Part 135 Pilot Rest and Duty Rules

Aviation Rulemaking Committee

Report from the Part 135 Rest and Duty Rules ARC

July 2, 2021

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Executive Summary

The Part 135 Pilot Rest and Duty Aviation Rulemaking Committee (ARC) was tasked to identify the effectiveness and deficiencies of the current part 135 regulatory framework, in the context of the Federal Aviation Administration's (FAA) tiered level of safety; and to consider the need to accommodate the diversity of operations conducted under part 135, including unique duty and rest time requirements of air ambulance flightcrew members. The FAA asked the ARC to provide specific consensus comments and recommendations to assist the FAA in future rulemaking activity in this area.

Issues with the current part 135 framework identified by the ARC include deficiencies with regard to enforceability, prospective scheduling of rest, and aspects of the duty and rest rules being too permissive to reliably prevent excessive fatigue, especially as related to cumulative sleep loss and exposure to the window of circadian low. After extensive review of the current part 135 framework, other regulatory frameworks in use in the US and abroad, the part 135 operational context, the relevant fatigue science, opportunities and challenges of using duty and rest regulations to help manage fatigue, and possible costs and benefits associated with regulatory change, the ARC derived – with unanimous consent – a set of core principles as a foundation for recommendations regarding the part 135 pilot rest and duty regulations.

This report contains the ARC's findings which, while aiming to minimize the overall economic impact, include specific recommendations regarding recordkeeping and rest scheduling provisions. This report also contains a detailed proposal for regulating duty and rest with a solution for a subset of part 135 certificate holders with inherently low fatigue-related risk; and a more comprehensive rule set for part 135 certificate holders more likely to be exposed to fatigue-inducing circumstances, including specific provisions for air medical operations, with additional fatigue mitigations codified in an Alertness Management Program for which guidelines are provided.

1. Part 135 Pilot Rest and Duty Rules ARC Charter

1.1. Original ARC Charter

Effective Date: May 21, 2019

SUBJECT: Part 135 Pilot Rest and Duty Rules Aviation Rulemaking Committee

1. **PURPOSE.** This charter establishes the Part 135 Pilot Rest and Duty Rules Aviation Rulemaking Committee (ARC), according to the Administrator's authority under Title 49 of the United States Code (49 U.S.C. § 106(p)(5)). The sponsor of the ARC is the Associate Administrator for Aviation Safety. This charter outlines the ARC's organization, responsibilities, and tasks.

2. **BACKGROUND.** Section 315, Aviation Rulemaking Committee for Part 135 Pilot Rest and Duty Rules, of the FAA Reauthorization Act of 2018 (Pub. L. 115-254) requires the following:

(a) IN GENERAL.—Not later than 180 days after the date of enactment of this Act, the Administrator shall convene an aviation rulemaking committee to review, and develop findings and recommendations regarding, pilot rest and duty rules under part 135 of title 14, Code of Federal Regulations.

(b) DUTIES.—The Administrator shall—
(1) not later than 2 years after the date of enactment of this Act, submit to the appropriate committees of Congress a report based on the findings of the aviation rulemaking committee; and
(2) not later than 1 year after the date of submission of the report under paragraph (1), issue a notice of proposed rulemaking based on any consensus recommendations reached by the aviation rulemaking committee.

(c) COMPOSITION.—The aviation rulemaking committee shall consist of members appointed by the Administrator, including—
(1) representatives of industry;
(2) representatives of aviation labor organizations, including collective bargaining units representing pilots who are covered by part 135 of title 14, Code of Federal Regulations, and subpart K of part 91 of such title; and
(3) aviation safety experts with specific knowledge of flight crewmember education and training requirements under part 135 of such title.

(d) CONSIDERATIONS.—The Administrator shall direct the aviation rulemaking committee to consider—
(1) recommendations of prior part 135 rulemaking committees;
(2) accommodations necessary for small businesses;
(3) scientific data derived from aviation-related fatigue and sleep research;
(4) data gathered from aviation safety reporting programs;
(5) the need to accommodate the diversity of operations conducted under part 135, including the unique duty and rest time requirements of air ambulance pilots; and
(6) other items, as appropriate.

3. **OBJECTIVE OF THE ARC.** The ARC will review and develop findings and recommendations regarding pilot rest and duty rules under Title 14, Code of Federal Regulations (14 CFR) Part 135.

4. **TASKS OF THE ARC.** The tasks of the ARC are:

    a. Review the FAA's current part 135 pilot rest and duty rules.
    b. Review other related commercial pilot rest and duty rules, to include those of the International Civil Aviation Organization (ICAO) and 14 CFR part 121.
    c. Identify the effectiveness and deficiencies of the current part 135 framework.
    d. Evaluate the current regulatory framework in the context of the FAA's tiered level of safety and provide specific consensus comments and recommendations to assist the FAA in developing future rulemaking activity in this area. For any recommendation to change regulatory requirements, the ARC will provide cost and benefit estimates.
    e. Consider the provisions under Section 315, paragraph D of Pub. L. 115-254.
    f. Within 16 months from the first meeting after the effective date of the charter, submit a recommendation report.

        i. The Industry Co-Chair sends the recommendation report to the Associate Administrator for Aviation Safety and the Director of the Office of Rulemaking.

        ii. The Associate Administrator for Aviation Safety determines when the recommendation report and records, pursuant to paragraph (8), will be made available for public release.

5. **ARC PROCEDURES.**

    a. The ARC acts solely in an advisory capacity by advising and providing written recommendations to the Associate Administrator for Aviation Safety.

    b. The ARC may propose related follow-on tasks outside the stated scope of the ARC to the FAA Co-Chair.

    c. The ARC may reconvene following the submission of the recommendation report for the purposes of providing advice and assistance to the FAA, at the discretion of the FAA Co-Chair, provided the charter is still in effect.

6. **ARC ORGANIZATION, MEMBERSHIP, AND ADMINISTRATION.** As directed by Pub. L. 115-254, the committee shall consist of members appointed by the Administrator, including representatives of industry; representatives of aviation labor organizations, including collective bargaining units representing pilots who are covered by 14 CFR part 135, and subpart K of part 91 of such title; and aviation safety experts with specific knowledge of flight crewmember education and training requirements under part 135.

The FAA will set up a committee of up to 20 members. Membership will be balanced in viewpoints, interests, and knowledge of the topics addressed in the committee's objectives and scope. Subject matter experts may be requested to participate as Observers and/or to provide technical support to the ARC members.

The provisions of the August 13, 2014 Office of Management and Budget (OMB) guidance, "Revised Guidance on Appointment of Lobbyists to Federal Advisory Committees, Boards, and Commissions" (79 FR 47482), continues the ban on registered lobbyists participating on Agency Boards and Commissions if participating in their "individual capacity." The revised guidance allows registered lobbyists to participate on Agency Boards and Commissions in a "representative capacity" for the "express purpose of providing a committee with the views of a nongovernmental entity, a recognizable group of persons or nongovernmental entities (an industry, sector, labor unions, or environmental groups, etc.) or state or local government." For further information, refer to the OMB Guidance at 79 FR 47482.

Membership is limited to promote discussion. Attendance, active participation, and commitment by members is essential for achieving the objectives and tasks. When necessary, the ARC may set up specialized and temporary working groups that include at least one ARC member and invited subject matter experts from industry and government.

a. At the request of the sponsor, the Flight Standards Service will appoint the FAA Co-Chair and will:

   1) Select and appoint industry and the FAA participants as members,
   2) Select the Industry Co-Chair from the membership of the ARC,
   3) Ensure FAA participation and support from all affected lines-of-business,
   4) Provide notification to the members of the time and place for each meeting, and
   5) Receive any status report and the recommendations report.

b. The Industry Co-Chair will be appointed from the part 135 operations community. Once appointed, the Industry Co-Chair will:

   1) Coordinate required ARC meetings in order to meet the objectives and timelines,
   2) Establish and distribute meeting agendas in a timely manner,
   3) Keep meeting notes, if deemed necessary,
   4) Perform other responsibilities as required to ensure the objectives are met,
   5) Provide status reports, as requested, in writing to the FAA Co-Chair, and
   6) Submit the recommendation report to the FAA Co-Chair and the Director of the Office of Rulemaking.

7. **PUBLIC PARTICIPATION.** Meetings are not open to the public. Persons or organizations outside the ARC who wish to attend a meeting must get approval in advance of the meeting from the Industry Co-Chair and the FAA Co-Chair.

8. **AVAILABILITY OF RECORDS.** Consistent with the Freedom of Information Act, Title 5, U.S.C., § 552, records, reports, agendas, working papers, and other documents that are made

available to or prepared for or by the ARC will be available for public inspection and copying at the Office of Rulemaking, FAA Headquarters, 800 Independence Ave. SW, Washington, D.C. 20591. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations, Part 7. You can find this charter on the FAA Committee Database website at: http://www.faa.gov/regulations_policies/rulemaking/committees/documents/.

9. **DISTRIBUTION.** This charter is distributed to the Office of the Associate Administrator for Aviation Safety, the Office of the Chief Counsel, the Office of Assistant Administrator for Policy, International Affairs, and Environment, and the Office of Rulemaking.

10. **EFFECTIVE DATE AND DURATION.** The ARC is effective upon issuance of this charter and will remain in existence for a maximum of 24 months, unless the charter is sooner suspended, terminated, or extended by the Administrator.

1.2. ARC Charter Extension

Original Effective Date: May 21, 2019
Extension Effective Date: April 27, 2021

SUBJECT: Part 135 Pilot Rest and Duty Rules Aviation Rulemaking Committee

1. **PURPOSE.** This charter establishes the Part 135 Pilot Rest and Duty Rules Aviation Rulemaking Committee (ARC), according to the Administrator's authority under Title 49 of the United States Code (49 U.S.C. § 106(p)(5)). The sponsor of the ARC is the Associate Administrator for Aviation Safety. This charter outlines the ARC's organization, responsibilities, and tasks.

   The Part 135 Pilot Rest and Duty Rules ARC has requested this extension so that the ARC can draft its recommendation report. The recommendation report is due on July 5, 2021.

2. **BACKGROUND.** Section 315, Aviation Rulemaking Committee for Part 135 Pilot Rest and Duty Rules, of the FAA Reauthorization Act of 2018 (Pub. L. 115-254) requires the following:

   (a) IN GENERAL.—Not later than 180 days after the date of enactment of this Act, the Administrator shall convene an aviation rulemaking committee to review, and develop findings and recommendations regarding, pilot rest and duty rules under part 135 of title 14, Code of Federal Regulations.

   (b) DUTIES.—The Administrator shall—
   (1) not later than 2 years after the date of enactment of this Act, submit to the appropriate committees of Congress a report based on the findings of the aviation rulemaking committee; and
   (2) not later than 1 year after the date of submission of the report under paragraph (1), issue a notice of proposed rulemaking based on any consensus recommendations reached by the aviation rulemaking committee.

   (c) COMPOSITION.—The aviation rulemaking committee shall consist of members appointed by the Administrator, including—
   (1) representatives of industry;
   (2) representatives of aviation labor organizations, including collective bargaining units representing pilots who are covered by part 135 of title 14, Code of Federal Regulations, and subpart K of part 91 of such title; and
   (3) aviation safety experts with specific knowledge of flight crewmember education and training requirements under part 135 of such title.

(d) CONSIDERATIONS.—The Administrator shall direct the aviation rulemaking committee to consider—
(1) recommendations of prior part 135 rulemaking committees;
(2) accommodations necessary for small businesses;
(3) scientific data derived from aviation-related fatigue and sleep research;
(4) data gathered from aviation safety reporting programs;
(5) the need to accommodate the diversity of operations conducted under part 135, including the unique duty and rest time requirements of air ambulance pilots; and
(6) other items, as appropriate.

3. **OBJECTIVE OF THE ARC.** The ARC will review and develop findings and recommendations regarding pilot rest and duty rules under Title 14, Code of Federal Regulations (14 CFR) Part 135.

4. **TASKS OF THE ARC.** The tasks of the ARC are:

    a. Review the FAA's current part 135 pilot rest and duty rules.
    b. Review other related commercial pilot rest and duty rules, to include those of the International Civil Aviation Organization and 14 CFR part 121.
    c. Identify the effectiveness and deficiencies of the current part 135 framework.
    d. Evaluate the current regulatory framework in the context of the FAA's tiered level of safety and provide specific consensus comments and recommendations to assist the FAA in developing future rulemaking activity in this area. For any recommendation to change regulatory requirements, the ARC will provide cost and benefit estimates.
    e. Consider the provisions under Section 315, paragraph D of Pub. L. 115-254.
    f. Submit a recommendation report on July 5, 2021.

        i. The Industry Co-Chair sends the recommendation report to the Associate Administrator for Aviation Safety and the Executive Director of the Office of Rulemaking.

        ii. The Associate Administrator for Aviation Safety determines when the recommendation report and records, pursuant to paragraph (8), will be made available for public release.

5. **ARC PROCEDURES.**

    a. The ARC acts solely in an advisory capacity by advising and providing written recommendations to the Associate Administrator for Aviation Safety.
    b. The ARC may propose related follow-on tasks outside the stated scope of the ARC to the FAA Co-Chair.
    c. The ARC may reconvene following the submission of the recommendation report for the purposes of providing advice and assistance to the FAA, at the discretion of the FAA Co-Chair, provided the charter is still in effect.

6. **ARC ORGANIZATION, MEMBERSHIP, AND ADMINISTRATION.** The organization, membership, and administration remain unchanged. As directed by Pub. L. 115-254, the committee shall consist of members appointed by the Administrator, including representatives of industry; representatives of aviation labor organizations, including collective bargaining units representing pilots who are covered by 14 CFR part 135, and subpart K of part 91 of such title; and aviation safety experts with specific knowledge of flight crewmember education and training requirements under part 135.

   The FAA will set up a committee of up to 20 members. Membership will be balanced in viewpoints, interests, and knowledge of the topics addressed in the committee's objectives and scope. Subject matter experts may be requested to participate as Observers and/or to provide technical support to the ARC members.

   The provisions of the August 13, 2014 Office of Management and Budget (OMB) guidance, "Revised Guidance on Appointment of Lobbyists to Federal Advisory Committees, Boards, and Commissions" (79 FR 47482), continues the ban on registered lobbyists participating on Agency Boards and Commissions if participating in their "individual capacity." The revised guidance allows registered lobbyists to participate on Agency Boards and Commissions in a "representative capacity" for the "express purpose of providing a committee with the views of a nongovernmental entity, a recognizable group of persons or nongovernmental entities (an industry, sector, labor unions, or environmental groups, etc.) or state or local government." For further information, refer to the OMB Guidance at 79 FR 47482.

   Membership is limited to promote discussion. Attendance, active participation, and commitment by members is essential for achieving the objectives and tasks. When necessary, the ARC may set up specialized and temporary working groups that include at least one ARC member and invited subject matter experts from industry and government.

   a. At the request of the sponsor, the Flight Standards Service appoints the FAA Co-Chair and will:

      1) Select and appoint industry and the FAA participants as members;
      2) Select the Industry Co-Chair from the membership of the ARC;
      3) Ensure FAA participation and support from all affected lines-of-business;
      4) Provide notification to the members of the time and place for each meeting; and
      5) Receive any status report and the recommendations report.

   b. The Industry Co-Chair is appointed from the part 135 operations community. The Industry Co-Chair will:

      1) Coordinate required ARC meetings in order to meet the objectives and timelines;
      2) Establish and distribute meeting agendas in a timely manner;
      3) Keep meeting notes, if deemed necessary;
      4) Perform other responsibilities as required to ensure the objectives are met;
      5) Provide status reports, as requested, in writing to the FAA Co-Chair; and

6) Submit the recommendation report to the FAA Co-Chair and the Executive Director of the Office of Rulemaking.

7. **PUBLIC PARTICIPATION.** Meetings are not open to the public. Persons or organizations outside the ARC who wish to attend a meeting must get approval in advance of the meeting from the Industry Co-Chair and the FAA Co-Chair.

8. **AVAILABILITY OF RECORDS.** Consistent with the Freedom of Information Act, Title 5, U.S.C., § 552, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the ARC will be available for public inspection and copying at the Office of Rulemaking, FAA Headquarters, 800 Independence Ave. S.W., Washington, D.C. 20591. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations, Part 7. You can find this charter on the FAA Committee Database website at: http://www.faa.gov/regulations_policies/rulemaking/committees/documents/.

9. **DISTRIBUTION.** This charter is distributed to the Office of the Associate Administrator for Aviation Safety, the Office of the Chief Counsel, the Office of Assistant Administrator for Policy, International Affairs, and Environment, and the Office of Rulemaking.

10. **EFFECTIVE DATE AND DURATION.** The ARC is effective upon issuance of this charter and will remain in existence for a maximum of 12 months, unless the charter is sooner suspended, terminated, or extended by the Administrator.

2. Part 135 ARC Membership

The Part 135 Pilot Rest and Duty Rules Aviation Rulemaking Committee (ARC) membership included representation from a wide spectrum of stakeholders and represented varying expertise, interests, and viewpoints. The industry could not be represented on the ARC in its entirety due to the diversity of the industry; single pilot operators holding OpSpec A040 authorization in particular were not directly represented. The conversations of the ARC focused primarily, but not exclusively, on on-demand passenger operations, and the recommendations in this report reflect those conversations. The ARC called on subject matter experts to better understand some of industry segments that were not directly represented by the ARC membership. Table 1 shows the names and organizations of the members of the ARC.

Table 1. Members of the Part 135 ARC.

Name	Organization	ARC Title
Kent S. Jackson	Jetlaw, LLC	Industry Chair
Daniel Carey	FAA, Part 135 Air Carrier Operations Branch	Designated Federal Official
Alex Beringer	Fair Wind Air Charter	Member
Tony Bonham	Air Evac Lifeteam	Member
Bill Cush	Cape Air	Member
Lauri Esposito	CAPA	Member
Dennis Florian	Flexjet	Member
Michael Hanson	NJASAP	Member
John W. Hazlet	RACCA	Member
Chris Hill	HAI	Member
Steven R. Hursh	IBR	Member
Tom Klassen	Halo-Flight	Member
Brian Koester	NBAA	Member
Eric McCarty	NetJets	Member
Bill McDonald	A4A	Member
Jessica Naor	Grandview Aviation	Member
Brian Noyes	ALPA	Member
Marilyn Rhude	IBT	Member
W. Ashley Smith, Jr.	Jet Logistics, Inc.	Member
Hans P.A. Van Dongen	Washington State University	Member
Sally Veith	AMOA	Member
Ryan Waguespack	NATA	Member
Eric Walter	Bemidji Aviation	Member

3. Part 135 ARC Objective

Consistent with its Charter (see section 1), the objective of the Part 135 ARC was to recommend revisions to the applicable regulatory framework to achieve the following:

- Reduce the potential for excessive fatigue across the complexity of part 135 operations.
- Provide a tiered approach with options for effective management of fatigue that fits a variety of business models and operational fatigue risks.
- Improve the enforceability of part 135 regulations.
- Minimize the economic impact of the ARC's recommendations.
- Ensure the continued provision of air medical services within a consistent fatigue risk management framework.
- Create additional protections for flightcrew members flying during or through the window of circadian low (WOCL).

4. Rationale and Science

4.1. Complexity of the Part 135 Industry

The FAA tasked the Part 135 ARC to consider the need to accommodate the diversity of operations conducted under part 135, including the unique duty and rest time requirements of air ambulance flightcrew members. Covering more than 1,900 certificate holders, the regulatory framework of part 135 reflects the industry's unique needs, which are diverse in terms of size, scope, and mission. See Figure 1.

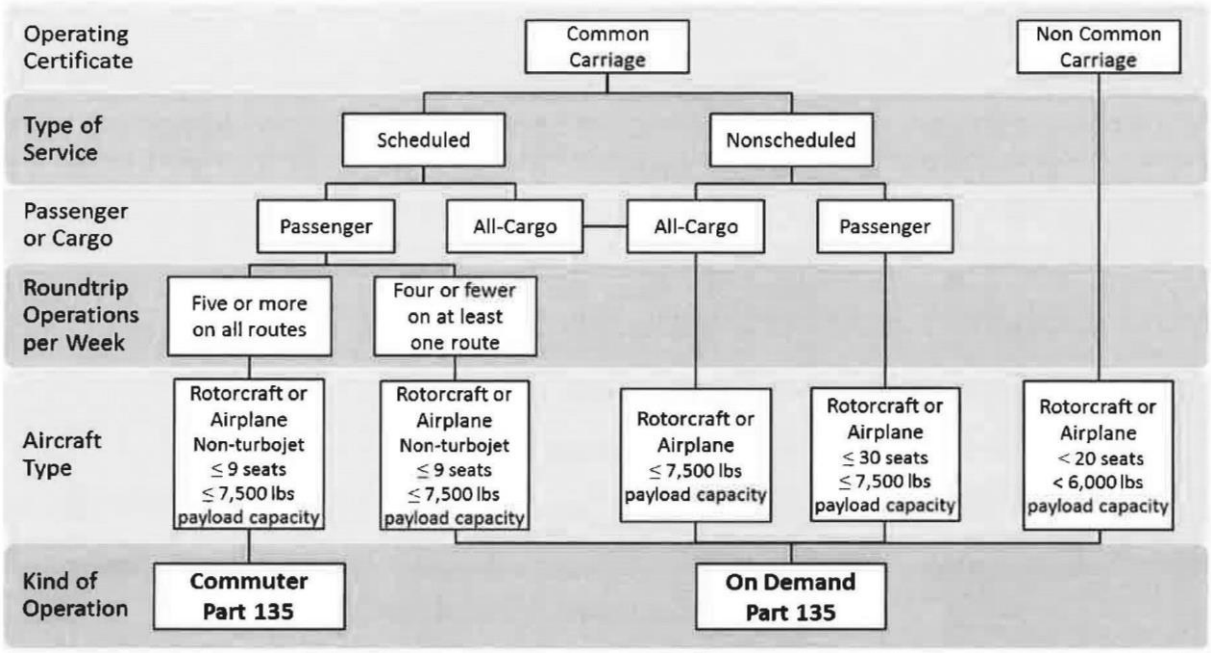

Figure 1. Overview of part 135 operations. Source: Study of Operators Regulated under Part 135, Federal Aviation Administration, April 2016.

Some *on-demand* part 135 operators with "air feeder" operations elect to use the *scheduled* regulations (14 CFR § 135.265), as the nature of their flying makes that section of the regulations most practicable for them. The repetitive nature of such operations, with schedules set by their large integrator customers (e.g., FedEx, UPS) provides opportunities for fatigue mitigation through predictable rest and often also provides a significant mid-day sleep opportunity.

Part 135 operators vary widely in size, both by the number of employees and management personnel required by part 119 and the size of aircraft used in their operations. Operations range in size from a single-engine piston aircraft to several hundred turbojet aircraft. Notably, the Small Business Administration (SBA) measures the part 135 industry by the number of employees. A "small business" has a maximum of 1,500 employees for:

- Scheduled passenger air transportation
- Scheduled freight air transportation
- Nonscheduled chartered passenger air transportation
- Nonscheduled chartered freight air transportation

According to the FAA's Air Operator Information Table,[1] part 135 operators range in size up to 4,500 employees. Currently, only three operations would not qualify as a small business as defined by SBA. Less than 10% of part 135 certificate holders employ more than 50 people, and the average is 30 employees. More than 300 operators employ only a single person, so that the single employee must run the business as well as accomplish all the tasks typically assigned to a flightcrew member. These tasks include, but are not limited to:

- Administrative duties
- Aircraft servicing
- Aircraft stocking
- Customs coordination (as required)
- De-icing (as required)
- Exterior cleaning/detailing
- Flight planning
- Flight plan filing
- Flying the aircraft
- Interior cleaning/detailing
- Loading and unloading of baggage/cargo
- Passenger requests
- Pre-flight inspections
- Post-flight inspections

Part 135 operations vary by scope. Scope ranges from single pilot operators holding OpSpec A040 authorization flying single-engine piston-powered aircraft that carry only one or two passengers to large ultra-long-range multi-engine turbine-powered aircraft able to seat up to 30 passengers. It is also worth noting that part 135 includes fixed-wing and rotor-wing operations, which may fly very short legs dozens of times per day.

The industry uniquely accommodates commercial on-demand missions. Missions are not limited to large airports; rather, part 135 operators may take passengers or cargo to non-towered airports, buildings, oil rigs, ships, or mountainsides. Some operate on a fixed schedule, repeatedly flying the same routes which are known well in advance. On the other hand, many missions may occur without regularity or on short notice, such as air ambulance missions.

[1] https://av-info.faa.gov/dd_sublevel.asp?Folder=%5CAirOperators

Airplane and helicopter air ambulance operations are considered an essential service for the communities they serve. Congress, the FAA, and the Cybersecurity and Infrastructure Security Agency have recognized the need for these 24-hour services, which provide critical life-saving care to their passengers. The emergency nature of their mission often requires air ambulance operations to dispatch with only a few minutes notice to save lives. Because these missions are often life-critical, they were afforded due consideration throughout the ARC's discussions.

Other part 135 operator missions may include, but are not limited to:

- Private passenger transportation
- Cargo transportation
- Aerial Inspection
- Construction
- Firefighting
- Aerial advertising
- Surveillance
- Oil and gas offshore transport
- Air ambulance
- Transport of emergency personnel
- Organ transplant transportation

4.2. Effectiveness and Deficiencies of the Current Part 135 Framework

4.2.1. Effectiveness

The current part 135 regulations for pilot rest and duty, which became effective October 1, 1986, differentiate between the rest and flight time limitations for scheduled operations, on-demand operations, and medical emergency flights. This differentiation allows an operator to adopt the rest schemes best suited to the conditions under which it will operate, as found in Title 14 of the Code of Federal Regulations (14 CFR) part 135 subpart F (§§ 135.261 through 135.273).

Although these operations and the associated regulatory rest and flight time limits may vary by type of operation, they are relatively simple in nature and apply equally among certificate holders, regardless of size or complexity. Additionally, these simple regulations allow flightcrew members and operators to track regulatory compliance without memorizing a complex set of regulations.

The duty and flight time limitations of part 135 seek to prevent cumulative fatigue, which occurs after multiple, successive periods of extended wakefulness. The current part 135 framework is effective in that regard for day operations. This is acceptable for many operators, particularly those that fly exclusively during the day or only occasionally fly at night, which accounts for a significant percentage of certificate holders. Limiting time on duty to 14 hours

and requiring 10 hours of rest for day operations helps to place sleep opportunities for flightcrew members in the WOCL, which contributes to preventing cumulative fatigue from diminishing flightcrew member performance.

4.2.2. Deficiencies

Fatigue science has advanced significantly since the current regulations were established. Many certificate holders take advantage of the flexibility provided by the part 135 rule set, which sometimes puts them in situations of potential fatigue that would not be recommended based on current science. For operators conducting flights on short notice, at night, across multiple time zones, or with extended range enabled by modern aircraft, the regulations can be improved by adding additional clarity and incorporating scientific advancements. The part 135 rest and duty regulations would also benefit from enhancing provisions that require rest to be assigned prospectively, adding clarity to reduce or eliminate the need for chief counsel interpretations, adopting performance-based measures, incorporating protections for flightcrew members flying through the WOCL and/or across multiple time zones, addressing crew rest facilities, and creating mechanisms to enable enforcement.

Since the current regulations pertaining to rest and duty for part 135 became effective, the FAA Office of the Chief Counsel has published more than four dozen opinions and legal interpretations to help operators and inspectors understand operators' regulatory obligations. This large number of interpretations illustrates that a pared-down regulation may not be clear enough to allow for consistent practical application of the regulation. Thus, a simple regulation may make it difficult for operators to understand their responsibilities fully without significant research and indicates the regulations could benefit from additional context and clarity.

Current part 135 regulations apply equally to all operations within each subpart, requiring the same restrictions no matter the fatigue risk to an operation. By contrast, tiered regulations would allow operators to apply the mitigations necessary to meet the required safety levels. Less risky operations would necessitate fewer mitigations, while more risky operations would require more mitigations to reach the same level of safety.

At the time the current part 135 regulations were developed, fatigue science was limited in scope and understanding of the biological processes underlying fatigue. These biological processes and their interactions with operationally relevant circumstances are now much better understood, contributing to a greater understanding of fatigue risks and effective mitigations for flightcrew members. It is clear that there is a need to address previously unforeseen risks associated with a variety of part 135 operations.

Deficiencies in existing part 135 regulations include:

- No requirement for an operator to document duty time, rest time, or the time at which assignments are made. This makes enforcement impossible for safety inspectors. Prospective rest is a legal requirement per 14 CFR § 135.267, with multiple letters of interpretation addressing the issue of rolling rest (Orellana 2015, Kidd 2017, Jimenez

2011, etc.). “Rolling rest” is the illegal and widespread practice of requiring a crew member to be in rest on a rolling (continuing) basis without assigning an end to the rest period. In a rolling rest operation, crew members complete a duty period and are then left “in rest” indefinitely until called in for a new duty assignment, leaving them in a constant “on call” state with no ability to plan sleep adequately. It is widely known among the part 135 community that some operators, either intentionally or unknowingly, use rolling rest.

- No accounting for additional risks associated with flying through the WOCL. Current flight and duty limits apply equally around the clock. Modern science tells us that each person’s level of fatigue ebbs and flows throughout a 24-hour day. Fatigue is high and alertness is low during the WOCL, which is around 0200–0600 (in the time zone to which they are acclimated) for most individuals. Regulations should account for the additional safety risks of increased fatigue during this period.

- No mitigations for flights across multiple time zones. Flightcrew members’ circadian rhythm is tied to their acclimated location; when flightcrew members travel across multiple time zones, daylight and the internal drive to sleep are not aligned. Obtaining recuperative sleep at night in the new time zone is therefore difficult.

- Insufficient definition for adequate sleeping facilities. Under the current regulations, operations using an augmented crew must be conducted on aircraft equipped with adequate sleeping facilities. Varying degrees of isolation, size, darkness, and comfort, depending on what is allowable in different parts of the country, results in a competitive advantage for some operators and poor-quality rest for some flightcrew members.

These deficiencies have possible solutions based in scientific evidence, which are already implemented to some degree by various part 135 operators and have also found widespread use in other operational settings in aviation, other modes of transportation, and other industry sectors.

4.2.3. Review of other related commercial pilot rest and duty rules

Commensurate with the tasks assigned to the ARC, the committee commenced a review of the pilot rest and duty rules of multiple regions and countries. The foci of review were 14 CFR part 121, 14 CFR part 117, Canadian Aviation Regulations (CARs), European Union Aviation Safety Agency (EASA) regulations, and documents from the International Civil Aviation Organization (ICAO) including Standards and Recommended Practices (SAPRs), Document 9966, the Fatigue Management Guide (FMG) for General Aviation Operators of Large and Turbojet Airplanes, and the FMG for Helicopter Operators.

Further, the ARC honored ICAO guidance stating that the regulations shall be based upon scientific principles, knowledge, and operational experience with the aim of ensuring flightcrew members are performing at an adequate level of alertness. ICAO also states that the regulations

shall establish prescriptive limits for flight time, duty period limitations, rest period requirements, and, where authorized, the use of a Fatigue Risk Management System (FRMS).

The ARC noted that, under ICAO and other foreign regulatory frameworks, all commercial operations are required to follow a single set of regulations. The FAA's regulatory framework takes a more risk-based approach and bifurcates the regulations for commercial operations into two parts: part 121 for large, scheduled operations and part 135 for on-demand and commuter operations.

All foreign rest and duty rules recognize the WOCL and limit of allowable duty times, as well as maintain cumulative limits to address cumulative fatigue. Additionally, the ARC felt keeping hard limits on allowable flight time remained consistent with past practice and current regulations. The ARC membership believes the recommendations of the ARC meet these standards, have adopted the best practices reviewed, and are inclusive of allowing FRMS-based regulations (see section 6).

4.3. Scientific Concepts Governing Fatigue and Alertness

The fatigue associated with duty and rest schedules, and the mitigation thereof, is scientifically well understood (Dinges et al., 1996; Rosekind et al., 1996; Caldwell et al., 2009; Van Dongen & Hursh, 2011; Van Dongen et al., 2017) and has previously been described in the 2010 FAA Advisory Circular 120-100. Scientific evidence is more limited regarding the fatiguing effects of workload (e.g., Honn et al., 2016) and the rate of dissipation of fatigue after time zone changes (e.g., Powell et al., 2010), but extensive operational experience provides some knowledge on these topics. For the purposes of this report, the following is a reasonable summary of the relevant knowledge base:

- The average adult needs at least 7 hours of recuperative sleep per day (Watson et al., 2015).
- Loss of sleep relative to this daily sleep need induces fatigue.
- Repeated loss of sleep across consecutive days leads to a progressive build-up of fatigue.
- Catch-up sleep is needed to recover from prior sleep loss.
- Recovery from sleep loss is relatively quick (1–2 days of unrestricted sleep) after a single bout of acute sleep loss, but takes multiple days after repeated exposure to sleep loss.
- Consolidated sleep is most efficient for recovery. Napping can partially compensate for lost sleep.
- The biological clock promotes alertness during the afternoon and early evening, and fatigue during the night and early morning.

- The fatigue-inducing and sleep-promoting effect of the biological clock is strongest during the primary WOCL, approximately between 0200 and 0600 (in the reference time zone).
- There is a secondary fatigue-inducing and sleep-promoting WOCL in the afternoon, approximately between 1500 and 1700 (in the reference time zone), which is moderately conducive to a daytime nap.
- Sleep loss amplifies the fatigue-inducing effect of the primary WOCL and the afternoon secondary WOCL.
- The quality and quantity of sleep obtained during a rest opportunity is greatest during the physiological night, when the biological clock does not promote alertness. For most people, this includes the period from 0100 to 0700 (in the reference time zone).
- Sleep outside the physiological night tends to have less recuperative value.
- The rhythm of the biological clock, and thereby the physiological night and the WOCL, is relatively robust to travel across time zones over the short term (up to 2 days), staying anchored to the reference time zone.
- Across a longer stay in a new time zone, the biological clock gradually adapts, and the new time zone becomes the reference time zone. The time it takes for the biological clock to adapt to the new time zone depends on multiple factors and is not well understood; in the context of managing fatigue, 3 days is a reasonable estimate as a rule of thumb.
- Whether high workload has a fatigue-inducing effect per se is not well understood. However, high workload exposes fatigue built up across consecutive days due to sleep loss and/or WOCL exposure.
- Other variables related to the operational context – e.g., ambient light and temperature, time pressure, delays, weather, crowded airspace, air traffic control interactions – can also expose fatigue built up across consecutive days due to sleep loss and/or WOCL exposure.
- Self-assessment of fatigue is not a reliable gauge of the actual, objective state of fatigue.
- Fatigue increases risk of errors, which may contribute to incidents and accidents.
- This fatigue-related risk may be alleviated or enhanced by the environment and the operational context.
- A variety of fatigue mitigations is available to help manage fatigue-related risk. These include duty and rest schedule interventions (e.g., nap opportunities), fatigue countermeasures (e.g., caffeine), and safety measures (e.g., flight augmentation).

The timing and duration of duty and rest periods dictate when crewmembers must be awake or have opportunities to sleep and for how long. There is thus a direct relationship between duty and rest schedules and fatigue-related risk; see Figure 2 for an illustration. Scheduling practices may increase fatigue, but – with an understanding of the underlying principles –can also be harnessed to address fatigue. Because factors in the environment and the operational context may affect fatigue during duty periods and sleep during rest periods in ways that are not

necessarily related to the schedule, other fatigue controls (e.g., pre-flight risk assessments, fatigue reporting) are also needed. With such additional tools in place, however, science-based duty and rest regulations can help manage fatigue-related risk.

Even so, the relationship between duty and rest scheduling and fatigue-related risk is multi-factorial. Moreover, because fatigue outcomes depend on time of day and prior sleep debt, the relationship between duty and rest scheduling and fatigue-related risk is history-dependent and non-linear. This relationship may even be non-monotonic (i.e., changing direction); for example, a longer period of wakefulness may in some cases be associated with reduced fatigue, like when the wake extension falls in the late afternoon when the biological clock promotes alertness (Honn et al., 2019). These challenges clarify why the part 135 ARC charter called specifically for addressing WOCL exposures and cumulative fatigue. They also explain why duty and rest regulations aiming to address fatigue must either consider only a limited set of scheduling possibilities (where the impact of these issues can be known to be limited); or incorporate a degree of regulatory complexity and codify the use of other fatigue controls through an Alertness Management Program (AMP). This is further explained in section 4.5.

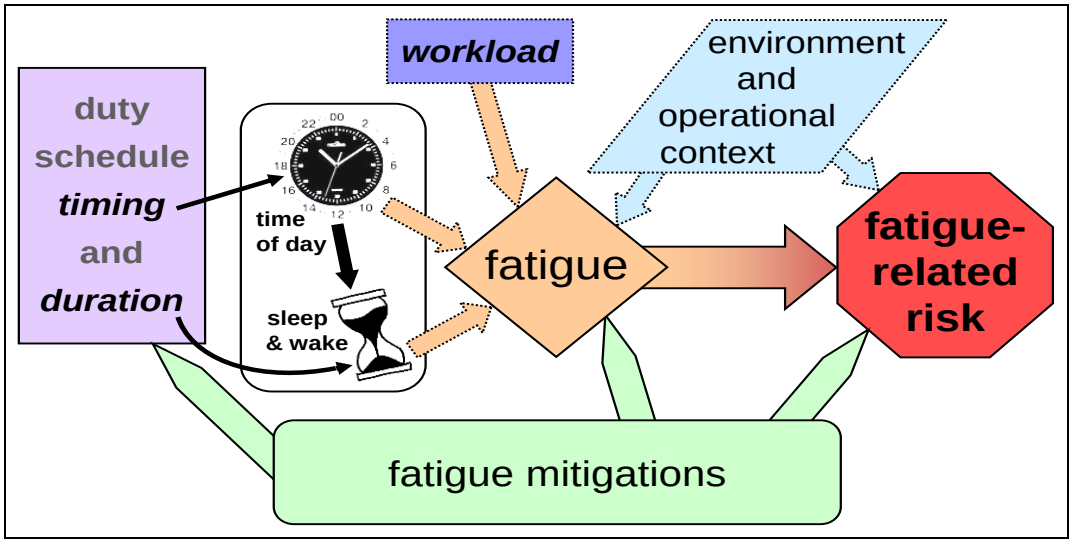

Figure 2. Schematic of scientific principles underlying the relationship between duty and rest scheduling and fatigue-related risk during part 135 operations.

4.4. Core Principles Guiding the Development of Recommendations

With careful consideration of the diversity of operations and the potential sources of fatigue in the part 135 industry, the ARC unanimously agreed upon the following core principles to guide the development of regulatory recommendations based on the available science of fatigue:

A. Recognize that the two primary factors that modulate alertness are the circadian rhythm and sleep drive. Fatigue is controlled by:
   a. Managing the timing of duties relative to the circadian function; and
   b. Managing the opportunities for sleep (rest) to minimize excessive sleep debt.

Hence, the ARC concluded that the prescriptive limits should do the following:

B. Limit exposure to unmitigated WOCL duties.

C. Limit cumulative fatigue that results from consecutive unmitigated WOCL exposures.

D. Protect sleep opportunities (or rest) as the primary mitigation for fatigue.

E. Prevent rolling rest and require that rest be assigned prospectively.

F. Encourage sleep opportunities during duty that can serve to mitigate fatigue. When beneficial sleep opportunities are provided during a duty, allow for additional duty time to accommodate that rest time as a function of time of day.

G. Recognize that the recuperative value of a sleep opportunity is based on circadian physiology and that there are two times in the day when sleep propensity is optimal.

H. Recognize that consistency in rest and duty scheduling improves the ability of flightcrew members to plan sleep opportunities so as to be more rested and fit for duty.

I. Recognize that many activities are part of duty in part 135 operations, and those duties may occur prior to, during, and after flight time and limit opportunities for sleep.

J. From a safety perspective, eliminate “tail-end ferries” that function like additional duty time beyond allowable limits and reduce sleep opportunities.

K. Accommodate the diversity of part 135 operations.

L. Recognize the unique nature of air medical operations serving a life-saving function.

M. Create hard limits and requirements that are enforceable. Require recordkeeping regarding the scheduling of both duties and prospective rest.

N. Recognize that Fitness for duty is a joint responsibility between flightcrew members and operators.

O. Provide a low-cost and simple-to-implement alternative for relatively small operations that operate mostly during the day and have limited fatigue-inducing WOCL exposures.

P. Provide for the use of an AMP that increases operational flexibility and provides additional opportunities to operate into the WOCL.

Q. Accommodate international operations that move across theaters, while considering the physiology of circadian adjustment. Recognize that currently many part-135 flightcrew members do not have a defined home base that serves as a constant time zone reference.

R. Recognize that flight time (independent of duty time) is a workload factor. While there is minimal science to guide flight time limits, flightcrew experience can be relied upon to guide those limits.

S. Recognize that the impact of flight time on safety is amplified when in a state of reduced alertness such as during operations in the WOCL.

4.5. Framework of Recommendations

4.5.1. Scientific basis for regulatory approach

Science- and data-based development of effective regulations for duty and rest to help minimize fatigue and manage fatigue risk involves a balancing act between (1) schedules that are highly fatigue-avoiding but too restrictive to be workable in day-to-day operations versus (2) schedules that are operationally flexible but too permissive to reliably address fatigue (Honn et al., 2019). Complicating this endeavor is the fact that the relationship between duty and rest duration on the one hand, and fatigue and fatigue-related risk on the other hand, is non-linear and non-monotonic – meaning that sometimes more duty time does not lead to increased fatigue, and sometimes more rest time does not lead to reduced fatigue, as co-determined by time of day (through circadian rhythm) and other factors (see section 4.3 on the science of fatigue). As such, finding an optimal rule set is inherently an exercise in compromise, as illustrated in Figure 3.

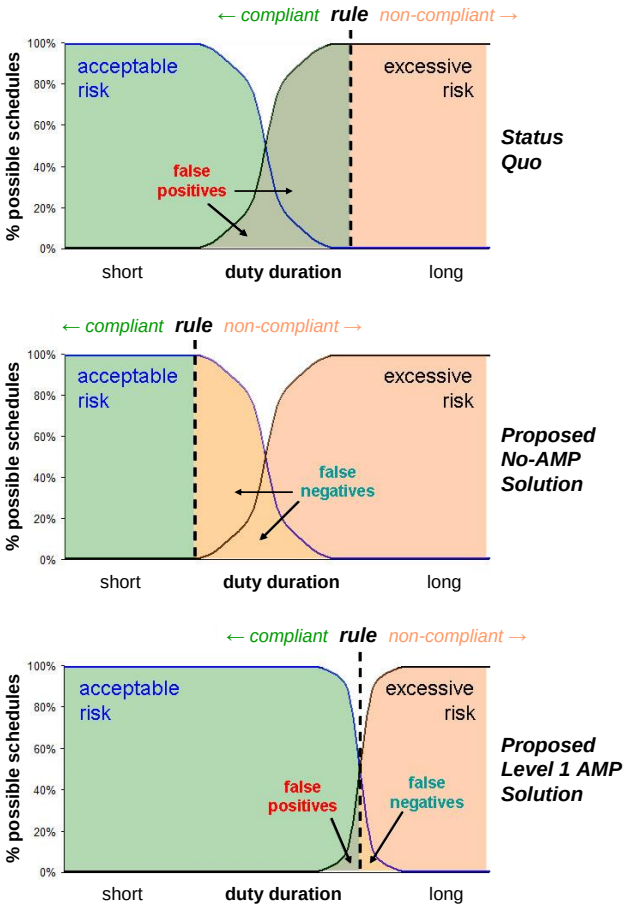

Figure 3. Balancing between being too restrictive versus being too permissive in the development of duty and rest rules to address fatigue risk. Each graph shows the percentage of possible schedules of a given duty duration with either acceptable risk (blue curve) or excessive risk (black curve), plotted as a function of duty duration (short to long). For regulations to be effective at addressing fatigue, there needs to be a high level of congruence between acceptable risk (blue curve) and rule compliance (green background) on the one hand, and excessive risk (black curve) and rule non-compliance (orange background) on the other hand, so that compliance may be expected to engender low risk. However, because of the non-linear and non-monotonic relationship of duty and rest durations to fatigue (e.g., more duty time does not always lead to greater fatigue, depending on time of day and other factors), the separation between acceptable versus excessive risk based on rule compliance is not perfect. There can be "false positives" (brownish area under the curve), which are schedules that are rule compliant but would be associated with excessive risk); and there can be "false negatives" (yellow area under the curve), which are schedules that are non-compliant even though they would have acceptable risk). In general, the fewer false positives (i.e., conditions that are legal but create excessive risk), the more effective the regulatory framework for addressing fatigue. These concepts are illustrated here for a given rule prescribing a particular duty duration limit as part of a larger rule set. *Top panel*: In this simplified representation of the current part 135 duty and rest regulations (status quo), the rules are too permissive, which allows for considerable scheduling flexibility – but not all rule-compliant schedules have acceptable risk, with too many false positives that undermine regulatory effectiveness in avoiding fatigue risk. *Middle panel*: One way to reduce the number of false positives is to purposely set comparatively restrictive duty and rest limitations in order to prohibit any schedules that might include false positives. This comes at the cost of increasing false negatives (i.e., prohibiting schedules that would have had acceptable risk) and thus less scheduling flexibility, but would be suitable for operations that do not require much scheduling flexibility (e.g., operations that are limited predominantly to schedules that avoid the WOCL, with only occasional short schedules that infringe on the WOCL). This approach to addressing fatigue risk is straightforward to implement without requiring an AMP to address false positives, yet still improves regulatory effectiveness in addressing fatigue risk. *Bottom panel*: Another way to reduce the number of false positives is to institute a more elaborate rule set and incorporate fatigue countermeasures, coupled with an AMP to address false positives. This approach actually accomplishes three things: a greater subset of schedules would have acceptable risk, there are fewer false positives and false negatives, and the AMP is a secondary barrier to address the occasional false positive. That is, by embracing a degree of complexity in the rule set and specifying the implementation of preselected fatigue countermeasures in a Level 1 AMP (see section 6.2), a high level of scheduling flexibility can be retained while simultaneously improving regulatory effectiveness in addressing fatigue risk.

A priority in the development of effective regulations for duty and rest is to prevent schedules that are rule-compliant but do not sufficiently address fatigue risk ("false positives"), which is considered to be a problem with the current part 135 duty and rest regulations; see the top panel of Figure 3. One way to improve regulatory effectiveness is through a prescriptive rule set that is purposely restrictive, so that false positive cases are ruled out while accepting an increase in false negative cases. This approach emphasizes fatigue-avoidance over flexibility, as illustrated in the middle panel of Figure 3. This would not be suitable across the full range of circumstances that characterize the diversity of part 135 operations, but it could be readily used in a subset of operations for which fatigue risk is generally low and the relationship between duty and rest durations and fatigue is approximately linear – such as operations that predominantly work daytime schedules. Such operations could be effectively regulated with a small and straightforward set of rules that is comparatively restrictive by design, and need not be burdened with overhead from extensive scheduling or fatigue mitigation requirements. With maximal overlap between rule compliance and acceptable risk, such a simple prescriptive rule set is expected to be intrinsically safe most of the time. This notion provides a basis for the no-AMP duty and rest requirements proposed in section 7.1.

While a prescriptive rule set that is purposely restrictive should be effective in addressing fatigue, it would limit access to some scheduling options that are not expected to be particularly fatiguing and, moreover, it would severely limit scheduling for operations that may be inherently fatiguing due to WOCL infringement, repeated exposure to sleep loss, and/or other fatigue factors. Some operations, therefore, may need to (or wish to) manage fatigue differently – not through a purposely restrictive rule set, but rather through implementation of science- and data-based fatigue mitigations that reduce risk overall (i.e., put more scheduling options into the realm of acceptable risk) and bring about a better separation between schedules with acceptable versus unacceptable risk. Such mitigations could include more elaborate duty and rest rules that account for time of day, cumulative effects, and other fatigue factors; in combination with a range of preselected fatigue countermeasures, which would be specified in an AMP. The added complexity leads to more scheduling options and greater congruence between compliance and acceptable risk, thereby keeping a high level of scheduling flexibility while improving effectiveness of the regulatory framework, as illustrated in the bottom panel of Figure 3. This concept provides a basis for the Level 1 AMP duty and rest requirements proposed in sections 7.2 through 7.6 (in addition to section 7.1), with the Level 1 AMP requirements described in section 6.2.

Because of the considerably non-linear relationship between duty and rest hours and fatigue, as well as the effects of fatigue countermeasures, even an elaborate rule set and the implementation of selected fatigue countermeasures would leave some scheduling options classified as non-compliant while not excessively risky. (These are the remaining false negatives in the bottom panel of Figure 3.) Opening up these schedules for use in operations through an even more elaborate rule set or a wider selection of fatigue countermeasures is possible in principle based on science and data (Gurubhagavatula et al., 2021), but to codify this generically across the wide variety of part 135 operations would result in an unacceptable level

of regulatory complexity. However, doing so in a more limited fashion, specific for any given operation, is feasible; this provides a basis for the Level 2 AMP option proposed in section 6.3.

The relatively simple, more restrictive no-AMP approach and the more elaborate, less restrictive AMP-based approach combine to form a tiered approach to regulations, thereby fulfilling one of the criteria laid out in the ARC's charter.

4.5.2. Regulatory and practical implementation

The prescriptive rule sets described in section 7 and the AMP requirements described in section 6 can be implemented in regulatory language and operational practice in various different ways. The most straightforward is in the form of a set of separate provisions that are either met or not met – regulatory compliance is achieved when the applicable provisions are all met. This is the way the proposed rules are described in this report, taking the form of tables for the duty and rest requirements and (check)lists for the AMP requirements. The intent of the ARC was to recommend a process whereby, with proper recordkeeping, compliance should be readily verifiable and enforceable, whether by flightcrew members, operators, or regulators, or through the use of computer software.

One alternative implementation that was proposed involves a point-based scoring system, rather than a strictly rule-based system, to capture and prevent the occurrence of excessive fatigue. Biomathematical models of fatigue, which compute expected fatigue levels based on a given duty and rest (or wake and sleep) schedule, represent a science-based variation of this idea. Biomathematical models of fatigue capture the non-linear relationships between duty and rest on the one hand, and fatigue on the other hand, through mathematical equations reflecting the known science of fatigue (Hursh et al., 2016). In principle, these equations could be mimicked through a point-based scoring system, but to work reliably, such a system would need to be so fine-grained as to be nearly unworkable (or more effectively done with a biomathematical model). That complication aside, a primary difference between a rule-based system and a point-based scoring system to manage fatigue lies in the approach to information gathering. An efficient implementation of a rule-based system would call for just enough information (e.g., planned duty length, prior rest duration) to make a determination on the applicable rules, until either one encounters a rule that is not met (meaning non-compliance) or all applicable rules are met (meaning compliance). A point-based scoring system, by design, would require information on each of the items being scored, which would have to form a sufficiently rich data set to cover the diversity of part 135 operations. The sum (or some other algebraic function) of the scores obtained would then be compared to a predefined threshold that should differentiate scenarios with acceptable risk from scenarios with excessive risk, similar to the illustration in the bottom panel of Figure 3. This process could potentially be reduced to a single decision point for determining regulatory compliance for a given schedule, which curbs complexity on that end.

A point-based scoring system could also be implemented to constitute a performance-based regulatory approach to managing fatigue (Honn et al., 2019), rather than a prescriptive regulatory approach like that considered in this report. In a performance-based regulatory

approach, compliance is not judged based on whether *duty* and *rest* meet certain criteria deemed to be associated with acceptable risk, but rather whether *fatigue* as an outcome stays below a certain threshold deemed to represent acceptable risk. It is important to note that in this context, fatigue would have to be measured objectively and not just by self-report, as subjective fatigue assessments based on self-report cannot be relied upon to accurately reflect objective fatigue (Van Dongen et al., 2003; Honn et al., 2016; Sparrow et al., 2016). Yet, in operational settings where there is evidence that, at least in principle, objective fatigue could be measured relatively easily and reliably, such as commercial motor vehicle driving (Sparrow et al., 2019), a performance-based regulatory approach to managing fatigue could be effective. A key obstacle to implementation is the problem that, strictly speaking, regulatory compliance can be verified only retrospectively or in the moment – that is, based on measurements obtained during actual operations. This issue can be overcome with the use of biomathematical modeling of fatigue, which may be used to make prospective assessments of the expectation of performance-based regulatory compliance of schedules yet to be executed, to subsequently be verified retrospectively with actual measurements obtained during operations. It should be noted that no modes of transportation in the United States are currently regulated on such a basis. While promising conceptually, a performance-based regulatory approach would be considerably more complex than the rule-based approach proposed in this report.

5. ARC Recommendations for Definitions

5.1. Rationale for Proposed Definition Changes

For the purpose of the recommendations provided in sections 5 through 8 of this report, this section describes definitions used in the current part 135 regulations or in 14 CFR parts 91, 117, or 121 that need to be clarified, updated, or changed.

Notably, in line with the typical duties of flightcrew members in part 135 operations, the definition of *duty* is such that it includes pre- and post-flight duties and other tasks performed as required or directed by the certificate holder, and no reference is made to *flight duty period* (FDP) as defined in 14 CFR part 117.

As part of the definition review process, the ARC looked at the differences between an FDP and the duty period definitions as set forth in part 117. During that review, the ARC members acknowledged the diverse duties that flightcrew members are tasked with in part 135 operations that are not necessarily present in part 121 operations. These additional duties (see section 4.1) comprise a significant portion of the time and attention of a part 135 flightcrew member and are not accurately represented within an FDP.

Because of the critical nature of the additional duties imposed on a part 135 flightcrew member, the ARC determined that a duty period limit would provide for the best fatigue mitigation and management, and more accurately reflects the nature of part 135 operations. Duty limits (rather than FDP limits) would be an appropriate and more accurate mechanism to limit the available duty period for a flightcrew member, and for this reason the ARC intentionally chose to recommend duty time as a limiting factor for a flightcrew member, and not a FDP. This decision was critical to the subsequent discussions pertaining to (and provided the foundation for) the duty limits contained in all tables in the proposed recommendations (see section 7).

Further, the ARC recommends introducing the term *Reference Time Zone* to help regulate duties that cross multiple time zones. Because flightcrew members in part 135 operations do not necessarily have an assigned home base or other anchor point that would unambiguously specify the time zone to which they are adjusted, provisions specified in part 117 such as acclimated time zone for the regulation of duties that cross multiple time zones need modification to be applicable. The definition for Reference Time Zone provided here is functionally similar to that of acclimated time zone in part 117 without requiring an assigned base and without dependence on specifics of the part 117 rest provision. The ARC concluded that 56 hours in a new theater was sufficient to establish a new Reference Time Zone, rather than 72 hours as specified in part 117, because 56 hours would encompass two Physiological Nights' Rest plus an allowance for time zone changes. Importantly, the Reference Time Zone determines the timing of physiological night's rest and WOCL and thereby the applicability of rest and duty limitations proposed in section 7 of this report.

5.2. Recommended Definitions

The ARC recommends that the following definitions be adopted for part 135.

Alertness Management Program (AMP): A program further described in section 6 of this report, and acceptable to the administrator, wherein a certificate holder puts forth key elements (policies and procedures) addressing and mitigating specific operational risks in order to follow provisions contained in sections 7 and 8 of this Recommendation while providing an equivalent level of safety against fatigue-related accidents or incidents.

Augmented Flightcrew: Additional, qualified flightcrew members, in excess of pilot-in-command and second-in-command, assigned to the same duty period to operate the aircraft to allow a flightcrew member to be replaced to have in-flight rest.

Calendar Day: Any 24-hour period from 0000 through 2359 using Coordinated Universal Time or local time.

Certificate Holder: A person who holds or is required to hold an air carrier certificate or operating certificate issued under part 119.

Deadhead Transportation: Transportation of a flightcrew member as a passenger or non-operating flightcrew, by any mode of transportation, as required by the certificate holder, excluding Transportation Local in Nature. All time spent in Deadhead Transportation is considered duty and is not rest.

Duty: Any task that a flightcrew member performs as required or directed by the certificate holder, including, but not limited to, a duty with flight duty (including pre- and post-flight duties), administrative work, training, Deadhead Transportation, Logistical Ferry Flight, aircraft positioning on the ground, aircraft loading, and aircraft servicing.

Fatigue: A physiological state of reduced mental or physical performance capability resulting from lack of sleep, increased physical activity, or circadian misalignment that can reduce a flightcrew member's alertness and the ability to safely operate an aircraft and perform safety-related duties.

Fit for Duty: Physiologically and mentally prepared and capable of performing assigned duties at the highest degree of safety.

Flight Duty: A period that begins with the Report Time when a flightcrew member is required to report for duty – with the intention of conducting a flight, series of flights, in-aircraft training flights, logistical ferry flights, positioning flight, or maintenance, or being available to conduct a flight – and ends at the release time. A flight duty includes the duties performed by the

flightcrew member on behalf of the certificate holder that occur before or between flight segments without a required intervening rest period.

Flightcrew Member: A pilot properly trained, certificated, and qualified in accordance with a specific certificate holder's approved training program, and the general requirements of part 135, to conduct operations assigned by that certificate holder.

Home Base: The location designated by a certificate holder where a flightcrew member normally begins and ends his or her duty periods. Designation of a home base is optional and not a requirement.

Logistical Ferry Flight: Any flight segment under the operational control of a certificate holder without carrying passengers or cargo for remuneration or hire (including training flights in aircraft and/or maintenance test/check flights).

Physiological Night: The time period that encompasses 0100 to 0700 in a flightcrew member's Reference Time Zone.

Physiological Night's Rest: A period consisting of a minimum of 10 consecutive hours of rest that encompasses the hours of 0100 and 0700 in the flightcrew member's Reference Time Zone.

Reference Time Zone: A flightcrew member's local time zone when starting any new duty:

a) Within a theater, after at least 36 consecutive hours free of duty has elapsed;
b) After entering a new theater, if 36 consecutive hours free of duty occurs in the new theater; or at least 56 hours has elapsed since ending the first duty in the theater unless returning to the original theater within 56 hours.

Note that this definition under b) does not require that the flightcrew member be in a single time zone for 56 hours.

Release Time: The time that the certificate holder releases a flightcrew member to begin a rest period.

Report Time: Constitutes a) the end of a rest period and b) the prospectively assigned time that the certificate holder requires a flightcrew member to report for duty.

Rest Facility: A bunk or seat accommodation installed in an aircraft that provides a flightcrew member with a sleep opportunity.

1) *Class 1 rest facility*: A bunk or other surface that allows for a flat sleeping position and is separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the flightcrew member to control light, and provides isolation from noise and disturbance.
2) *Class 2 rest facility*: A seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and

some sound mitigation; and is reasonably free from disturbance by passengers or flightcrew members.

3) *Class 3 rest facility*: A seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.

Rest Period: Continuous time interval that (a) precedes a duty (and any required post-duty rest), which is prospectively determined, or (b) follows a duty – assigned by the certificate holder – during which the flightcrew member is entirely free from restraint by the certificate holder, including freedom from present responsibility for work should the occasion arise.

Suitable Accommodation: A temperature-controlled facility with sound mitigation and the ability to control light that provides a flightcrew member with sleep opportunity either in a bed, a bunk, or a chair that allows for flat or near flat sleeping positions. Suitable accommodation applies only to ground facilities and does not apply to a rest facility.

Theater: A geographical area in which the distance between the flightcrew member's Reference Time Zone at the departure point and arrival point differs by no more than 60 degrees longitude.

Transportation Local In Nature: Transportation between a flightcrew member's residence and respective home base as well as transportation between an intermediate layover location and a suitable accommodation, excluding Deadhead Transportation.

Unforeseen Operational Circumstance: An unplanned event of insufficient duration to allow for adjustments to schedules, including unforecast weather, equipment malfunction, or air traffic delay, that is not reasonably expected.

Window of Circadian Low (WOCL): A period of high sleepiness that occurs between 0200 and 0559 during a Physiological Night.

WOCL Duty: A duty period that infringes upon any portion of, or encompasses in it entirety, the period from 0200 to 0559 in a flightcrew member's Reference Time Zone.

6. ARC Recommendation for Alertness Management Program Concept

The ARC recommends that the FAA adopt the concept of an Alertness Management Program (AMP) as part of revised part 135 regulations. As elaborated in Section 4.5 and Figure 3, the use of an AMP provides a central component of the recommended regulatory approach detailed in section 7. For the AMP to be an effective tool for promoting alertness and protecting against fatigue, it must be comprehensive and enforceable. It is recommended that the FAA develop an Advisory Circular (AC) defining the requirements for a part 135 AMP.

Overall, the purpose of the AMP is to promote flightcrew member alertness by providing fatigue monitoring and fatigue mitigations, which allows an operator to increase duty times and/or reduce rest times relative to operations without an AMP. The complexity of the AMP and the mitigations included will depend on the type of operation, as specified in the limitations contained in the tables for different kinds of operation (see section 7). A Level 1 AMP defines approved flight, duty, and rest limits for specific kinds of operations (defined in the tables of section 7), provided the operation is conducted under an accepted AMP that also defines the necessary fatigue mitigations.

An AMP should be accepted by a principal operations inspector if an operator meets the requirements set forth in the above-mentioned AC. The guidance in the AC should be scalable such that a single pilot operator holding OpSpec A040 authorization could still realize the safety benefits of an AMP. Despite not being required to have manuals, these single pilot operators are intended to be able to develop an AMP and have it accepted by the FAA.

A Level 2 AMP defines a customized set of flight, duty, and rest limits accompanied by an expanded AMP that defines the mitigations necessary for that operation. Level 2 AMPs are described below and would require approval at the FAA headquarters level.

The specific sections of an AMP are similar to those defined in FAA Information for Operators (InFO) 10017SUP. Appendix B contains details of the recommended components of an AMP combined with the flight and duty limits exercised by the operation. The following sections are the minimum required elements of an AMP (see Appendix B):

1. Senior Level Management Commitment to Reducing Fatigue and Improving Flightcrew Member Alertness
2. AMP Scope and Applicable Fatigue Management Policies and Procedures
3. Fatigue Risk Management and Mitigation
4. Safety Assurance and Fatigue Reporting Policy
5. Fatigue Incident Reporting Process
6. System for Monitoring Flightcrew Member Fatigue
7. The Organization’s AMP Evaluation Program
8. Fatigue Education and Awareness Training Program

9. Prescriptive Flight Time and Duty Period Limitations and Mitigations

6.1. Operations without an Alertness Management Program

The ARC recommends that a set of duty, flight, and rest limits be made available for operations that do not have or need an AMP. Those limits are deliberately more restrictive to avoid the potential for unmitigated fatigue but are sufficient for many operations that limit most operations to hours of the day that do not infringe on or encompass the WOCL. This tier of regulations is designed to reduce complexity and cost for many operations that can fit within that simple framework. See section 7.1.

6.2. Operations with a Level 1 AMP within Prescriptive Limits

It is recommended that the FAA develop an AC defining the requirements for a part 135 AMP. Overall, the purpose of the AMP is to promote flightcrew member alertness by providing a set of fatigue monitoring and fatigue mitigations that allow an operator to increase duty times and reduce rest times relative to operations without an AMP. The complexity of the AMP and the mitigations included will depend on the type of operation, as specified in the limitations contained in the tables for different kinds of operation.

Level 1 AMP operations are conducted in conjunction with defined flight, duty, and rest limits for specific kinds of operations (described in the tables), provided the operation is conducted under an accepted AMP that also defines the necessary fatigue mitigations. The level of acceptance would be the principal operations inspector based on the requirements set forth in the AC. A detailed description of the required elements of a Level 1 AMP can be found in Appendix B.

6.3. Operations with a Level 2 AMP with Customized Limits

A Level 2 AMP defines a customized set of flight, duty, and rest limits accompanied by an expanded AMP that defines the mitigations necessary for that operation. A Level 2 AMP is required to exceed any of the table limits for Level 1 AMPs as described in sections 7.2 through 7.6. The ARC recommends that the FAA issue an AC to define the Level 2 AMP application and approval process using a standardized format.

The purpose of a Level 2 AMP is to extend the applicability of the proposed rules to as many cases as possible, without excessively complicating the limitations specified for Level 1 AMP operations or requiring an extensive exemption and validation process such as that currently used to obtain an approved Fatigue Risk Management System under part 117. The reason to avoid such an approach is that part 135 operations, by their nature, encounter exceptional

operational conditions very infrequently, which limits the ability to conduct a statistically valid study to validate an equivalent level of safety.

Instead, it is envisioned that a Level 2 AMP would require the following elements, in addition to the standard AMP elements:

- Prior operational experience with verifiable safety indicators, fatigue modeling, and/or prior studies that demonstrate that the proposed duty pattern is safe.
- Additional mitigations to offset additional flight and/or duty time or reduced rest.
- Provisions to address protection of sleep during physiological nights' rest and prevention of cumulative fatigue and excessive workload.
- Periodic and ongoing fatigue risk assessment and fatigue monitoring to ensure that the mitigations support alertness.

Structured appropriately, and coupled with an effective feedback mechanism, ongoing fatigue monitoring can substitute for a scientific study to establish safety equivalence to operations conducted within the approved limits. Elevated fatigue indicators under the increased limits relative to operations within the original limits would be reported and mitigated through alteration of the Level 2 AMP duty limits to return fatigue to acceptable levels.

Due to the critical nature and potential ramifications of a certificate holder seeking a deviation from the prescriptive limits contained within this recommendation, the ARC believes that a higher level of approval is required for a Level 2 AMP. The ARC recommends that a Level 2 AMP would require approval at the FAA headquarters level and would be operator-specific.

7. ARC Recommendations for Duty, Flight, and Rest Requirements

Based on its review of the part 135 industry, the current part 135 regulations and other regulatory frameworks, the science of fatigue, and the core principles embraced by the ARC with unanimous consensus (see section 4), the ARC recommends that the FAA adopts revised duty, flight, and rest requirements for part 135.

In this section, the ARC details recommendations regarding maximum duty and flight times and minimum rest (prior to and after duties, as appropriate) categorized by type of operation in subsections, limits on transitioning between kinds of operation (prerequisites), applicable mitigations associated with each kind of operation, and allowable duty and flight time extensions. The recommended maximum duty and flight times and minimum rest requirements are divided into two parts: Operations without an AMP, and Operations with an AMP (see section 6). Each subsection below begins with a list of core principles relevant to that subsection (by reference to the master list in section 4.4). Following the core principles is a narrative justification for the recommended limits and a discussion of any recommendations with alternative points of view. Finally, each subsection concludes with a table that summarizes the recommended limits and mitigations. The tables are to be used based on a flightcrew member's Reference Time Zone.

Although the ARC did not specifically define separate duty and flight time limits or rest requirements for scheduled versus unscheduled operations, the ARC recommends retaining the following cumulative flight time limits as a useful mechanism to minimize the cumulative effects of flight time workload:

- Previous cumulative *scheduled* flight time limits under § 135.267 remain applicable:
    - 34 hours/7 consecutive days
    - 120 hours/calendar month
    - 1,200 hours/calendar year
    - Each certificate holder shall relieve each flightcrew member engaged in scheduled air transportation from all further duty for at least 24 consecutive hours during any 7 consecutive days.

- Previous cumulative *unscheduled* flight time limits under § 135.267 remain applicable:
    - 500 hours/calendar quarter
    - 800 hours/2 consecutive calendar quarters
    - 1,400 hours/calendar year
    - The certificate holder must provide each flightcrew member at least 13 rest periods of at least 24 consecutive hours in each calendar quarter.

7.1. Operations without an AMP

Applicable core principles from section 4.4: A–E, G, I, K, M–O, R, S.

For part 135 operations without an AMP, consistent with the part 135 ARC charter, a distinction was made between *non-WOCL operations* and *WOCL operations* because they involve different levels of physiological alertness, and WOCL operations interfere with the prime opportunity for sleep. As a result, WOCL duties imply that the prior and subsequent sleep will occur at a less-than-ideal time for sleep, but this is not a problem expected for non-WOCL operations. Based on this, the duty period (which includes preparation for flight and activities after flight) during the non-WOCL day is permitted to be as long as 14 hours because it leaves 10 hours available for an 8-hour sleep opportunity at night, considering the time necessary to transition to and from a sleep environment. The prior rest period, therefore, can be as short as 10 hours if it includes the time for optimal sleep provided by a physiological night's rest, or 12 hours if it does not totally include a physiological night's rest.

Given the many activities that must occur during duty in addition to flight, flight time is necessarily less than the permitted duty time. For two pilots, the workload of 10 hours of flight time is considered the maximum allowable outside the WOCL. For only one pilot, the workload of 8 hours of flight time is considered the maximum allowable outside the WOCL. Both limits are identical to current part 135 limits. Duties that infringe on or encompass the WOCL may or may not include flight time that infringes on or encompasses the WOCL. When operating into the WOCL when alertness is impaired, flight time is reduced to 8 hours for two pilots and is reduced to 7 hours for one pilot when flight time infringes on or encompasses the WOCL, and 8 hours when it does not.

It is recognized that successive duties that infringe on or encompass the WOCL create the potential for cumulative sleep debt. Since those impacts are not managed here with an AMP, consecutive WOCL duties are not permitted and WOCL duties are limited to three in any 168-hour period. The requirement for a physiological night's rest prior to any WOCL duty ensures that such duties cannot be performed consecutively and it ensures an optimal opportunity for sleep prior to WOCL duties.

The pre-duty rest requirement is increased from 10 hours to 12 hours when it does not include the optimal time for sleep, i.e., a physiological night's rest. The ARC recognizes that the proposed rest and duty limits do not always sum to a 24-hour day. That was done deliberately to allow flexibility and to accommodate the diversity of the part 135 industry. In particular, consecutive non-WOCL duties that start between 0600 and 0700 would, in practice, be limited to 12 hours of duty.

In the absence of an AMP to manage flightcrew member fatigue, no duty extensions are permitted prior to takeoff. Similarly, duties must remain within a single theater without an AMP to manage the fatigue induced by time zone changes.

The recommended limits for operations without an AMP are summarized in Table 2.

Table 2. Flight operations without an AMP.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14	8	12 10, if physiological night's rest included
Two Pilots	14	10	
WOCL Duty – one pilot	10	7 hours if flight period infringes on or encompasses the WOCL; otherwise, 8 hours	• A physiological night's rest in prior 24 hours • No more than three such periods in a 168-hour period
WOCL Duty – two pilots	10	9	
Pre-takeoff flight time extension not allowed. Duty time extension: no extension prior to takeoff. No operations permitted that include duties operating into more than one theater.			

7.2. Operations with a Level 1 AMP That Do Not Infringe on the WOCL

Applicable core principles from section 4.4: A, D, F–H, K, M, N, P–R.

7.2.1. Non-WOCL duties without sleep opportunities

For operations with a Level 1 AMP, a distinction was made between *non-WOCL operations WOCL operations* because they involve different levels of physiological alertness and WOCL operations interfere with the prime opportunity for sleep. For non-WOCL duties, the prior and subsequent sleep are expected to occur at a more ideal time for sleep. Based on this, the duty period during the day is permitted to be as long as 14 hours because it leaves 10 hours available for an 8-hour sleep opportunity at night, considering the time necessary to transition to and from a sleep environment. While this provision does not guarantee a full physiological night's rest prior to such duties, it does provide for rest during the WOCL, and the AMP will provide additional protections to mitigate fatigue.

Given the many activities that must occur during duty in addition to flight, flight time is necessarily less than the permitted duty time. For two pilots, the workload of 10 hours of flight time is considered the maximum allowable outside the WOCL. For only one pilot, the workload of 8 hours of flight time is considered the maximum allowable outside the WOCL. Both limits are identical to current part 135 limits. While the duty and flight time limits are identical to operations without an AMP, the provision of an AMP permits the use of pre-takeoff duty extensions for unforeseen circumstances and to operate into multiple theaters.

The recommended limits for non-WOCL duties without sleep opportunities, with an AMP, are summarized in Table 3.

Table 3. Flight operations with a Level 1 AMP that do not infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14	8	10
Two Pilots	14	10	
Pre-requisites for using these provisions: An AMP.			
Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 2 hours of duty for two-pilot operations; limited to 1 hour of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.2.2. Non-WOCL duties with sleep opportunities during duty

Sleep opportunities during duty can be beneficial to offset fatigue. However, the benefits of naps during the day are less than they are at night. Hence, there are two alternative views on the benefits of naps during non-WOCL duties. *One point of view* is that such naps in a suitable accommodation may benefit flightcrew members due to the secondary WOCL and should provide for some increase of maximum duty time, at a ratio of 30 minutes for each hour of sleep. *Another point of view* is that day sleep is difficult to guarantee and obtain, and the provision of such sleep opportunities should not be counted on to justify an increase of the duty limits. In accordance with the first point of view, Table 4 describes how the provision of a day duty with a sleep opportunity would allow for additional duty time. In accordance with the second point of view, Table 4 would be redundant and would not be included.

Table 4. Flight operations with a Level 1 AMP that have sleep opportunities during duty and do not infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14 or 16*	8	10
Two Pilots	14 or 16*	10	
Pre-requisites for using these provisions: • An AMP • A physiological night's rest prior to any such duties.			
*Maximum duty period: *One point of view* is to allow an increase by 0.5 hours for each hour in a suitable accommodation, up to a limit of 16 hours. *Another point of view* is to not allow an increase and to limit the duty period to 14 hours. Mitigations: • Minimum of 2 consecutive hours of sleep opportunity in a suitable accommodation during duty, measured from the time the flightcrew member reaches the suitable accommodation, starting no sooner than 2 hours after start of duty • Up to 5 long -day duties with rest mitigation allowed in 168 hours • One physiological night's rest prior • One physiological night's rest after Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension permitted up to 2 hours of duty for two-pilot operations, limited to 1 hour of duty for one-pilot operations. • In view of the potential for sleep opportunities to increase such duties to 16 hours, pre-takeoff extensions are limited to an additional 30 minutes beyond 16 hours or a maximum duty duration with extension of 16.5 hours. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.3. Operations with a Level 1 AMP That Infringe on or Encompass the WOCL

Applicable core principles from section 4.4: A–G, I–K, M, N, P–S.

7.3.1. WOCL duties without sleep opportunities

Consistent with the part 135 ARC charter, a distinction was made between *non-WOCL operations* and *WOCL operations* because they involve different levels of physiological alertness, and WOCL operations interfere with the prime opportunity for sleep. As a result, WOCL duties imply that the prior and subsequent sleep will occur at a less-than-ideal time for sleep. In line with the limitations set forth in section 7.1, therefore, WOCL duties are limited to 10 hours. Furthermore, since duties that infringe on or encompass the WOCL dictate that the prior sleep is during less optimal times or the prior wakefulness since WOCL sleep is long, the rest period is required to be 12 hours.

Given the many activities that must occur during duty in addition to flight, flight time is necessarily less than the permitted duty time. Duties that infringe on or encompass the WOCL may or may not include flight time that infringes on or encompasses the WOCL. When operating into the WOCL (when alertness is impaired), flight time is reduced to 9 hours for two pilots. For one pilot, flight time is reduced to 7 hours when it infringes on or encompasses the WOCL, and 8 hours when it does not. It is acknowledged that the flight time of 9 hours for two pilots is only 1 hour less than maximum duty time. This is possible when the AMP specifies mechanisms to mitigate fatigue to permit this additional flight time compared to operations without an AMP. While the duty and flight time limits are not greatly different from operations without an AMP, the provision of an AMP permits up to three consecutive WOCL duties, use of pre-takeoff duty extensions for unforeseen circumstances and operation across multiple theaters.

It is recognized by the ARC that transitions from a non-WOCL duty to a WOCL duty have the potential to create excessive fatigue because they can place the time for pre-duty rest in a less-than-ideal circadian time. The ARC agreed that additional rest is required prior to transitioning to a series of WOCL duties to minimize this impact. There are two alternative views on the length of additional required rest prior to entering the WOCL duty table (Table 5). *One point of view* is that 14 hours of prior rest is sufficient because, depending on the starting time of the WOCL duty, it should provide an opportunity for either nighttime sleep in the primary WOCL or an afternoon nap during the afternoon secondary WOCL. *Another point of view* is that it is also important to minimize the chances of a day duty immediately prior to the WOCL duty; 16 hours of prior rest more effective in limiting that possibility and also increases the opportunity for sleep during one of the optimal times for sleep.

The reduced alertness during WOCL duties dictates a reduction in the allowable pre-takeoff duty extensions compared to non-WOCL duties because the extended duty is likely to occur during a period of maximal fatigue.

The recommended limits for WOCL duties with an AMP are summarized in Table 5.

Table 5. Flight operations with a Level 1 AMP that infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	10	7 hours if flight period infringes on or encompasses the WOCL; otherwise, 8 hours	12
Two Pilots	10	9	
Pre-requisite for using these provisions: An AMP. Pre-requisite for using these provisions when transitioning from a non-WOCL duty: *One point of view* is 14 hours of rest. *Another point of view* is 16 hours of rest.			
Limit of three consecutive such duties. Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 1 hour of duty for two-pilot operations; limited to 30 minutes of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.3.2. WOCL duties with sleep opportunities

For duties that infringe on or encompass the WOCL, any scheduled sleep opportunity is likely to be recuperative. Therefore, provided the scheduled sleep opportunity is received, the maximum duty time can be increased based on the amount of that sleep opportunity in a suitable accommodation. With a minimum of 2 consecutive hours of sleep opportunity (measured from the time the flightcrew member reaches the suitable accommodation) scheduled and provided to the flightcrew member, the increase is 1 hour for each hour of sleep opportunity because the opportunity is occurring at an optimal time of day for sleep.

There were two points of view on how much additional duty should be allowed. *One point of view* recognizes the risk that sleep may not occur during the scheduled sleep opportunity. In addition, it is likely that WOCL duties will come after daytime sleep; therefore, a flightcrew member may have sleep debt at the start of the duty such that the additional sleep does not yield the same level of alertness as during a non-WOCL duty. Hence, the maximum allowable duty with sleep opportunity should be 12 hours. *Another point of view* holds that since the sleep is at an optimal time, a maximum duty duration should be allowed up to the duty limit for a non-WOCL duty of 14 hours, as this would incentivize operators to provide mid-duty sleep opportunities. These recommended limits are summarized in Table 6.

Table 6. Flight operations with a Level 1 AMP that have sleep opportunities during duty and infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	10 up to 12 or 10 up to 14*	7 hours if flight period infringes on or encompasses the WOCL; otherwise, 8 hours	12
Two Pilots	10 up to 12 or 10 up to 14*	9	
Pre-requisite for using these provisions: An AMP. *Pre-requisite for using these provisions when transitioning from a non-WOCL duty: *One point of view* is 14 hours of rest. *Another point of view* is 16 hours of rest.			
• Minimum mid-duty sleep opportunity of 2 hours, measured from the time the flightcrew member reaches the suitable accommodation. • Additional duty based on mid-duty sleep opportunity: *One point of view* is to allow the maximum duty time to be increased by 1 hour for each hour in a suitable accommodation (measured from the time the flightcrew member reaches the suitable accommodation), up to a maximum of 12 hours. *Another point of view* is to allow the maximum duty time to be increased by 1 hour for each hour in a suitable accommodation (measured from the time the flightcrew member reaches the suitable accommodation), up to a maximum of 14 hours. • Limit of five consecutive such duties in any 168-hour period provided at least two of the first three WOCL duties have minimum 2-hour sleep opportunities and at least three of the five WOCL duties overall have minimum 2-hour sleep opportunities. • The scheduled sleep opportunity should commence no sooner that the first two hours of the start of the duty and be scheduled between 2000 and 0400. • The scheduled sleep opportunity must be received. If the scheduled sleep opportunity is not received, the duty and rest limitations for WOCL duties revert to those provided in section 7.3.1. Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 2 hours of duty for two-pilot operations; limited to 1 hour of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.3.3. Long WOCL duties without sleep opportunities

The ARC recognized the diversity of potential WOCL duties and that some situations require a long duty duration, but this does not have to be done repeatedly. In order to limit exposure to unmitigated WOCL duties and to limit cumulative fatigue that results from consecutive

unmitigated WOCL exposures, the ARC agreed on the possibility of an operator with an AMP to conduct a single WOCL duty up to 14 hours, provided it is mitigated by a prior minimum 12-hour rest opportunity that includes a physiological night's rest and by a recuperative rest following that includes a physiological night's rest.

The recommended limits for long WOCL duties without sleep opportunities are summarized in Table 7.

Table 7. Long flight operations with an AMP that infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14	7 hours if flight period infringes on or encompasses the WOCL; otherwise, 8 hours	12 hours including a physiological night's rest, or 16 hours if not physiological night's rest
Two Pilots	14	10	
Pre-requisite for using these provisions: An AMP. Pre-requisite for using these provisions when transitioning from a non-WOCL duty: *One point of view* is 14 hours of rest. *Another point of view* is 16 hours of rest.			
Immediately following the duty, must provide the opportunity for a physiological night's rest. *One point of view* is to limit to two such duties in 168 hours. *Another point of view* is that no limit is required given the other mitigations provided. Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 1 hour of duty for two-pilot operations; limited to 30 minutes of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.4. Operations with an AMP that include Early Starts between 0500 and 0600

Applicable core principles from section 4.4: A–K, M, N, P–S.

7.4.1. Early duties without sleep opportunities

Consistent with the part 135 ARC charter, a distinction was made between *non-WOCL operations* and *WOCL operations* because they involve different levels of physiological alertness, and WOCL operations interfere with the prime opportunity for sleep. As a result, WOCL duties imply that the prior and subsequent sleep will occur at a less-than-ideal time for sleep. While it is

recognized that it is important to protect sleep opportunities (or rest) as the primary mitigation for fatigue, duties that start between 0500 and 0600 are a special case because the duty only partly infringes on the WOCL and impairs the opportunity to obtain sleep. In addition, if repetitions of such duties are arranged to be consistent in start time, it is possible for a person to temporarily, at least, start sleep earlier by several hours to compensate. Under these circumstances, a maximum duty time of 12 hours is proposed. This is more than that the maximum duty time for a WOCL duty without a sleep opportunity and less than that allowed for a non-WOCL duty.

This additional allowable duty time that partially interferes with WOCL sleep opportunities must be accompanied by important mitigations. To allow for adjustment of sleep timing, any series of duties that include any starts between 0500 and 0600 must all be within a 3-hour window, but no earlier than 0500, to ensure regular start times. In addition, to minimize cumulative sleep debt prior to such duties, additional rest is required prior to a series of duties that include early starts between 0500 and 0600. *One point of view* is that 12 hours prior rest is required. *Another point of view* is that 14 hours prior rest is required.

Finally, there must be a limit on the number of duties in this table. *One point of view* is that the opportunities for recuperative rest for early starts must be more frequent to combat cumulative fatigue. This view recommends that in any 168-hour period, the number of such duties should be limited to five. Within any 168-hour period that includes four or five such duties, a minimum of two physiological night's rest is required. *Another point of view* is that there are currently many operations that follow this pattern for 7 to 14 days consecutively, followed by 7 to 14 days of off-duty time. Hence, this view recommends a limit such that in any 384 hours, there must be a minimum of two 24-hour periods free of duty. This provision would effectively set a limit of 14 consecutive early starts followed by 2 days of rest, while not precluding a sequence of seven consecutive early starts followed by one 24-hour period free of duty.

Like other WOCL duties that dictate that the prior sleep is during less optimal times, the rest period is required to be 12 hours. Also, given the many activities that must occur during duty in addition to flight, flight time is necessarily less than the permitted duty time. Early duties that infringe on the last hour of the WOCL are not likely to include flight time that infringes on the WOCL. Therefore, the allowable flight time is identical to that for non-WOCL duties. And since such duties do not include flight time in the WOCL, the allowable duty extensions are identical to those for non-WOCL duties.

The recommended limits for early duties without sleep opportunities are summarized in Table 8.

Table 8. Early flight operations with an AMP.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	12	8	12
Two Pilots	12	10	
Pre-requisite for using these provisions: An AMP. Pre-requisites for using these provisions when transitioning from a non-WOCL duty: *One point of view* is 12 hours rest. *Another point of view* is 14 hours rest prior to a series of duties that include early starts between 0500 and 0600.			
Any series of duties that include any starts between 0500 and 0600 must all be within a 3-hour window, but no earlier 0500, to ensure regular start times. Limitation according to *one point of view*: Maximum of five duty starts under this table in 168 hours, with two physiological night's rest after five consecutive such duties. Limitation according to *another point of view*: 48 hours free of duty in 384 hours. Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 2 hours of duty for two-pilot operations; limited to 1 hour of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff duty extension per 168 hours. Operating in multiple theaters permitted.			

7.4.2. Early duties with sleep opportunities

Sleep opportunities during duty can be beneficial to offset fatigue; however, the benefits of naps during the day are less than they are at night. Hence, there are two alternative views on the benefits of naps during non-WOCL duties. *One point of view* is that such naps in a suitable accommodation should provide for some increase of maximum duty time, in a ratio of 30 minutes for each hour of sleep. *Another point of view* is that day sleep is difficult to guarantee and to obtain, and the provision of such sleep opportunities should not be counted on to justify an increase in the maximum duty time. In accordance with the first point of view, the following table describes how the provision of day duties would allow for additional duty time. In accordance with the second point of view, Table 9 would be redundant and would not be included.

To minimize cumulative sleep debt prior to such duties, additional rest is required prior to a series of duties that include early starts between 0500 and 0600. *One point of view* is that 12 hours prior rest is required. *Another point of view* is that 14 hours prior rest is required.

The recommended limits for early duties with sleep opportunities are summarized in Table 9.

Table 9. Early flight operations with an AMP and sleep opportunities during duty.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	12 to 14*	8	12
Two Pilots	12 to 14*	10	
Pre-requisite for using these provisions: An AMP. Pre-requisites for using these provisions when transitioning from a non-WOCL duty: *One point of view* is 12 hours rest. *Another point of view* is 14 hours rest prior to a series of duties that include early starts between 0500 and 0600.			
*Maximum duty period: O*ne point of view* is to allow an increase by 0.5 hours for each hour in a suitable accommodation, measured from the time the flightcrew member reaches the suitable accommodation, up to a limit of 14 hours. *Another point of view* is to not allow an increase and limit the duty period to 12 hours. Any series of duties that include any starts between 0500 and 0600 must all be within a 3-hour window, but no earlier than 0500 to ensure regular start times. Limitation according to *one point of view*: Maximum of five early starts in 168 hours, with two physiological night's rest after five consecutive early starts. Limitation according to *another point of view*: 48 hours free of duty in 384 hours. Mitigations: • Minimum of 2 consecutive hours of rest during duty in a suitable accommodation, measured from the time the flightcrew member reaches the suitable accommodation. Flight time extension not allowed in accordance with section 7.7.2. Duty period extensions allowed in accordance with section 7.7.1: • Pre-takeoff duty extension for unforeseen circumstances permitted up to 2 hours of duty for two-pilot operations; limited to 1 hour of duty for one-pilot operations. • Minimum of 24 hours free of duty after any duty extension of 30 minutes or longer for two pilots, and any duty extension for one pilot, must be reported to principal operations inspector. • Limit of one pre-takeoff extension duty per 168 hours. Operating in multiple theaters permitted.			

7.5. Air Medical and Organ Transport Operations with an AMP

Applicable core principles from section 4.4: A–G, I–N, P–S.

The ARC was specifically chartered to give special consideration to air medical operations. Airplane and helicopter air ambulance operations are considered an essential service for the communities for which they serve. The FAA has recognized the need for these 24-hour services and has focused mostly on helicopter air ambulance operations in 14 CFR part 135 subpart L and § 135.271. The ARC recommends revising the § 135.271 rule to include air ambulance operations issued Operations Specifications (OpSpec) A021 and A024 and apply the same duty and flight time and rest limitations as recommended in this section.

The ARC recommends that medical operations that utilize the air medical duty and flight time limits include all air medical transport, including both patient and organ transport, provided such operations are conducted by an operator holding OpSpecs A021 or A024 and operated according to the OpSpec. These operations may include all flights associated with patient and organ transport, performed at the behest of the Certificate Holder. However, flight time extensions are not permitted once the medical transport function is completed, with the exception of § 135.601 helicopter air ambulance operations to allow for repositioning the helicopter away from the medical facility and vacate the landing pad.

In addition, air medical operations will be required to operate with an accepted AMP that will provide an additional layer of fatigue mitigations, similar to the flight risk analysis tools currently used under OpSpec A021 and best practice under OpSpec A024. Here, the provisions for an AMP will be applied to all air medical operations, including fixed wing air medical operations, as well as helicopter medical operations.

The ARC recognizes that organ transport operations and transplant surgical team movements may be performed without OpSpecs A021 or A024. Under this circumstance, such operations would have to comply with the provisions of the non-medical tables in sections 7.1–7.4 and 7.6. However, the ARC does *not* recommend that an air ambulance Operations Specifications (A024) should be required for fixed-wing carriage of human organs or movement of transplant surgical teams. If rulemaking were to be imposed to require OpSpec A024 to carry human organs or transplant surgical teams, there would be fewer than 300 air ambulance carriers with just 1,400 aircraft (Loyd et al., 2020), an 87% reduction in available aircraft compared to the current situation. This would cripple the national organ transplant system and would adversely impact life-saving operations.

7.5.1. Air medical operations with sleep opportunities

Sleep opportunities during duty can be beneficial to offset fatigue. Medical air operations often operate from a fixed base, which provides for a suitable accommodation for sleep either at the flightcrew member's home or at a defined facility. Moreover, the on-call nature of medical operations makes it possible for flightcrew members to make use of those facilities. Table 10

describes how the provision of duties would allow for additional duty time. These duties may or may not infringe on or encompass the WOCL.

Air medical operations perform a life-saving function, and the ARC recognizes the need to balance the levels of acceptable risks associated with these duties and the risks associated with not being able to perform these duties when needed to save lives. Hence, some of the allowable duty limits are greater for medical operations. However, they are coupled with fatigue risk assessments within the AMP to ensure that even with these longer duties, flightcrew members are not performing duties when unfit to perform them safely.

The maximum allowable duty period of 14 hours is the same for WOCL and non-WOCL medical duties. This is because of the availability of sleep opportunities during the duties that would mitigate the differences between WOCL and non-WOCL sleep opportunities and the extra allowable duty time. However, to avoid the cumulative fatigue associated with consecutive WOCL duties, the limits on consecutive WOCL duties is similar to non-medical operations. Furthermore, because of the available sleep opportunities, there is no distinction between WOCL and non-WOCL flight times. The prior rest requirement is similar to non-WOCL duties.

Medical operations often encounter unforeseen circumstances necessitated to respond to medical requirements. Hence, the provisions for duty and flight extensions are greater than allowed for non-medical operations to allow for the completion of medical transport functions. The provision for duty and flight extensions makes no distinction between WOCL and non-WOCL duties because of the availability of sleep opportunities during duties. However, the ARC recognizes that duty and flight time extensions may create additional exposure to the WOCL and/or cumulative fatigue that must be mitigated during the operation with on-duty sleep opportunities and following the duties with a physiological night's rest. Therefore, there is a requirement of a post-duty physiological night's rest after any flight time extension. In addition, if a duty that infringes on or encompasses the WOCL is extended, or if the extension infringes on or encompasses the WOCL, one post-duty physiological night's rest is required, unless a 2-hour continuous on-duty sleep opportunity was provided and received.

Table 10. Air medical operations with an AMP and sleep opportunities during duty.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14	8	10
Two Pilots	14	10	
Pre-requisites for using these provisions: An Air Medical OpSpec (either A021 or A024), pre-flight risk assessments, and an AMP.			
• Access to suitable accommodation. • Up to 2 hours of duty extension and 1 hour of flight time extension for unforeseen circumstances if required to complete an air medical transport, reportable to the principal operations inspector within 10 business days, or quarterly. • One physiological night's rest after three consecutive WOCL exposures without at least one 2-hour sleep opportunity received in the WOCL. • For duties that infringe on or encompass the WOCL, one physiological night's rest after any extended duty time if a 2-hour on-duty sleep opportunity is not available. • One physiological night's rest after any extended flight time. • Pre-flight risk assessment of the flightcrew to be reviewed by a second operational control person, to include fatigue monitoring. • Operating in multiple theaters permitted.			

7.5.2. Air medical non-WOCL duties without sleep opportunities

The minimum prior rest is 12 hours for non-WOCL operations because it would allow the flightcrew member to be fully rested in the event the duty and/or flight time must be extended to complete the medical function, and there is no rest facility available during duty. The ARC recognizes that the maximum duty time and minimum rest do not sum to a 24-hour day. That is because the 14-hour limit is a maximum allowed when needed, but most operations will schedule 12-hour duties with a 12-hour rest to avoid schedule rotation and to provide around-the-clock service.

When on-duty sleep opportunities are not available, duty and flight time extensions are limited to 1 hour. In addition, one physiological night's rest is required after any duty or flight time extension.

The recommended limits for air medical non-WOCL duties without sleep opportunities are summarized in Table 11.

Table 11. Air medical operations with an AMP that have no sleep opportunities and do not infringe on or encompass the WOCL.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	14	8	12
Two Pilots	14	10	
Pre-requisites for using these provisions: an Air Medical OpSpec (either A021 or A024), pre-flight risk assessments, and an AMP.			
• Up to 1 hour of duty and flight time extension for unforeseen circumstances if required to complete an air medical transport, reportable to the principal operations inspector within 10 business days, or quarterly. • One physiological night's rest after any extended duty or flight time. • Pre-flight risk assessment of the flightcrew to be reviewed by a second operational control person, to include fatigue monitoring. • Operating in multiple theaters permitted.			

7.5.3. Air medical WOCL duties without sleep opportunities

The minimum prior rest is 12 hours for WOCL operations because it would allow the flightcrew member to be fully rested in the event the duty and/or flight time must be extended to complete the medical function, and there is no rest facility available during duty. Duty time is reduced from 14 to 12 hours for WOCL duties. To mitigate cumulative fatigue, there is a limit of three consecutive WOCL exposures. Since on-duty sleep opportunities are not available, duty and flight time extensions are limited to 1 hour. In addition, one physiological night's rest is required after any duty or flight time extension.

The recommended limits for air medical WOCL duties without sleep opportunities are summarized in Table 12.

Table 12. Air medical operations with an AMP that infringe on or encompass the WOCL and have no sleep opportunities.

Crew Complement	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (minimum hours)
One Pilot	12	8	12
Two Pilots	12	10	
Pre-requisites for using these provisions: an Air Medical OpSpec (either A021 or A024), pre-flight risk assessments, and an AMP.			
• Up to 1 hour of duty and flight extension for unforeseen circumstances if required to complete an air medical transport, reportable to the principal operations inspector within 10 business days or quarterly. • Limit of three consecutive WOCL exposures. • One physiological night's rest after any extended duty or flight time. • Pre-flight risk assessment of the flightcrew to be reviewed by a second operational control person, to include fatigue monitoring. • Operating in multiple theaters permitted.			

7.6. Augmented Operations with an AMP

Applicable core principles from section 4.4: A–G, I, K, M, N, P–S.

The ARC recognizes that sleep opportunities during duty serves to mitigate fatigue. Therefore, when a flightcrew is augmented with more than the minimum complement and a rest facility is present to allow in-flight sleep, the maximum duty times and maximum flight times can be safely increased. The amount of increase depends on the number of additional pilots and the number and quality of the rest facilities. Each additional flightcrew member allows for longer periods of relief from flying and increases in-flight sleep opportunity. The allowable duty time increases with the quality of the sleep opportunity available. However, flight time is strictly determined by the number of pilots to divide the workload of flying duties (noting that the flight time maximum for a class 3 rest facility with four pilots is limited by duty time).

The quality of sleep depends on the quality of the rest facility, and the definitions of rest facilities and the general environmental requirements of a rest facility for part 135 operations should be modeled after AC 117-1, Flightcrew Member Rest Facilities, but with physical dimensions adjusted to reflect the general characteristics of airframes used by part 135 operators conducting augmented operations requiring a rest facility. For example, a Class 1 facility should provide a flat sleeping position, separate from flight deck and passenger cabin, temperature-controlled, light-controlled, and isolated from noise and disturbance. However, the ARC recommends that the FAA retain the definitions of the three different classes of rest facilities but adjust the physical space requirements to account for the limitations placed on aircraft used under part 135.

In consideration of the longer duty periods permitted with augmented flightcrews and the potential that these duties will infringe on or encompass the WOCL, it is important that flightcrew members be fully rested prior to such duties. Hence, there is the requirement that the pre-duty rest be at least 12 hours and that it include one physiological night's rest. Likewise, since these duties may infringe on or encompass the WOCL and may prevent a full night of sleep, post-duty rest is also required, and is longer for duties that are 16 hours or more. Augmented duties less than 14 hours do not have a post-duty requirement for any other set of limits; hence, none is required here. For augmented duties longer than 14 hours, flight time is often greater than 10 hours and may infringe on the WOCL; hence, post-duty rest is required and increases with the length of the duty reflecting the greater chances of infringing the WOCL. starting with 14 hours of post-duty rest following duties of 14–16 hours. *One point of view* is that after a duty period of 16 hours or greater, flightcrew members should receive 18 hours of post-duty rest as this allows them an opportunity to sleep in both the nighttime and daytime optimal times for sleep and, when combined with a prior night's rest, provides sufficient fatigue mitigation and recovery. *Another point of view* is that after a duty period of 16 hours or greater, flightcrew members should receive 24 hours of post-duty rest as this ensures an opportunity for both a physiological night's rest and daytime sleep at the most optimal time prior to the next duty.

The ARC recognizes that in-flight sleep is planned, but the quality of that sleep may be dependent on operational conditions; hence, other mitigations are appropriate to fully mitigate the potential fatigue associated with these longer duties. Pre-flight planning must be performed to minimize critical phases of flight that coincide with periods of impaired alertness (i.e., the WOCL) and the method should be defined in the AMP. Additionally, a separate risk assessment must be performed for any additional segments added after the start of duty. Pre-flight duty extensions for unforeseen circumstances are permitted up to 2 hours with concurrence of all flightcrew members, provided the extension does not position the end of flight in the WOCL. Also, there shall be a limit of two augmented duties in a 168-hour period to minimize cumulative fatigue.

It is important that the structure of the duty period and the sequence of flights permits the flightcrew to have available a minimum of 4 consecutive hours of sleep opportunity (shared by the flightcrew), with preference given to the landing crew. The number of flight segments in an augmented duty is limited to three, to afford the pilots the opportunities for sufficient consolidated sleep.

The recommended limits for augmented operations are summarized in Table 13.

Table 13. Operations with augmented flightcrews, in-flight sleep opportunities, and an AMP.

Flightcrew Complement [1, 2]	Duty Period (maximum hours)	Flight Time (maximum hours)	Prior Off-Duty Period (min hrs)	Post-Duty Rest (min hrs)
Class 3 Rest Facility			12 hours pre-duty rest including one physiological night's rest	14 hours of post-duty rest following duties of 14–16 hours 18 or 24 hours of post-duty rest following duties of 16 hours or more*
Three Pilot	15	13		
Four Pilots	16	17		
Class 2 Rest Facility				
Three Pilots	16	13		
Four Pilots	18	17		
Class 1 Rest Facility				
Three Pilots	17	13		
Four Pilot	19	17		

Pre-requisites for using these provisions: Pre-flight risk assessments and an AMP.

*_One point of view_ is that after a duty period of 16 hours or greater, flightcrew members should receive 18 hours of post-duty rest. _Another point of view_ is that after a duty period of 16 hours or greater, the pilots should receive 24 hours of post-duty rest.

Mitigations:

- Planning to minimize critical phases of flight that coincide with periods of impaired alertness, i.e., not in the WOCL, method defined in the AMP.
- A separate risk assessment must be performed for any additional segments added after the start of duty.
- Limit of two augmented duties in a 168-hour period.
- Each flightcrew member to have maximum sleep opportunity, with a minimum of 4 consecutive hours total for the entire flightcrew, with preference given to the landing crew.
- Augmented duties are limited to duties that include no more than three segments.

Flight time extension not allowed in accordance with section 7.7.2.

Duty period extensions allowed in accordance with section 7.7.1:

- Maximum of 2 hours duty extension with concurrence that all flightcrew members are fit for the extension.
- Permissible when extension does not include the end of flight in the WOCL.
- Reportable to the FAA within 10 days.
- Limit of one pre-takeoff duty extension per 168 hours.

Operating in multiple theaters permitted.

[1.] To get the increase for four pilots, there must be two sleep surfaces so that two pilots can have sleep opportunities simultaneously.

[2.] For aircraft with a mix of classes of rest facilities, the limits associated with the lower class apply.

7.7. Recommendations Regarding Duty and Flight Time Extensions

Applicable core principles from section 4.4: A–D, H, I, M, N, P, R, S.

The ARC recommends that operators with an AMP be allowed limited duty extensions for unforeseen circumstances that arise immediately preceding the last flight segment of a duty period, as specified in the applicable tables in this section.

The ARC recommends that (with the exception of unforeseen circumstances that could not have been known in advance, or for exceptionally limited circumstances pertaining to medical operators with an AMP as outlined in section 7.5) no certificate holder may assign, and no pilot may accept, a flight assignment known to exceed the flight time limitations, or duty time limitations, including any legal extensions, if the duty time limitation is more limiting, for the operation being conducted.

Finally, the ARC recommends that "legal to start, legal to finish" be eliminated. The flightcrew member must be able to complete the flight (estimated time en-route plus taxi-in time, as stated on the flight plan) within the prescribed duty and flight limits (plus any legal extension), or the flight cannot depart.

7.7.1. Background and rationale: duty time extensions

In the decades that have passed since the part 135 rest and duty rules were last updated, the understanding of science surrounding fatigue has advanced greatly. In that time, it has been well established from a physiological standpoint that time spent awake (generally measured from the time the last restorative sleep opportunity was obtained) increases fatigue levels and decreases performance in the average person. In addition, while less established from a scientific study perspective, workload factors (including flight time and flight segments) contribute to acute fatigue and should be mitigated to the greatest extent possible (see section 4.3 on the science of fatigue). This combination of time spent awake and workload is especially critical to consider when evaluating the introduction of safety-sensitive functions at the end of a duty period. This is even more significant when introduced to a duty period that has been extended to the maximum duration allowable in a regulation.

The ARC recognizes the aviation industry operates in an ever-changing and dynamic environment. Consequently, the ARC acknowledges that unforeseen circumstances will be encountered that may lead to a delay in the departure of a scheduled flight (including unforecast weather, equipment malfunction, air traffic delay, and late-arriving passengers or cargo). In certain instances under the current part 135 rules, such unforeseen circumstances have allowed a certificate holder to extend duty periods to an unlimited duration in order to complete a flight or series of flights, even though the unforeseen circumstances occurred early in the duty period. Within the industry, this is known as "legal to start, legal to finish." However, the ARC believes that unforeseen circumstances should not be used as a scheduling tool to extend a flightcrew member's duty period when those circumstances are not or are no longer unforeseeable.

During review of the part 135 rules, the ARC recognized that the application of “legal to start, legal to finish” often results in the current maximum duty period limit of 14 hours being extended to complete delayed segments. These duty days in excess of 14 hours contribute to higher levels of acute fatigue for flightcrew members. As outlined in section 4 of this recommendation, appropriate fatigue mitigation must be in place to counteract these effects.

The ARC determined that an AMP would provide the necessary structure to appropriately mitigate fatigue in a certificate holder’s operation. Consequently, the ARC determined that in order for a certificate holder to be able to continue using limited duty time extensions for its operations, implementation of an approved AMP be required. The structure of the AMP and its corresponding training requirements, policies, and procedures are described in more detail in section 6 and Appendix B.

In discussions among the ARC members, it was agreed that flightcrew member concurrence to a duty time extension is critical. It allows flightcrew members to assess whether they are fit to extend a duty period prior to accepting the extension. As outlined in the recommendation regarding fitness for duty in section 8.2, both the certificate holder and flightcrew member hold a joint responsibility for fatigue mitigation, and flightcrew member concurrence is a required component of any duty time extension. It was also discussed that the concurrence for a duty extension be obtained for each flightcrew member involved in the operation, and the ability to concur with a duty time extension should not be at the sole discretion of the pilot-in-command. The concurrence of each flightcrew member should be documented, and the records of the extension and concurrence should be maintained by the certificate holder.

In addition to an AMP requirement and flightcrew member concurrence, the ARC agreed that duty time extensions for unforeseen circumstances must be limited in scope and duration. Sufficient opportunity for rest must be available for a flightcrew member who has accepted a duty extension. In certain circumstances, extended, recuperative rest may be required to mitigate a duty extension. The duration, scope, and any recuperative rest associated with a duty time extension are necessarily tied to the operation being conducted, details of which can be found in this section in the applicable tables that pertain to AMP operations. For example, a duty time extension for unforeseen circumstances during a WOCL operation is more limited in duration than a duty extension for a non-WOCL operation.

Finally, the ARC agreed that in order to exercise an extension (prior to takeoff), the unforeseen circumstances must pertain to the segment that would exceed the duty limits. The extension may not be the result of unforeseen circumstances impacting previous legs in the duty period. Additionally, the ARC agreed that once a flightcrew member is operating under a duty time extension to complete a planned flight, no additional flights may commence within that duty period. This is because once an extension has been used to complete a flight assignment, additional flight assignments are no longer unforeseen.

Additional commentary can be found in COVID-19 Addendum at the end of this report.

7.7.2. Background and rationale: flight time extensions

In conjunction with the review of duty time extensions under part 135, the ARC also reviewed flight time extensions. It should be noted that in this recommendation, flight time is considered a primary workload factor to be used to gauge and mitigate fatigue. Because of this, it is critical that flight time limits be strictly adhered to, with the exception of encountering unforeseen circumstances after a flight is airborne that could not have been known in advance. Outside of exceptionally limited circumstances for air medical operators with an AMP, as outlined in section 7.5, the ARC recommends that no certificate holder may assign, and no pilot may accept, a flight assignment if it is known prior to takeoff that the assignment will exceed the flight time limitations for the operation being conducted.

The ARC was tasked by the ARC Charter to consider "the need to accommodate the diversity of operations conducted under part 135, including the unique duty and rest time requirements of air ambulance pilots" (see section 1). As the ARC membership was comprised of a diverse selection of representatives, including several air medical associations and operators, the ARC spent considerable time evaluating the rest and duty requirements of air ambulance pilots. The recently enacted part 135 subpart L was reviewed, including the Operational Control Centers and the various facets of the required pre-flight risk assessments.

After much discussion and deliberation, the ARC recommends allowing infrequent and limited flight time exceedances that are short in duration, and limited in scope, because of the risk tolerance and special circumstances surrounding air medical operators. These limited flight-time extensions should be allowed only for medical operations being conducted by an operator using OpSpecs A021 or A024.

Additional commentary can be found in COVID-19 Addendum at the end of this report.

7.7.3. Mitigations for extension usage

To further expand on the mitigations for the usage of extensions outline above, the ARC recommends that with the use of any extension to *duty time* of 30 minutes or greater for two-pilot operations, and any extension amount for one-pilot operations (whether prior to takeoff or after takeoff), flightcrew members would, at a minimum, need to be placed into rest and be given a minimum of 24 hours free from duty. Further, the recommendation is that the rest period follow immediately after the use of the extension. An extension for duty time of 30 minutes or greater for two-pilot operations, and any extension amount for one-pilot operations, would also have to be recorded and reported to the principal operations inspector.

The ARC recommends that with the use of any extension to *flight time*, whether prior to takeoff as applicable only to medical operators with an AMP (as outlined in section 7.5) or after takeoff, flightcrew members, at a minimum, would need to be placed into rest and be given a minimum of 24 hours free from duty. Further, the recommendation is that the rest period follow immediately after the use of the extension. An extension for flight time would also have to be recorded and reported to the principal operations inspector.

Additionally, with the exception of the specific mitigations for air medical operators outlined in section 7.5, the ARC recommends that the use of any duty time or flight time extension be limited to one extension in any 168-hour period.

8. ARC Recommendations for Prospective Rest, Fitness for Duty, Recordkeeping, Enforceability, and Tail-End Ferry

Applicable core principles from section 4.4: D, E, H, J, M, N.

8.1. Recommendation for Assigning Rest Prospectively

Predictable rest and duty scheduling aids in the planning of sleep, such that flightcrew member are better able to be fit for assigned duties. The ARC recommends that the FAA require operators to prospectively assign rest period and duty period start and end times so that flightcrew members may best plan their sleep opportunities to maximize fitness for their next duty.

The ARC recognizes sleep as the primary mitigation for fatigue. For a flightcrew member to be able to attain sufficient sleep to mitigate fatigue, Certificate Holders must assign a prospective rest period to flightcrew members as stipulated in the regulation. The minimum prospective rest stipulated in any table in section 7 is 10 hours to permit the flightcrew member to obtain 8 hours of uninterrupted sleep opportunity "behind the door," similar to 14 CFR § 117.25(e). Additionally, flightcrew members have an obligation to report for duty well rested and fit for duty and, thus, to sleep during their assigned rest periods. Flightcrew members are best able to maximize their fitness for duty when they prospectively know when their rest period will end and their duty period will start, as it allows them to plan their sleep opportunities. Advanced planning facilitates sleep at the most opportune times to optimize the quality of the sleep and minimize the amount of time awake when reporting for duty. This allows the flightcrew member to report in a maximum state of alertness and reduces fatigue risks.

Pilot rest requirements for operations conducted under part 135 have been the subject of debate, misapplication, and the subsequent issuance of various letters of interpretation for decades (Orellana 2015, Kidd 2017, Jimenez 2011, etc.). Through those interpretations, the FAA has long held that a flightcrew member is either on-duty or in-rest. Further, the FAA has held that when a flightcrew member is in rest, the flightcrew member's rest period must be "(1) continuous, (2) determined prospectively (i.e., known in advance), and (3) free from all restraint by the certificate holder, including freedom from work or the present responsibility for work should the occasion arise." However, in spite of the language contained in the rule and the interpretations that support it, operators and flightcrew members still struggle to understand and comply with the concept of prospective rest.

The ARC believes it is common within the industry for some operators, upon completion of a duty assignment, to place flightcrew members in rest and considers them in rest indefinitely until they are called for their next duty assignment. Under this scheme, an operator claims that the flightcrew member was not on duty during a period of time prior to being placed on duty. Therefore, when looking back 10 hours, they state that the flightcrew member was in rest for

the required period of time. This is commonly referred to in the part 135 industry as “rolling rest.” The practice of rolling rest does not provide sufficient opportunity for flightcrew members to plan their sleep opportunities to maximize their fitness for duty.

For example, if a pilot was relieved of duty at 1200, the pilot may enter a rest period and become available for duty again 1000. However, if the operator does not have a trip scheduled and has not prospectively assigned a duty period, the operator may leave the pilot in rest. Then, if a trip presents itself at 1700, the operator calls the pilot to perform the trip. Because the pilot did not expect this trip, the pilot shows up for duty having been awake since 0800. If the trip requires a full 14-hour duty period, the pilot will have been awake for 23 hours when the trip concludes, creating a fatigue risk. However, if the pilot knew in advance when the rest period would end and the duty period would start, the pilot could nap during the afternoon secondary WOCL, obtain adequate sleep, and reduce fatigue risk in the subsequent operation.

By prospectively assigning rest periods and duty period start and end times, and when used in conjunction with additional recordkeeping requirements as outlined in section 8.2, the ARC believes that “rolling rest” can be effectively eliminated from part 135.

8.2. Recommendation Regarding Fitness for Duty

The ARC recommends that the FAA makes fatigue mitigation the joint responsibility between the certificate holder and the flightcrew member. It also recommends that the FAA establishes that no certificate holder may assign, and no flightcrew member may accept, assignment to a duty period if the flightcrew member has reported for a duty period too fatigued to safely perform his or her assigned duties. As part of the flight preparation process, each flightcrew member must affirm that he or she is fit for duty prior to commencing flight.

The ARC agrees that both the certificate holder and the flightcrew member jointly share in the responsibility to mitigate fatigue, consistent with core principle N in section 4.4 and with the recommendation for assigning rest prospectively in section 8.1. The ARC considers the mitigation of fatigue to be central to all recommendations made herein. The ARC also considers that a consolidated, prospective rest opportunity provides the best opportunity for a flightcrew member to receive restorative rest. In order for this rest opportunity to provide the sleep necessary to mitigate fatigue, certificate holders are responsible for scheduling flightcrew members in such a manner as to provide a reasonable prospective rest period to ensure a meaningful rest opportunity. Flightcrew members are responsible to adequately manage their sleep opportunities and must report for any flight duty rested and prepared to perform their assigned duties. As such, as part of the flight release, each flightcrew member must affirmatively state that he or she is fit for duty prior to commencing each flight.

The ARC acknowledges that occasions will arise when a certificate holder may provide an adequate prospective rest opportunity and, despite a flightcrew member’s best effort to sleep, a flightcrew member may be too fatigued to perform the assigned duty. In these circumstances,

it is the responsibility of the flightcrew member to report that he or she is fatigued and is not fit for duty. Upon receiving a report that a flightcrew member is too fatigued for duty, it is the responsibility of the certificate holder to remove the flightcrew member from safety sensitive functions until such time that the flightcrew member receives adequate sleep and can report fit for duty.

8.3. Recommendation for Additional Recordkeeping

The ARC recommends that the FAA require the Certificate Holder to record rest, duty, and flight times in sufficient detail to determine compliance with the rest, duty, and flight time limitations of part 135.

Central to the identification of current deficiencies within the current part 135 regulatory structure, the ARC believes the current record keeping requirements of part 135 certificate holders, as it pertains to flight time, rest, and duty time assignments, are insufficient to enable the FAA to effectively enforce the regulation. For example, 14 CFR § 135.63(a)(4)(vii) does not require a certificate holder to maintain a specific record of a flightcrew member's duty time, but only a record of flight time.

The result of the insufficient record keeping requirements is that enforcement is nearly impossible for aviation safety inspectors, thereby creating an environment in which operators fail to assign rest prospectively. As a result, part 135 operators that keep records beyond the current requirements find themselves at a disadvantage in competing with operators that keep only the minimum required information. This situation tends to punish the companies that follow industry best practices.

In addition to the current requirement to document a "pilot's flight time in sufficient detail to determine compliance with the flight time limitations of this part," the proposed updates to part 135 should contain changes to recordkeeping regulations. The changes should mandate that Certificate Holders document, and have available for inspection, records to show compliance with regulations pertaining to:

1) Flightcrew assignment
2) Flightcrew rest notifications, including:
    a. Prospective rest period start and end times
    b. Date and time in which the assignment was made
3) Compliance with flight and duty time limitations pertaining to the specific operation planned and performed, including:
    a. Assignment of a prospective duty report time
    b. Date and time in which the duty assignment and prospective duty report time assignment was made
    c. Duty period start and end times

d. Any change made to the duty start and end times, and the time at which the change was made
e. For applicable AMP operations that permit duty extensions:
    i. All records of duty time extensions
    ii. Time-stamped record of flightcrew concurrence to the duty extension prior to takeoff (all flightcrew members)

4) Compliance with cumulative flight and duty time limitations
5) Records documenting the amount and reason for any exceedance to the regulatory limitations contained therein
6) Records showing compliance with any post-duty rest requirements contained in the regulations
7) Records documenting the Reference Time Zone for a flightcrew prior to beginning any sequence of duty periods

8.4. Recommendation Regarding Enforceable Regulatory Language

The ARC recommends that the FAA adopt regulatory language that captures the intent of the ARC recommendations with sufficient clarity and completeness. This would aid certificate holders in complying with proposed regulations, and aid aviation safety inspectors in enforcing those regulations.

The introduction and application of up-to-date fatigue science fails if the regulations implementing them lack needed enforceability. In order for the proposed recommendations to be successful in application, the ARC discussed numerous current practices of enforcement, including their effectiveness and related deficiencies. At the conclusion of those discussions, the ARC unanimously agreed that the FAA's ability to enforce any revised regulations pertaining to prospective rest for flightcrews is a paramount objective of any such regulatory modernization.

In addition to the aforementioned recordkeeping requirements, the ARC discussed other concepts to further assist in certificate holder compliance and FAA enforcement. The ARC believes clear and concise definitions and regulatory clarity serve as core tenets of enforceability and should be considered during the implementation of the recommendations.

Clear and concise definitions have been developed, proposed, and are outlined within the ARC's overall recommendations (see section 5). These should be contained within a separate (umbrella type) regulation within part 135 subpart F so as to apply specifically and directly to certificate holders operating under this part of 14 CFR.

Additionally, the proposed regulations must be written in such a clear and succinct manner as to avoid the need for repetitive and unnecessary interpretations. Preamble text as well as overall ARC recommendations must be written to support and underscore the regulatory text where necessary.

8.5. Part 91 Tail-End Ferry Segments during Part 135 Operations

The intent of the ARC is that a flightcrew member operating under part 135 and reaching the duty time limit should not be required to perform additional duties under part 91. But the ARC recognizes the complexities of intermixing requirements under part 135 and part 91. The ARC recommends, at a minimum, that any flight segment conducted by a flightcrew member during an assigned duty period under the operational control of the certificate holder, before, during, or after the duty period (including any part 91 segments), without an intervening rest period, should count towards a flightcrew member's part 135 flight time and duty period limitations.

8.5.1. Background

Pursuant to the ARC's assigned tasks, numerous and varied discussions were held related to components of part 135. Of particular concern to ARC members was the current practice of operators assigning, and pilots accepting, a part 91 flight(s) after the conclusion of a duty period that contained flights segments conducted under part 135. The acceptance of these flights outside of a part 135 duty period can directly impact the safe operation of aircraft as they further extend a long duty period.

It has been well established that, from a physiological standpoint, the time spent awake (measured from the time the last restorative sleep opportunity was obtained) increases fatigue levels and decreases performance in the average person. In addition, while less established from a scientific study perspective, workload factors (including flight time and flight segments) contribute to acute fatigue and should be mitigated to the greatest extent possible (see section 4.3 on the science of fatigue). This combination is especially critical to consider when evaluating the addition of safety-sensitive functions at the end of a duty period that has been continued to the maximum duration allowable in a regulation.

Currently, an operator may assign, and a pilot may accept, a part 91 flight at the conclusion of a part 135 duty period that would have otherwise exceeded the allowable duty limits for part 135, had the part 91 flight been considered as a part of the part 135 duty period. This practice – referred to as "tail-end ferry flights," "logistical ferry flights," "91 home," or "positioning flights," among other terms – allows an operator or pilot to claim the flight is outside the scope of the part 135 duty period, and therefore, the rest and duty regulations for part 135 would not apply.

From a safety perspective, the ARC believes that the continued allowance of the extended pilot duty for tail-end ferry flights exposes the flightcrew and operator to a potential accident as a direct result of this fatiguing practice. These types of flights fit the description of "safety-sensitive" and, as such, the ARC members recommend that part 91 flights conducted for compensation or hire before, during, or after a part 135 duty assignment should be considered as a part of the part 135 duty assignment for the application of part 135 rest requirements and duty limitations.

The ARC members also believe that there is ample evidence and support for including these part 91 flights as part of a pilot's part 135 flight time and duty period limitations, as evidenced by the following.

8.5.2. NTSB support

The National Transportation Safety Board (NTSB) has identified fatigue as one of the top priorities in its safety recommendations "Most Wanted List." Specifically, the NTSB has the following open recommendations to "Reduce Fatigue Related Accidents" in part 135 operations:

- *A-94-194: Status: Open–Unacceptable Response*
  "TO THE FEDERAL AVIATION ADMINISTRATION: Revise the Federal Aviation Regulations contained in Title 14 Code of Federal Regulations Part 135 to require that pilot flight time accumulated in all company flying conducted after revenue operations—such as training and check flights, ferry flights and repositioning flights—be included in the crewmember's total flight time accrued during revenue operations."

- *A-95-113: Status: Open–Unacceptable Response*
  "TO THE FEDERAL AVIATION ADMINISTRATION: Finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues. The new regulations should prohibit air carriers from assigning flightcrews to flights conducted under 14 CFR 91 unless the flightcrews meet the flight and duty time limitations of 14 CFR 121 or other appropriate regulations."

- *A-14-072: Status: Open–Unacceptable Response*
  "TO THE FEDERAL AVIATION ADMINISTRATION: Require principal operations inspectors to ensure that operators with flight crews performing 14 CFR 121, 135, and 91 subpart K overnight operations brief the threat of fatigue before each departure, particularly those occurring during the window of circadian low."

As demonstrated by the NTSB recommendations above, part 91 flying after the conclusion of a maximum duration part 135 duty period has long been identified as an unacceptable safety hazard.

8.5.3. FAA support

In addition to the NTSB's recommendations, the FAA has also recognized the need to limit additional part 91 flying that would lead to a fatigued flightcrew. The following are a sample of the FAA's support of this recommendation.

In response to NTSB Recommendations A-94-194, A-95-113, and A-14-72 listed above, the FAA issued a response dated March 16, 2020, stating:

> "The FAA will publish an advance Notice of Proposed Rulemaking (NPRM) addressing part 91 tail-end ferry operations for part 135 operators and an NPRM to extend part 121 flight, duty, and rest limits to tail-end ferry flights that follow an all-cargo flight."

On June 24, 2009, the FAA convened the Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee to address flightcrew fatigue in pilots operating under part 121 and part 135. At the conclusion of that ARC, the FAA published the final rule in the Federal Register, Vol. 77, No. 2. for FAR 117 - Flightcrew Member Duty and Rest Requirements on January 4, 2012. Contained in the final rule is the following excerpt:

> "The NTSB's list of Most Wanted Transportation Safety Improvements also includes a safety recommendation on pilot fatigue and ferry flights conducted under 14 CFR part 91. Three Flightcrew Members died after a Douglas DC–8–63 operated by Air Transport International was destroyed by ground impact and fire during an attempted three engine takeoff at Kansas City International Airport in Kansas City, Missouri. The NTSB noted that the flightcrew conducted the flight as a maintenance ferry flight under part 91 after a shortened rest break that followed a demanding round trip flight to Europe that crossed multiple time zones. The NTSB further noted that the international flight conducted under part 121 involved multiple legs flown at night following daytime rest periods; this caused the flightcrew to experience circadian rhythm disruption. In addition, the NTSB found that the captain's last rest period before the accident was repeatedly interrupted by the certificate holder.
>
> "In issuing its 1995 recommendations, the NTSB stated that the flight time limits and rest requirements under part 121 that applied to the flightcrew before the ferry flight did not apply to the ferry flight operated under part 91. The NTSB found that the regulations permitted a substantially reduced flightcrew rest period for the nonrevenue ferry flight. As a result of the investigation, the NTSB reiterated earlier recommendations to (1) finalize the review of current flight and duty time limitations to ensure the limitations consider research findings on fatigue and sleep issues and (2) prohibit certificate holders from assigning a flightcrew to flights conducted under part 91 unless the flightcrew met the flight and duty time limits under part 121 or other applicable regulations (recommendation No. A–95–113)."

Additionally, the Flight and Duty Time Limitations and Rest Requirements ARC recommendation document contains the following excerpt:

> "In 1994 the NTSB issued a safety study on commuter airline safety. The NTSB noted that most of the pilots surveyed for the study had flown fatigued. The NTSB concluded that the practice of scheduling part 135 pilots for training, check flights, or other nonrevenue flights at the end of a full day of scheduled revenue flying increases the potential for fatigue-related accidents. The NTSB recommended that the FAA revise part 135 to require that pilot flight time accumulated in all company flying conducted after revenue operations, such as training and check flights, ferry flights, and

> repositioning flights, be included in the Flightcrew Member's total flight time accrued during revenue operations."

While the final rule excluded part 135 operations, the Notice of Proposed Rule Making (NPRM) issued by the FAA on September 14, 2010, stated the following:

> "…the part 135 community should expect to see an NPRM addressing its operations that looks very similar to, if not exactly like, the final rule the agency anticipates issuing as part of its rulemaking initiative.''

Finally, as implemented in the final rule, the FAA included all part 91 operations as part of the flight and duty time limits of part 117, if at least one of their flight segments is operated under part 117:

> "..it applies to Flightcrew Members operating under part 91 only if at least one their flight segments is operated under part 117. Flightcrew Members operating under part 91 and who do not have any flight segments subject to part 117 (e.g. pilots flying only part 91 operations) are not subject to the provisions of this rule."

Given the support of the NTSB and the FAA, the ARC members believe that the continued practice of extending pilot duty after a part 135 duty period for tail-end ferry flights not only subverts the intention of rest and duty limits for flightcrew members, but it also exposes the flightcrew and operator to unnecessary safety risks. This provides the foundation for our recommendation.

9. Economic Impact of Revised Part 135 Regulations

FAA data indicate that the part 135 industry is comprised of over 1,900 certificate holders with an average of 10.5 pilots-in-command and 2.4 other pilots per certificate, totaling 25,220 pilots. According to IBISWorld,[2] industry wage earnings in 2018 totaled $3.87 billion. The Part 135 ARC was tasked to provide cost and benefit estimates for any recommendation to change regulatory requirements (see section 1).

The ARC considered economic impact on operators throughout the course of its work. As part of its objective (see section 3), the ARC recommends a tiered approach with options for effective management of fatigue that fits a variety of business models and operational fatigue risks (see section 6). In this context, the ARC recommends that a set of duty, flight, and rest limits be made available for operations that do not have or need an AMP (see sections 6.1 and 7.1). While those limits are deliberately more restrictive to avoid the potential for unmitigated fatigue, they are sufficient for many operations that limit most operations to non-WOCL hours of the day. For many operations that can fit within that framework, this tier of regulations is designed specifically to reduce complexity and cost.

More broadly, if the ARC's recommendations are adopted, operators would incur costs scaled in accordance with the complexity of their operations. Operators that opt not to develop and implement an AMP will have tighter restrictions on their pilots' flight time and duty limits, but will also minimize costs associated with fatigue mitigations. Conversely, operators that choose to invest in additional fatigue mitigations are afforded additional flexibility in the form of less strict pilot flight time and duty limits. For such operators, any additional costs are expected to be offset by the ability to operate under a wider range of circumstances.

Upon request from the FAA, the Part 135 ARC will reassemble and provide examples to illustrate use of the tables in section 7 and any of the further recommendations in this report (see sections 5 through 8). These examples will illustrate how certain operations would have to change under the recommended limits compared to how those operations are conducted under the current part 135 rules. Some of the examples may represent an adverse economic impact; some may represent a beneficial economic impact. The ARC did not attempt to quantify the dollar value of such impacts, whether positive or negative, across the industry, because the ARC did not know a) the prevalence of the various part 135 operations, b) whether more economical alternatives might be devised that could operate under the recommended rules, or c) whether operations would be less fatiguing and safer, thus incurring lower costs based on fewer fatigue calls and incidents.

Throughout the discussions that led the ARC to recommend the AMP concept and the fatigue risk analysis tools included in the AMP, the ARC operated under the assumption that a rule

[2] https://www.ibisworld.com

requiring part 135 operators to have an active safety management system (SMS) would be effective before any regulatory changes to part 135 pilot rest and duty requirements. This assumption was based on statements from the FAA that a notice of proposed rulemaking requiring an SMS for airports, part 135 operators, and part 145 repair stations would be published in September 2022. The ARC assumed that most operators would include a flight risk analysis tool as part of their SMS. Therefore, any cost from specifically addressing fatigue in their pre-flight risk assessment would be minimal. Further, such costs would be justified by addressing risks specific to each flight that may not be captured by a regulatory framework, such as whether or not a flightcrew member was actually able to sleep during the assigned rest period.

The ARC evaluated the economic impact of the recommendation to add recordkeeping requirements that prevent rolling rest, as outlined in section 8.2. It determined that most part 135 operators were already keeping these records out of necessity to ensure compliance with rest and duty requirements. Further, the ARC determined that requiring such recordkeeping would provide a mechanism to enforce future rest and duty requirements. FAA stakeholders informed the ARC that current recordkeeping requirements are insufficient for enforcing rest and duty regulations. The ARC agreed that the ability of the FAA to ensure operator compliance with the rules, which exist to provide safe rest and duty limitations, outweighs the costs associated with the recordkeeping.

The unprecedented circumstances of the national emergency resulting from the novel coronavirus disease 2019 (COVID-19) caused significant delays in the ARC's deliberations. As all meetings came to a halt due to the contagious nature of COVID-19, the ARC did not meet for 3 months. Like many, the ARC believed the inability to meet in person would be limited to a matter of weeks. Simultaneously, the attention of many ARC volunteers was diverted to keeping their businesses from closing as the entire industry was slowed to nearly 25% of pre-pandemic levels. As the impact and effects of the pandemic became better understood, the ARC resumed meeting using video communication technology (VCT). While VCT allowed the ARC to interact, it did not prove sufficiently conducive to engagement on complex subjects. The FAA granted the ARC a six-month extension to continue developing recommendations based on the assigned tasks (see section 1.2). Because members of the ARC were unable to meet and discuss the assigned tasks in person for over a year, the 6-month extension was insufficient for the ARC to effectively determine cost and benefit estimates associated with the whole of its recommendations to change regulatory requirements.

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Appendix A. Abbreviations and Acronyms

AC	Advisory circular
AMP	Alertness Management Program
ARC	Aviation Rulemaking Committee
ASAP	Aviation Safety Action Program
ASRS	Aviation Safety Reporting System
CARs	Canadian Aviation Regulations
CFR	Code of Federal Regulations
EASA	European Union Aviation Safety Agency
FDP	Flight duty period
FMG	Fatigue Management Guide
FOQA	Flight operational quality assurance
FRMS	Fatigue Risk Management System
ICAO	International Civil Aviation Organization
InFO	Information for Operators
NPRM	Notice of Proposed Rulemaking
NTSB	National Transportation Safety Board
OpSpec	Operations Specifications
SAPRs	Standards and Recommended Practices
SBA	Small Business Administration
SMS	Safety management system
VCT	Video communication technology
WOCL	Window of Circadian Low

Appendix B. ARC Recommended Components of an Alertness Management Program

1. ***Senior-Level Management Commitment to Reducing Fatigue and Improving Flightcrew Member Alertness***

2. ***AMP Scope and the Organization's Fatigue Management Policy and Procedures***
   a) Define the scope and objectives of the organization's AMP.
   b) Indicate how the organization's policies and procedures are adequate to mitigate and manage the effects of fatigue and improve flight-crew alertness. (Level 2 AMP only.)
   c) Define the organization's AMP safety objectives and expectations.
   d) Define the structure of the alertness management program and roles and responsibilities of those assigned to implement and manage the program.

3. ***Fatigue Risk Management and Mitigation***
   a) Define within the AMP which reactive, proactive, or predictive tools will be used to manage alertness and avoid excessive fatigue.
   b) Define how alertness considerations will be factored into the overall operational risk assessment process. Fatigue factors shall be considered a risk factor in combination with other operational risk factors, such as weather, terrain, airfield factors, and aircraft factors.
   c) AMP shall define how the organization will ensure that flight planning is conducted with protections to avoid excessive fatigue.

4. ***Safety Assurance and Fatigue Reporting Policy***
   a) AMP defines how fatigue reporting system enables and encourages crewmembers and other employees to report subjective fatigue and, from time to time, and request relief from duties because of chronic fatigue.
   b) AMP defines the required content of a fatigue report, how a crewmember files a fatigue report, and who in the organization has the responsibility for monitoring fatigue reports and what actions are to be taken when a fatigue report is filed.
   c) AMP defines how fatigue reports are used as data sources by the organization to determine the causes of fatigue and to develop new and amended fatigue mitigation strategies when needed.
   d) AMP defines how that information is used to improve operating practices to reduce fatigue in future operations.
   e) Useful guidance for fatigue reporting is available at the following link: https://www.ifalpa.org/publications/library/ifalpa-fatigue-reporting-guidance--3362

5. Fatigue Incident Reporting Process

a) AMP defines detailed procedures for reviewing and acting upon reports of performance errors that may be attributable wholly or in part to fatigue. Such reports are similar to crew fatigue reports (item 4) and can serve as a mechanism for obtaining all relevant data regarding fatigue contributions to the incident.
b) AMP defines how other data sources such procedural errors, Flightcrew Member deviations, flight exceedances, Aviation Safety Action Program (ASAP) or Aviation Safety Reporting System (ASRS) reports and flight operational quality assurance (FOQA) data may help the operator to objectively document fatigue.

6. System for Monitoring Flightcrew Member Fatigue

a) AMP defines a process to capture all relevant information, such as the schedule leading up to the fatigue event, the actions of the employee to obtain rest, subjective and objective evidence of fatigue, environmental conditions that may have contributed to fatigue, relevant health or medical conditions, specific actions related to the incident, and communications prior to and during the event.
b) AMP defines a corporate policy to protect the employee from adverse actions that would discourage reports of fatigue.
c) AMP defines how an event is evaluated for potential fatigue involvement as well as defining the methodology used for conducting a detailed root cause analysis.
d) AMP contains operational procedures to follow when one identifies, or suspects, fatigue risk in oneself or others.

7. The Organization's AMP Evaluation Program

a) The AMP defines a methodology that continually assesses the effectiveness of the AMP, including the effectiveness of the AMP to improve alertness, and to mitigate performance errors.
b) AMP has a process for determining the need for amending the AMP, as appropriate, when it is determined that a policy or procedure is no longer effective in managing fatigue events, and documentation of acting upon such need.
c) AMP shall specify procedure for documenting any deviation of the provisions of the AMP and procedures for remediating the deviation.

8. Fatigue Education and Awareness Training Program

a) AMP define the frequency of the Fatigue Education and Awareness training program and the persons required to take the training, to include at minimum all pilots and other personnel involved with scheduling aircraft or crew members.
b) Reviews the flight, duty, and rest requirements as implemented by the organization.
c) AMP defines how awareness of the AMP program itself is presented to employees, including fatigue related policies and procedures, and the responsibilities of management and employees to mitigate or management the effects of fatigue and improve flight-crew member flight deck alertness.
d) AMP promotes training on the basics of fatigue, including sleep fundamentals and circadian rhythms.

(1) The causes and awareness of fatigue.
(2) The effects of fatigue relative to flight-crew member performance, including the ability to react to unusual or emergency circumstances.
(3) Fatigue countermeasures, prevention, and mitigation.
(4) The influence of lifestyle, including nutrition, exercise, and family life, on fatigue.
(5) Familiarity with sleep disorders.
(6) The potential impact of commuting on alertness and fatigue.
(7) Flight-crew member responsibility for ensuring adequate rest and fitness for duty.
(8) The effects of operating through multiple time zones.
(9) Operational procedures to follow when one identifies, or suspects, fatigue risk in oneself or others.
(10) Incorporate lessons learned regarding the effects of fatigue and mitigation initiatives relative to the operator's operations.

e) AMP provides a methodology that continually assesses the effectiveness of the training program.

9. Prescriptive Flight Time and Duty Period Limitations and Mitigations

a) General requirements.
(1) AMP defines how the organization will enforce the prescriptive duty and rest limits, document compliance with the limits, and how crewmembers will be informed in advance of scheduled rest and duties.
(2) AMP defines operating procedures to provide the fatigue mitigations that accompany each set of prescriptive limits.
(3) AMP defines which prescriptive limits that apply to their organization, and which do not. An organization may prescribe more restrictive limits than defined in the approved Duty, Flight and Rest requirements and required mitigations but may not adopt less stringent limits without approval from the FAA.
(4) If the organization schedules a flight duty that is not defined in their AMP, then the organization will follow the prescriptive limits defined for organizations without an AMP.

b) Organizational methods to implement the limitations and mitigations.
(1) The AMP will define any limitations and mitigations specific to the organization.
(2) The AMP will define how those limitations and mitigations will be applied and enforced within the organization.
(3) The AMP will define what recordkeeping will be performed to verify compliance with the prescriptive limits and required mitigations.

COVID-19 Addendum. Additional Conversation and Viewpoints Not Addressed by the ARC

The unprecedented circumstances of the national emergency resulting from the novel coronavirus disease 2019 (COVID-19) caused significant delays in the ARC's deliberations. As all meetings came to a halt due to the contagious nature of COVID-19, the ARC did not meet for 3 months. Like many, the ARC believed the inability to meet in person would be limited to a matter of weeks. Simultaneously, the attention of many ARC volunteers was diverted to keeping their businesses from closing as the entire industry was slowed to nearly 25% of pre-pandemic levels. As the impact and effects of the pandemic became better understood, the ARC resumed meeting using VCT. While VCT allowed the ARC to interact, it did not prove sufficiently conducive to engender effective engagement on many of the complex issues.

Because members of the ARC were unable to meet and discuss the assigned tasks in person for over a year, the 6-month extension granted by the FAA was insufficient for the ARC to thoroughly discuss the full range of viewpoints on all matters related to the complex nature of fatigue, duty limits, operational extensions, minimum required rest, and the operational and economic impacts related to these issues. The ARC members listed at the end of this Addendum would like to describe various topics that were not fully deliberated. These are points of view that did not result in formal recommendations.

Additionally, the complexity of the part 135 industry cannot be understated. Although membership of the ARC consisted of representatives of the general categories of stakeholders operating under part 135 (e.g., scheduled, on-demand, air ambulance, passengers, and cargo), it is imperative to note that within these categories many sub-categories, nuances, and diversities exist, each representing distinct operational, geographic, and economic challenges and requirements. In addition to the topics described below, scheduled and cargo operations were not thoroughly addressed by the ARC due to the time constraints.

ARC members representing industry offer the following additional points of view for FAA's overall consideration of the ARC's report. FAA should provide, to the broadest degree possible, opportunity for industry participation and should seek comments as to the impacts of any proposed regulatory activities prior to publishing a notice of proposed rulemaking.

COVID-19 Addendum. 1. Flight and Duty Time Extensions for Unforeseen Circumstances

ARC members reached consensus on the removal of the "legal to start, legal to finish" concept from rulemaking, yet due to the complexity of on-demand operations, some ARC members felt a provision similar to 14 CFR § 135.267(e) should remain, with strong limitations. Currently, §

135.267(e) allows for unlimited extensions of flight time due to unforeseen circumstances. All ARC members feel unlimited extensions are potentially hazardous and should be reduced.

The part 135 industry is vastly different from scheduled service, operating from remote locations and often under complex operational circumstances. 14 CFR § 135.267(e) has been a key provision for the part 135 industry to adapt to rapidly changing operational environments, while maintaining the highest degree of safety. Recognizing the ever changing, dynamic environment in which unforeseen circumstances will be encountered that may lead to delays, the ARC discussed the importance of maintaining provisions that allow for extensions.

14 CFR § 135.267(e) allows for extensions of flight time due to unforeseen operational circumstances, such as delays due to weather, and provides compensatory rest to offset the fatigue induced by a longer day. Further, there is no limit on the amount a duty day can be extended due to unforeseen circumstances, such as late-arriving cargo or passengers, in the current part 135 rules, provided the operator reasonably scheduled the flight. This allows an operator, under current rules, to extend duty and flight time in any segment of flight, provided the day was scheduled within duty limitations when assigned. Some ARC members feel both extensions of flight time and duty time, limited in scope, should be allowed for operational flexibility for operators with either a Level 1 or Level 2 AMP.

Some ARC members believe that the combination of an AMP and the consideration for fatigue mitigations presented in the operating tables make a limited extension of flight or duty time low-risk. Certain additional mitigations would be considered. For example, to avoid frequent abuse and over-use of this provision, operators should be required to report duty and flight time extensions, when taken in quantities over a certain threshold, to their principal operations inspector as well as track these extensions in the company's AMP for ongoing internal evaluation. However, the number of extensions should not be restricted, as the rest requirements ensure flightcrew members would have ample opportunity for recuperative sleep prior to the next scheduled duty, and a restriction would fail to accommodate the on-demand nature of the industry. Also, these extensions should only be made available for use on the final segment of flight during the duty day (for example, a delay on the first segment of flight would not be considered an unforeseen operational circumstance for a segment of flight later in the duty day, only the segment of flight in which the unforeseen event occurred).

Extensions of flight time are currently permitted prior to taxi and prior to takeoff. Recognizing that the extension should not be of unlimited duration, some ARC members suggest extensions of flight time be should capped at no more than 60 minutes and only be permitted at "block out" time (when the aircraft taxis with intent to depart) and extensions of duty time should be capped at no more than 120 minutes. Such mitigations, when combined with the AMP and rest requirements, would sufficiently mitigate fatigue-related risk to a safe level, while accommodating the unique and diverse operational environments encountered under part 135.

When either duty or flight time is extended, additional compensatory rest must be provided to the flightcrew for recuperative time off; however, some ARC members felt that additional

discussion is needed to more completely address the issues and explore alternative science-based solutions that meet the physiological mitigations desired for the crew members, while balancing the subsequent impact to operations.

The following text outlines the details of the modification to § 135.267 for additional consideration suggested by some ARC members:

> **(e)** When a flightcrew member has exceeded the daily flight time or duty time limitations in this section, because of circumstances beyond the control of the certificate holder or flightcrew member (such as adverse weather conditions, late-arriving cargo or passengers), that flight crewmember must have a rest period before being assigned or accepting an assignment for *flight time* of at least:
>
> > **(1)** 12 consecutive hours of rest if the flight time limitation is exceeded by not more than 30 minutes or if the duty time limitation is exceeded by not more than 60 minutes;
> >
> > **(2)** 18 consecutive hours of rest if the flight time limitation is exceeded by more than 30 minutes, but not more than 60 minutes, or if the duty time limitation is exceeded by more than 60 minutes, but not more than 120 minutes. Flight time extensions more than 60 minutes or duty time extensions more than 120 minutes are not permitted.
> >
> > **(3)** Flight time extensions are only permitted after the aircraft has taxied with the intent to depart, while duty time extensions are permitted prior to or after taxi.

Any provisions for extending flight or duty time must still be fully developed so as to understand the operational impact, potential unintended consequences of overly prescriptive regulations, staffing implications, and costs. Any mitigations should be predicated on the science related to alertness and fatigue management.

COVID-19 Addendum. 2. Consecutive Exposures to Window of Circadian Low

Circadian disruption is one of many causes of fatigue. Preventive strategies are designed to decrease the impact of circadian disruption and sleep loss on performance and alertness. There are a variety of different strategies to accomplish this goal. Some of these strategies include minimizing sleep loss, naps during duties, education on good sleeping habits, and acceleration of circadian adaptation to different shift types. In light of the fact that a number of operators conduct routine operations through the WOCL, some members of the ARC desire to further explore the operational impact, unintended consequences of potentially overly prescriptive regulations, staffing implications, and costs of limiting flightcrew members to three consecutive WOCL duties.

For example, some members of the ARC would like to explore whether maintaining a WOCL schedule for extended periods of time would permit the circadian rhythm to adapt, which could provide an alternative fatigue mitigation. Similarly, a flightcrew member that is regularly scheduled for operations starting early in the morning or ending late in the evening could have the potential benefit of a circadian rhythm shift. This shift would be negated by strict limitations or mitigations on such operations, leading to shifting crew schedules and the unintended consequence of flightcrew members not being able to adapt to any one sleep cycle.

COVID-19 Addendum. 3. Contributors to the COVID-19 Addendum

Name	Organization	ARC Title
Tony Bonham	Air Evac Lifeteam	Member
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Eric Walter	Bemidji Aviation	Member