	Medium (3B)

Hazard ID	Hazard Description	Cause	System State	Controls	Control Justification	Effect	Severity	Severity Rationale	Likelihood	Likelihood Rationale	Current Risk
		- Environmental Protection Agency (EPA) mandate for DEF on diesel engine vehicles - Gaps in regulatory oversight of airport refueling operations - Inconsistent adoption of industry-wide standards and guidance for refueling at small airports		12. Office of Airports (ARP) Awareness & Guidance Letter (sent October 29, 2018) 13. FSII and DEF storage policies/ procedures 14. Fueling vendor SOPs 15. Fueling/ vendor training 16. NATA Safety1st Training and Best Practices 17. Outreach to aviation community 18. Safety Alert for Operators (SAFO) 18015 19. Special Airworthiness Information Bulletin (SAIB) HQ-18-08R2 20. SAIB HQ-18-28	12. Letter sent to airport sponsors regarding jet fuel contamination with DEF 13. Policies/ procedures to avoid confusion of FSII with DEF 14. SOPs to avoid jet fuel contamination with DEF 15. Education of Fixed Base Operators (FBOs) on proper fueling and storage procedures 16. Education of FBOs on the dangers of DEF, misfueling, and Operational Best Practice No. 36, DEF Handling and Contamination Prevention 17. Safety promotion regarding jet fuel contamination with DEF 18. SAFO advising aircraft operators, FBOs, repair stations, Flight Safety District Offices (FSDOs), and foreign civil aviation authorities on DEF 19. SAIB issued after first event in 2017, updated 6/10/19 to reflect new recommendations 20. SAIB issued after second event in 2018	**Commercial** Crash (off airport)	Catastrophic (1)	Per FAA Order 8040.4B, *Multiple fatalities (or fatality to all on board) usually with the loss of aircraft/ vehicle*	Extremely Remote (D)	To date, there have been no crashes as a result of jet fuel contamination with DEF. However, the SRM Team felt that this was a very credible outcome given the most recent jet fuel contamination with DEF event, which lead to a dual engine failure at altitude. The Team felt that the same scenario could result in a crash.	High (1D)
						GA Crash off-airport	Catastrophic (1)	Per FAA Order 8040.4B, *Multiple fatalities (or fatality to all on board) usually with the loss of aircraft/ vehicle*	Extremely Remote (D)	To date, there have been no crashes as a result of jet fuel contamination with DEF. However, the SRM Team felt that this was a very credible outcome given the most recent jet fuel contamination with DEF event, which lead to a dual engine failure at altitude. The Team felt that the same scenario could result in a crash	High (1D) * *Single point/ common cause[4]

[4] High risk, due to the common cause factor that the fuel system supplies all engines on the aircraft.

Hazard ID	Hazard Description	Safety Recommendations	Responsible Organization	Predicted Residual Risk	Predicted Residual Risk Rationale
DEF-01	Jet fuel contamination with DEF	1. Update AC 150/5230-4B to incorporate fuel additive training, to include DEF and FSII handling. 2. Communicate risk level of jet fuel contamination with DEF to the EPA. 3. Request the EPA to issue permanent relief from emission control/system performance inducements (which require the use of DEF) for any non-road compression engine powered vehicles operating at/on airports.	1. AAS-300 2. AVS-1 3. Industry 4. Industry/ AAS-100 5. AIR-20 6. AFS-900/AFS-300	**Commercial** Emergency Landing (On-Airport) 3D (Medium)	Based on all recommendations made by the SRM Team being acted up, the SRM Team concurred that the risk for this hazard would be reduced to a 3D (Medium).
		4. Engage with National Association of State Aviation Officials (NASAO) on the risk of DEF to airports not certificated under Part 139 or receiving funds through the National Plan of Integrated Airport Systems (NPIAS). 5. Investigate adding dye to DEF to distinguish from FSII or adding dye to FSII to distinguish it from DEF. 6. Investigate the creation of a required inspection item regarding DEF in the Program Tracking and Reporting Subsystem (PTRS) and Safety Assurance System (SAS). 7. Develop and publish an AC regarding incorporation of FSII as an operating limitation during aircraft and engine certification with a reference to potential DEF contamination.	7. AIR-20 8. AAS-300, AFS-300, AIR-20, AIR-6D1, and Industry 9. AFS-300 and AIR-20 10. AFS-800 11. Industry 12. AFS-300 13. AIR-700, Aircraft Certification Office Branch (ACOB), and AIR-6D1 14. ANG-E (Tech Center) 15. Industry	**GA** Emergency Landing (On-Airport) 3D (Low)	Based on all recommendations made by the SRM Team being acted up, the SRM Team concurred that the risk for this hazard would be reduced to a 3D (Low)
		8. Determine the best means to communicate information on jet fuel contamination with DEF to all pertinent parties. 9. Update SAFO 18015 to include information from latest DEF event and graphics/pictures. 10. Coordinate with the FAA Safety Team (FAASTeam) to conduct outreach and awareness regarding jet fuel contamination with DEF. 11. Use information from this SRM Assessment to update DEF training. 12. Update AC 20-43C to include information on jet fuel contamination with DEF 13. Coordinate with Type Certificate (TC) holders. Inform them of the jet fuel contamination with DEF issue and the potential airplane effects. Recommend that they add appropriate language into their Aircraft Flight Manuals (AFMs). 14. Conduct research on DEF crystallization reaction mechanism and FSII bio stat capability 15. Expand communication and outreach to include the following manufacturers and suppliers, as well as aviation fuel, DEF, Ground Support Equipment (GSE), and mobile refuelers.		**Commercial** Crash (Off-Airport) 1E (High)	If the recommendation to request an emergency exemption to EPA of the use of DEF on airports is made and the EPA acts upon it, the hazard (and risk) will be eliminated. If the request to the EPA is made, and not acted upon, the risk of the effect will remain a 1E (High).
				GA Crash (Off-Airport) 1E (Medium)	Based on all recommendations made by the SRM Team being acted up, the SRM Team concurred that the risk for this hazard would be reduced to a 1E (Medium).

Appendix C—Monitoring Plan

Hazard ID	Hazard Description	Current Risk	Safety Requirements**	Predicted Residual Risk	Monitoring Activities	Reporting Frequency	Reporting Duration	Safety Performance Targets
DEF-01$_{EM-C}$	Emergency Landing (On-Airport)	3B (High)	**Pending management decision regarding Safety Recommendations	3D (Medium)	1. Monitor event reporting mechanisms for jet fuel contamination with DEF events 2. Monitor SAS and PTRS for jet fuel contamination with DEF events	Quarterly	Three years	No more than one event every three years
DEF-01$_{EM-GA}$	Emergency Landing (On-Airport)	3B (Medium)		3D (Low)				
DEF-01$_{CR-C}$	Crash (Off-Airport)	1D (High)		1E (High) *Common Cause/Single Point Failure				
DEF-01$_{CR-GA}$	Crash (Off-Airport)	1D (High) *Common Cause/Single Point Failure		1E (Medium)				

* High risk, due to the common cause factor that the fuel system supplies all engines on the aircraft.

Appendix D—Acronyms

A&P	Airframe and/or Powerplant
A4A	Airlines for America
AAAE	American Association of Airport Executives
AC	Advisory Circular
ACI-NA	Airports Council International – North America
ACM	Airport Certification Manual
ACOB	Aircraft Certification Office Branch
AFM	Aircraft Flight Manual
AIR	Aircraft Certification Service
AOC	Air Operator's Certificate
AOPA	Aircraft Owners and Pilots Association
ARP	Office of Airports
ASE	Aviation Safety Engineer
ASH	Office of Security and Hazardous Materials Safety
ASI	Aviation Safety Inspector
ATA	Air Transport Association
ATC	Air Traffic Control
AVP	Office of Accident Investigation and Prevention
AVS	Aviation Safety
AVS-1	Associate Administrator of Aviation Safety
COS	Continued Operational Safety
DEF	Diesel Exhaust Fluid
DiEGME	Diethylene glycol monomethyl ether
EGMME	Ethylene glycol monomethyl ether
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAASTeam	FAA Safety Team
FBO	Fixed Based Operator
FSDO	Flight Standards District Office
FSII	Fuel System Icing Inhibitor
GA	General Aviation
GSE	Ground Support Equipment
HAZMAT	Hazardous Materials

HAW	Hazard Analysis Worksheet
HIRMT	Hazard Identification, Risk Management & Tracking Tool
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NATA	National Air Transportation Association
NBAA	National Business Aviation Association
NOx	Nitrogen oxide
NPIAS	National Plan of Integrated Airport Systems
OBP	Operational Best Practice
OEM	Original Equipment Manufacturer
OMA	Eppley Field Airport
OPF	Miami-Opa Locka Executive Airport
OPR	Office of Primary Responsibility
PGD	Punta Gorda Airport
PTRS	Program Tracking and Reporting Subsystem
SAFO	Safety Alert for Operators
SAIB	Special Airworthiness Information Bulletin
SAS	Safety Assurance System
SCR	Selective Catalytic Reduction
SCT	Safety Collaboration Team
SME	Subject Matter Expert
SMS	Safety Management System
SOP	Standard Operating Procedures
SRM	Safety Risk Management
TC	Type Certificate
U.S.	United States